The International Response to Disease Outbreaks: The Relevance of Epistemic Communities in International Cooperation

by

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Abstract

This research explores the question why does the level of international cooperation vary in the international response to pandemics? The research presents an analytical model to analyse the differences among the levels of international cooperation in four disease outbreaks: Influenza H1N1 in 2009, MERS-CoV in 2012, Ebola in 2013-2016, and Zika in 2013-2016. The model introduces sixteen indicators categorized in four main areas: i) international participation; ii) international assistance; iii) scientific response, and; iv) policy convergence. These indicators facilitate comparison across cases and show that Influenza H1N1 had a high level of cooperation, MERS-CoV a low-medium level, Ebola a low-medium level, and Zika a high level.

This study applies the theory of epistemic communities developed by Peter Haas to explain variation in the level of cooperation in global health. The research identifies an epistemic community for each case and examines three general characteristics underlined in Haas' theory: a) the creation of consensual knowledge; b) the dissemination of knowledge to the policymakers and; c) the institutionalization of bureaucratic power. This research shows that although all epistemic communities possess these characteristics, these do not equally depict the same values across epistemic communities. This variation affects the way epistemic communities actors influence cooperation. While some epistemic communities created consensual knowledge and a clear policy goal, they were unable to disseminate their knowledge to relevant policymakers, and thus had limited bureaucratic power. Other epistemic communities established consensual knowledge, disseminated it to key policymakers and therefore exhibited enough bureaucratic power to influence the policy-making process. The proposed framework presents a comprehensive and simplified model

that measures these characteristics.

The research finds that in the Influenza H1N1 outbreak, an epistemic community created consensual knowledge, disseminated it to key policymakers, and influenced the decision-making process during the outbreak. This epistemic community institutionalized and consolidated its bureaucratic position participating directly into the policy process and contributed to the level of cooperation seen during the international response at different levels. In the case of the MERS-CoV outbreak, the epistemic community had disagreements, and it was unable to build a strong consensus, affecting its capacity to disseminate relevant knowledge for policymaking. Therefore, its influence in the policy process was less evident, and it did not institutionalize its bureaucratic power, resulting in a lower capacity to increase cooperation. The Ebola outbreak in West Africa showed an epistemic community that confronted circumstances that challenged its previous knowledge of Ebola outbreaks. This created conflict within the community that debilitated its position and influence, affecting its capacity to improve international cooperation. Finally, in the Zika outbreak, an epistemic community built a fast consensus regarding the situation and was able to formulate strong recommendations to the international community. Policymakers accepted the epistemic community's advice leading to a quick response and high level of international cooperation even when there was much uncertainty.

The findings show that in the absence of a clear consensus regarding the nature of the problem and possible solutions among members of the epistemic community; the inability to disseminate this consensual knowledge to policymakers; and the building of bureaucratic power through their participation in crucial parts of the process; the ability to influence global health governance towards cooperative outcomes is diminished.

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Acronyms and abbreviations

AFRO	WHO Regional Office for Africa
AIDS	Acquired Immunodeficiency Syndrome
AMRO	WHO Regional Office for the Americas (PAHO)
APEC-HGW	Asia-Pacific Economic Cooperation Health Working Group
ASEAN	Association of Southeast Asian Nations
BMJ	British Medical Journal
CDC	Centers for Disease Control and Prevention
COP	Conference of the Parties
CSG	Coronavirus Study Group
DG	Director-General
DHHS	Department of Human Health and Services (US)
DRC	Democratic Republic of Congo
EB	Executive Board
EC	Emergency Committee
EDPLN	Emerging and Dangerous Pathogens Laboratory Network
EID	Emerging Infectious Disease
EMRO	WHO Regional Office for Eastern Mediterranean
EURO	WHO Regional Office for Europe
FAO	Food and Agriculture Organization
FCTC	Framework Convention on Tobacco Control
GAP	Global Programme on AIDS
GBS	Guillain-Barré syndrome
GHSI	Global Health Security Initiative
GISAID	Global Initiative on Sharing All Influenza Data
GISN	Global Influenza Surveillance Network
GISRS	Global Influenza Surveillance and Response System
GOARN	Global Outbreak and Response Network
HIV	Human Immunodeficiency Virus
HQ	Headquarters
IHR	International Health Regulations
IMF	International Monetary Fund
IPAPI	International Partnership on Avian and Pandemic Influenza
ISR	International Sanitary Regulations
IVM	Integrated Vector Management
LSHTM	London School of Hygiene and Tropical Medicine
MDG	Millennium Development Goals
MERS-CoV	Middle East Respiratory Syndrome
MPTF	Multi-Partner Trust Fund
MSF	Médecins Sans Frontières

NAPAPI	North American Plan for Avian and Pandemic Influenza
NHI	National Health Institutes (US)
NIC	National Influenza Centre
OAS	Organization of American States
OIE	World Organization for Animal Health
OIHP	Office International d'Hygiene Publique
PAHO	Pan-American Health Organization
PHAC	Public Health Agency of Canada
PHEIC	Public Health Emergency of International Concern
PIP	Pandemic Influenza Preparedness
ProMED	Program for Monitoring Emerging Diseases
REID	Re-Emerging Infectious Disease
SARS	Severe Acute Respiratory Syndrome
SDG	Sustainable Development Goals
SEARO	WHO Regional Office for South-East Asia
STI	Sexually transmitted infection
TRIPS	Agreement on Trade-Related Aspects of Intellectual Property Rights
UK	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNEP	United Nations Environment Program
UNGASS	United Nations General Assembly
UNMEER	United Nations Mission for Ebola Emergency Response
USA	United States of America
USAID	United States Agency for International Development
VCAG	Vector Control Advisory Group
WB	World Bank
WCTH	World Conference on Tobacco or Health
WHA	World Health Assembly
WHO	World Health Organization
WHOPES	WHO Pesticide Evaluation Scheme
WIC	World Influenza Centre
WPRO	WHO Regional Office for Western Pacific
WTO	World Trade Organization

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Chapter 1: Introduction

This research examines the question, why does the level of international cooperation vary in response to disease outbreaks with similar pandemic potential? This study presents evidence that the participation of epistemic communities in the international response contributes to the variance observed in the level of international cooperation.

The international response to infectious diseases is a set of activities to fight and control outbreaks. It consists of "detection systems, skilled and properly equipped personnel, authorities, methods and tools to coordinate different governing bodies, which possess varying levels of preparedness, capacity, and resources in a timely manner to prevent additional events (1)". International cooperation plays a central role in the global system to manage and control pandemic outbreaks, which occur when infectious diseases that are easily transmissible affect a large population and spread over a wide geographical area in a short period (2).

The transnational nature and pandemic potential of many emerging and re-emerging diseases represent a global threat. Globalization facilitates the transmission of these diseases and increases all countries' vulnerability, making them less capable of securing the health of their citizens through unilateral action (3,4,5,6,7,8). Therefore, international cooperation is more important than ever to complement and strengthen national efforts, to minimize the spread of the disease and mitigate its impact on the population (9,10,11).

The analysis of variation in international cooperation is relevant for the global response to pandemic diseases. There is always a degree of cooperation in the international response to disease outbreak (there is no defection), but full cooperation is only achieved when all the international community contributes to the prompt management and control of an outbreak, and all states comply with relevant international norms and agreements. Therefore, this research examines cooperation as a spectrum that "measures positive statements, agreements, and assistance (12)". International cooperation in global health manifests itself as adherence to the process of outbreak notification, pathogen identification, consensus on the nature of the event, identification of actions to mitigate the outbreak, implementation of measures, and the provision of financial, material and human resources to support the response. The failure to reach full cooperation means the difference between an outbreak being successfully managed and controlled, to one spinning out of control, infecting and killing more people, along with other severe economic and social consequences.

States have created international norms and institutions to guide both the domestic and international responses to infectious disease outbreaks, as well as to improve and increase their potential for the control and eradication of pandemic diseases. The constant evolution of factors generating and facilitating the spread of disease outbreaks has required a periodic assessment and adaptation of these norms and institutions to address new challenges. To this aim, in 2005, the World Health Assembly (WHA) approved the International Health Regulations (IHRs 2005), providing an updated framework to prevent and manage pandemics. These guidelines aimed to reduce the burden caused by infectious disease outbreaks with pandemic potential, to coordinate international action, and to increase cooperation. Despite providing procedures for a uniform response to outbreaks with similar pandemic potential, international cooperation – even under the IHRs 2005 - varied in recent cases. For some outbreaks, such as pandemic influenza H1N1 and Zika virus, the international community cooperated, responding rapidly and controlling the spread of the disease. Whereas in the Ebola outbreak in West Africa, international actors responded slowly and inadequately, facilitating the spread of the disease beyond national borders in a short period. The Ebola outbreak is now considered as “the most intense and prolonged epidemic of the disease ever recorded (13)”. This lack of initial response caused more deaths and high economic costs for affected countries (14). Finally, despite acknowledging the potential global threat of the Middle East Respiratory Syndrome (MERS-CoV), scientific and policy engagement with affected countries was limited (15).

The existence of variation in cooperation across these cases presents a puzzle. All four disease outbreaks needed international collaboration; they were diseases with the potential to rapidly spread, and it was in the interest of all states to manage the outbreaks. Yet, the four cases elicited very different responses. All four pandemics occurred under the same set of international norms and institutions that were created “to prevent, protect against, control and provide a public health response to the international spread of disease (16)”.

Traditional theories of international relations have not sufficiently examined *variation* in cooperation. International diplomacy, however, entails different degrees of cooperation -from treaties that are signed and approved for most countries, but partially implemented, or states negotiating norms in the United Nations General Assembly (UNGASS) without reaching an agreement, to the financing of development projects for only a few countries. Social constructivist theories provide a promising avenue of exploration due to their explanation that differences in processes influence the various policy approaches adopted by governments (17,18). Constructivism centres its attention on actors in the international system, including epistemic communities (19,20,21,22).

The role of epistemic communities in global health cooperation is related to the importance of scientific evidence in global health and the need for experts to both provide and translate this evidence to guide the policy process. Members of epistemic communities actively participate (through direct and indirect channels) in the formulation of policies in governments, multilateral institutions, and non-governmental organizations (NGOs). The dual role of some members of the epistemic community as both providers of evidence and as decisionmakers places them in a unique position to influence international cooperation.

Previous studies on epistemic communities provided evidence that these non-state actors improved international cooperation, moving it towards optimal levels (20,23,24). Researchers have systematically reviewed these groups' characteristics and how they influence the policy process. In his seminal work, Peter Haas characterized an epistemic community as a group of experts that share normative beliefs, causal beliefs, notions of validity, and a policy goal (25,24,26). His theory suggested that when epistemic communities develop a consensual knowledge and clear policy goal, disseminate this knowledge and institutionalize its bureaucratic power (consolidating its influence), they can improve cooperation. This research further explores Haas' theory and the hypothesis that these characteristics vary, and they are not homogenous across epistemic communities. The ability of an epistemic community to exercise influence on international cooperation will depend on the extent of its members' agreement on the problem and solutions; the availability of the epistemic community to disseminate its knowledge to policymakers; and the amount of bureaucratic power accumulated by the epistemic community's members within the policy process.

Other approaches have attempted to explain international cooperation during pandemics. One line of research considers diseases as security threats (27,28,29,30,31,32,33,34,35,36). Health security scholars expect that pandemic outbreaks will mobilize international cooperation due to security concerns (37), under the belief that "collective health security against infectious diseases (38)" is the best policy response. Yet this research does not examine or explore variation in international cooperation and does not explain why some ‘pandemic’ diseases are more relevant for security reasons than others.

Another set of arguments centres its explanations on the dynamics of globalization and international trade. This scholarship assesses the link between global health and trade, taking into consideration that for decades, countries have tried to remove public health measures that could limit trade disruptions during pandemic outbreaks (39). International norms, such as the IHRs, included this idea. The study of health and trade, however, does not clearly explain why some pandemics garner more cooperation and limit restrictions on the movement of people and goods, while the response to other disease outbreaks leads to establish trade and travel barriers.

Scholars working in the field of global health governance (40,41,42) state that sub-optimal global health cooperation results from the complexity of health problems, political interest, and inadequate mechanisms available for collective action (41,43). While these multiple factors affect cooperation during pandemics, the approach lacks specificity. Global governance can be identified as regimes (7) or institutions, and “it appears to be virtually anything (44).”

These theoretical approaches offer some explanation for sub-optimal cooperation. Yet, as outlined below, the examination of the role of epistemic communities in facilitating global health cooperation provides an important and overlooked explanation. Emphasizing the agency of epistemic communities recognizes actors that have an active role in the global system of governance.

1.1 The relevance of epistemic communities in the international response to infectious diseases: findings and recommendations

Global health problems are becoming more complex, with the participation of multiple actors at multiple levels and health intertwined with economic and security issues.

Policymakers rely upon several actors to get information, advice, and political support to advance their interests. There is especially an influx of global health networks providing resources, knowledge, advocacy, policy ideas, and defining programs that can effectively influence policy outcomes (45). Global health policy highly depends on the advice and evidence-based knowledge provided by experts and professionals with experience in highly technical and specialized areas. Although experts in global health[i] have a primary role in the definition of global health institutions, policies, and norms, their influence does not always translate into improved cooperation.

In the international response to any infectious disease, epistemic communities act as providers of knowledge and policy advisors. They produce the information to understand the context, the pathogen/disease, and the knowledge to develop interventions to manage and control the outbreak. Even though these actors are involved in the response to pandemic outbreaks, it is not clear how much they can "change the game" and move cooperation outcomes closer to the Pareto frontier (Chapter 3). The analysis of the international response to four pandemics, A(H1N1) Influenza, Zika, Ebola, and MERS-CoV, offers evidence to improve our understanding of these networks. Each one of these responses was unique, with a different level of cooperation. With the framework proposed in chapter 3, table 6, the study determined that the response to the A(H1N1) Influenza outbreak had the highest level of cooperation with 5.43 out of 6, followed by Zika with 4.62 out of 6, then Ebola with 2.62 out of 6 and with the lowest level MERS-CoV with 2.37 out of 6.

In all these cases, it is possible to identify an epistemic community and the

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[i] These experts are identified as all those people with the knowledge (technical, scientific, managerial, diplomatic, etc.) to design and participate in the definition of global health policy.

characteristics attributed to it. With this information, and following the analytical framework proposed in chapter 4, the research assesses the differences in the epistemic communities' characteristics across cases and estimates how these differences contribute to determining each epistemic community's capabilities to influence international cooperation. These results show that the epistemic communities' characteristics vary across cases, and this variance influences the level of international cooperation in each case.

During the A (H1N1) influenza outbreak, the influenza epidemic community developed explicit consensual knowledge, increased its bureaucratic power, and broadly socialized its ideas, improving the level of cooperation. The Ebola epistemic community did not consolidate itself as an important actor in the global policymaking system during the outbreak in West Africa, having problems to create consensual knowledge, with internal divisions, limiting the socialization of its ideas and reducing its bureaucratic power. The Influenza epistemic community was vital in the level of international cooperation depicted in the response to the influenza A (H1N1) outbreak. The Ebola epistemic community had marginal participation and influence in the level of cooperation during the outbreak in West Africa.

In the cases of MERS-CoV and Zika, the epistemic communities participating in these outbreaks formed under comparable circumstances but with different results and impact. They originated in epistemic communities that had previously worked on diseases with characteristics similar to the ones producing the outbreaks. Nonetheless, the MERS-CoV epistemic community was unable to generate explicit consensual knowledge to convince policymakers that global action was needed to control the epidemic. The lack of information slowed down the production of knowledge and dissemination of the epistemic community ideas. Instead, the Zika epistemic community used the uncertainty surrounding the virus to build an internal consensus about the risk of the disease and convince policymakers to implement worldwide control activities. The Zika epistemic community institutionalized its bureaucratic power in a short period, being able to disseminate its ideas fast, and reaching key actors in the process. Therefore, the MERS-CoV epistemic community had less influence and less ability to increase international cooperation, while the Zika epistemic community was a relevant actor in the implementation of international measures to control and manage the outbreak.

Even though there is evidence that epistemic communities can improve the level of cooperation, their influence has limitations. These networks are embedded in a system of global governance where the main actors are nation-states and international organizations. The dynamics in the system and its structure circumscribe epistemic communities' participation in the global policy-making process.

In global health, the importance of epistemic communities is increasing. The implications of their influence, or their failure to do it, are very relevant in a moment when evidence-based, and science-based policymaking is rejected by many. Hence, this research is an exploratory analysis since each of the cases studied here is rich in information and with multiple elements that could be analyzed with more detail. The next step would require doing a within-case empirical analysis for each outbreak, and with that to obtain other insights on the role of epistemic communities.

1.2 Contribution

This examination of the international response to disease outbreaks makes two main contributions. First, the system of global health governance built to face disease outbreaks requires high levels of international cooperation. Yet, there is little recognition that this cooperation is frequently suboptimal. The research shows that each outbreak case resulted in a different level of cooperation. This study presents an analytical tool to understand the different ways that the international community cooperates in global health, and it analyses the variance and patterns of cooperation in response to infectious disease outbreaks of international concern. This tool provides a method to operationalize the complex issue of how cooperation varies.

Second, the theoretical framework measuring the characteristics of epistemic communities, as well as the degree of international cooperation confirms that these actors can influence cooperation. The proposed model of epistemic communities examined the attributes of epistemic communities, including how they connect to the system of global institutions and governance, and how their participation impacts the outcome. Some epistemic communities can develop strong consensual knowledge and present a policy goal, disseminate their knowledge through their structure, and their multiple connections outside the network. They disseminate their widespread agreement on the problem definitions, the methods required to solve the 'problem,' and identification of possible solutions through publications and conferences. This activity will support an epistemic community's authoritative knowledge claim. Some epistemic communities will also influence the policy-making process to the extent they can participate and institutionalize their bureaucratic power in the policy-making process, with the possibility of having direct involvement in the formulation and implementation of policies. As outlined below, in the Influenza H1N1 case, with a high level of cooperation, the epistemic community developed consensual knowledge, a policy goal, and established a network connecting its members inside and outside. Members of the Influenza epistemic community disseminated their knowledge, published, and participated in conferences continuously transmitting and distributing their research. They also participated in critical expert groups and committees, which institutionalized and consolidated its bureaucratic power. Whereas in the case of MERS, where the level of cooperation was low, the epistemic community reached a partial consensus about the problem and solution, its structure was small, and its knowledge dissemination centered at the regional level, with limited bureaucratic power.

Epistemic communities are not the only factor that influences international cooperation. Yet, these findings confirm that epistemic communities facilitate the functioning of the system of global health governance, i.e., the implementation of norms, the creation of sound policy, and effective collaboration across the international system. Epistemic communities have a more substantial influence on international cooperation when they act together and produce consensual knowledge that is transmitted to policymakers, in a well-organized structure, with multiple connections among them and that have institutionalized their bureaucratic power in the global policymaking process.

1.3 Organization of chapters

This document consists of nine chapters, including the introduction. Chapter 2 explains the research methods used in this study. It outlines the roadmap guiding the analysis, and the methodological framework developed for the research. Chapter 3 discusses the dependent and independent variables, beginning with a literature review of international cooperation (dependent variable), introducing a model to analyze international cooperation in global health. The second part of the chapter focuses on analyzing epistemic communities to explain variation in international cooperation. It presents a proposal to measure epistemic communities' characteristics and their influence on the level of international cooperation. Chapter 4 discusses the problem of cooperation in the international response to infectious diseases. It briefly explains this process and its most essential aspects. The chapter also introduces the study cases and explains the role of epistemic communities in the international response to pandemics. Chapter 5 examines the A(H1N1) influenza pandemic of 2009, explaining the origins of the influenza epistemic community, its evolution, and the factors that have made this community stronger than others. Based on this analysis, the chapter analyzes if and how the epistemic community facilitated international cooperation during the pandemic outbreak. Chapter 6 reviews the MERS-CoV outbreak. It provides a general background about the disease and the origins of the epistemic community. The case examines the problems during the outbreak and the limited influence of the epistemic community. Chapter 7 presents the case of Ebola. It explains the complexity of the Ebola outbreak and the multiple factors that affected the level of cooperation. This chapter positions the participation of an epistemic community within this context and explains the epistemic community's influence in the process. Chapter 8 examines the Zika outbreak and the epistemic community that adapted itself to deal with the re-emergence of a virus that severely affects women and newborns. It explains the relevance of the epistemic community to achieve higher levels of cooperation. Chapter 9 summarizes the conclusions from all the cases, comparing the levels of cooperation and the influence of different epistemic communities. It gives a final analysis based on the evidence presented with some policy recommendations and provides options for future research.

Chapter 2: Research methodology

The research asks the question – why does international cooperation vary in the response to international infectious disease outbreaks of similar pandemic potential? To explore this research question, I undertake literature reviews of global health governance, international cooperation, and the response to infectious disease outbreaks, presented in Chapters 3 and 4. Through analyses of global health governance, the role of epistemic communities emerged as critically important to facilitate global health governance. After a thorough review of the literature on epistemic communities, this paper hypothesizes that epistemic communities affect variation in international cooperation due to differences in epistemic communities' characteristics (degree of consensual knowledge, capabilities to disseminate it, the extent of institutionalization of their bureaucratic power). The research then operationalizes the concept of epistemic communities (independent variable) and identifies how international cooperation varies in global health (dependent variable). It builds a theoretical framework showing the pathways between epistemic communities and international cooperation and applies this framework to the relationship between epistemic communities and cooperation in four case studies.

2.1 Identifying epistemic communities (independent variable)

The literature on epistemic communities provides a general definition of what an epistemic community is, and which actors are part of it. Most studies based their description of an epistemic community on the characteristics defined by Peter Hass (normative beliefs; casual beliefs; epistemological criteria; and a joint policy enterprise) (19). Scholars, however, do not usually identify who these actors are. There is an underlining assumption that a group of experts showing Haas' characteristics represents an epistemic community. Therefore, establishing the boundaries of any epistemic community is challenging. A critical element in the identification of these knowledge networks is their expertise in a field of knowledge (25,51,52,53). As a result, when describing epistemic communities' membership usually includes experts working for universities, research institutions, NGOs, and professionals working in government-financed agencies. Epistemic communities also have a direct connection to the policymaking process (24,51,54). Therefore, members of epistemic communities usually include bureaucrats (at the national and international level), policymakers and diplomats.

To operationalize the concept of epistemic community and determine why some succeed in influencing cooperation, and others do not, this research first identifies the epistemic communities of interest and their members (26,27,28). It tracks the creation and foundations of each one these networks, their membership, their members' interactions among themselves and within the policy process, the evolution of the communities over time, and their influence on cooperative outcomes (26,29). To conduct a thorough identification, the researcher used the criteria described in figure 1.

WHO are they?

- experts with knowledge in the field (epidemiologists, physicians, biologists, veterinarians, laboratory scientists, clinicians, academics, social workers, administrators, among others)
- they can be members of governments(diplomats, bureaucrats, decision makers); international organizations (mostly WHO), or other relevant policy actors
- they share a common interest in the topic
- they have a policy goal

HOW do they interact?

- international organizations' meetings (governance bodies)
- international committees or other technical groups
- experts meetings
- academic conferences
- internet

WHAT kind of resources do they have available to influence the policy process? What do they do?

- institutionalized expert's advice
- access to privileged information
- scientific publications
- holders of information
- access to the policy process
- personal relationships

Figure 1. Identification of an epistemic community. Based on Davis Cross 2011 and Löblová (27,26).

With these criteria, this research considers that epistemic communities in global health include WHO officials and other UN bureaucrats with expertise in fields related to health and international development; scientists and experts working in universities, research institutions, NGOs and non profit organizations from disciplines relevant to public health (epidemiologists, biologist, clinical laboratory scientist, public health experts among others); domestic bureaucrats (from health agencies and others agencies); and health attachés (diplomats specialized on global health). Identifying the members of a given epistemic community in global health, therefore, requires cross-checked lists of international meetings (28) such as the WHO governance bodies meetings, expert group consultations, and committees; recurrent names are usually members of these communities.

2.2 Determining the level of international cooperation (dependent variable)

To determine how international cooperation varies, Chapter 3 reviews the literature on global health and international cooperation. The literature is the foundation for operationalizing variation in global health cooperation, as outlined in Figure 2. Chapter 3 then describes the link between epistemic communities and international cooperation, namely through the structure of global health governance. Figure 3 lays out this link, and Chapter 3 articulates this framework in detail.

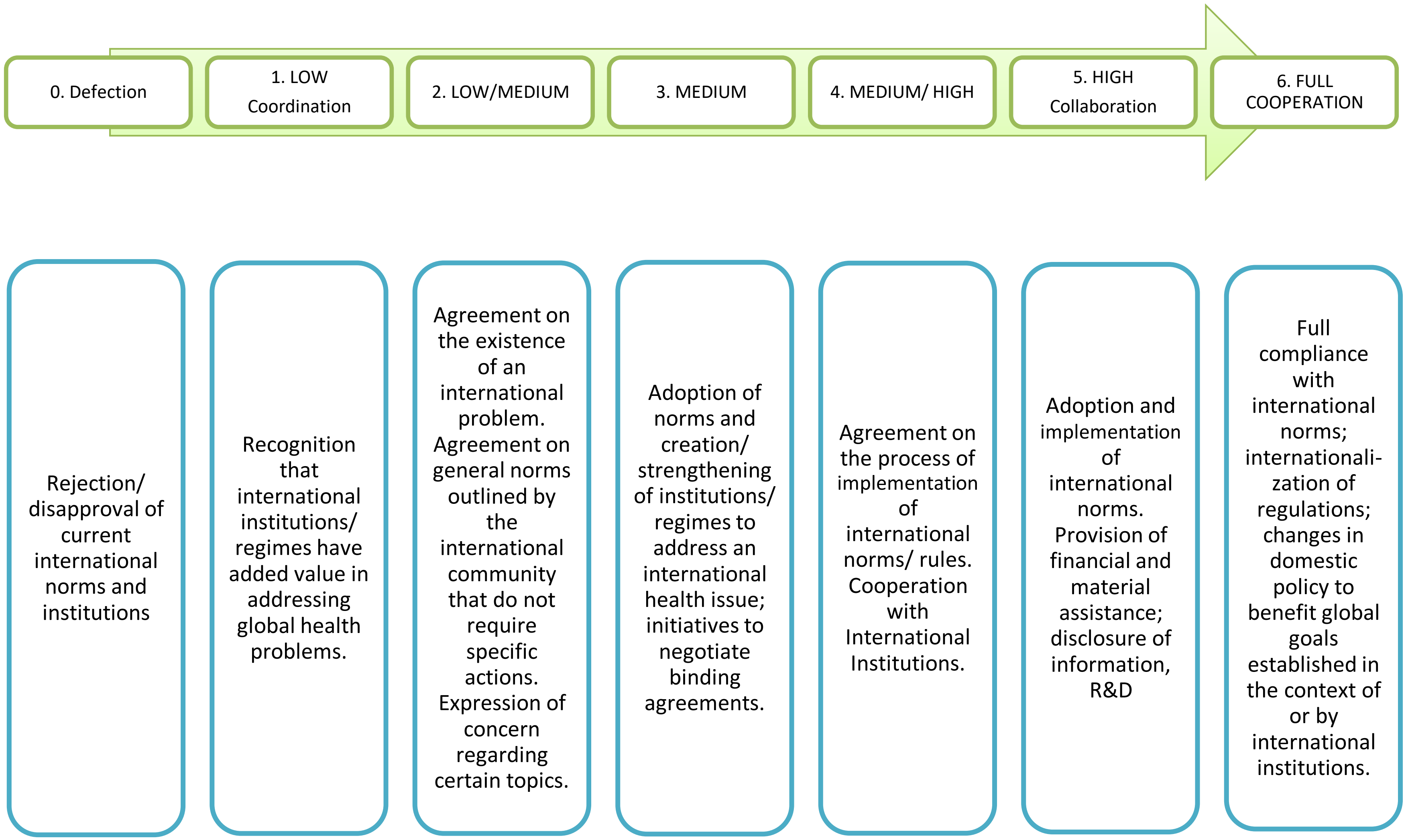

Figure 2. The proposed spectrum of cooperation in global health.

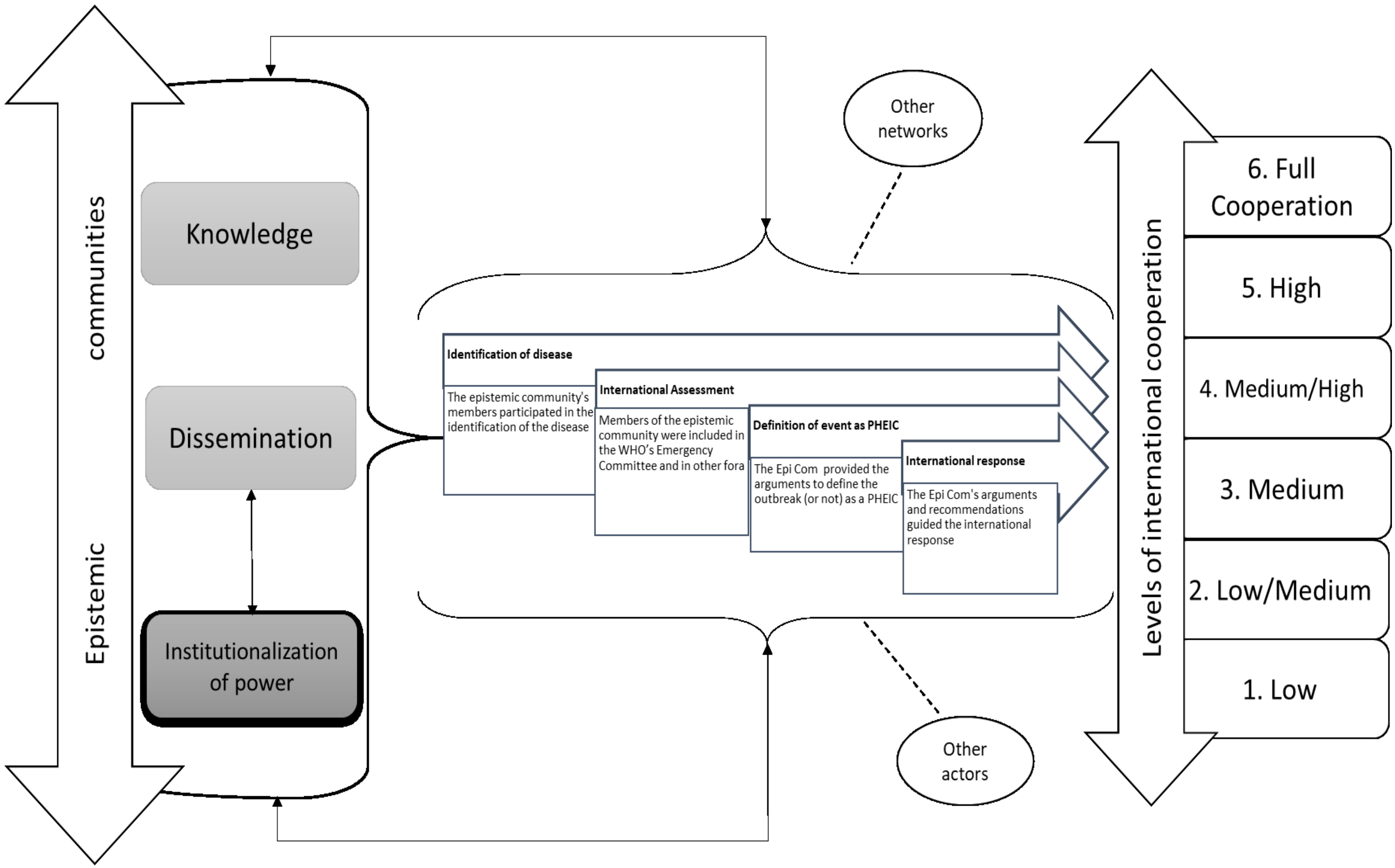

Figure 3. A theoretical framework for analyzing the role of epistemic communities in the international response to infectious disease outbreaks

To operationalize the framework, the research examines the epistemic communities' individual characteristics to determine how they contributed to the observed level of cooperation. The present study, however, is exploratory since it will likely generate other hypotheses related to epistemic communities and variation in international cooperation providing new insights into the problem (50).

2.3 Methodology: case study and process tracing

Case studies are a valuable tool for testing different hypotheses - particularly in the exploratory stages of research. Case studies enable researchers to test explanations that define how the independent variable affects the dependent (51,52). In some instances, particularly for exploratory analysis, case studies are considered more suitable than other approaches for testing theories. This methodology is also convenient to identify and measure indicators that represent the theoretical concepts the researcher intends to measure (51). Case studies are instrumental in analyzing policy transfer mechanisms such as epistemic communities since they permit the identification of complex relationships, interaction effects, and path dependency (51,49,53).

The study also applies the process-tracing method to understand how various factors are relevant to the outcome (54). Process-tracing is valuable for theory building and theory testing. Process-tracing enables researchers to explore the chain of events by which initial case conditions translate into outcomes (51,55). Process tracing supports theory testing as it allows the exploration of a hypothesized causal mechanism against evidence to determine if and how variables contribute to the observed outcome. For theory building, it works to uncover mechanisms that are not clear, and that can affect the outcome (56). It requires using empirical evidence to understand the results (56). Process tracing makes it possible to identify the relationship between independent and dependent variables (51). It facilitates the exploration of the hypothesis (51). Comparative case studies using process-tracing are standard and effective methods to understand the causal mechanism through which an epistemic community influences a policy process (48).

For each case, the study applies the proposed framework, characterizing each one of the epistemic communities, determining:

1. if and how members of an epistemic community demonstrated a robust and shared understanding of the problem, if they formulated a policy goal and shared it, or if areas of disagreement or contention existed;
2. if the structure of the epistemic community facilitated connections among its members – i.e., who the participants in the network were, how they connected among themselves, how extensive their network was, and how they disseminated information through this structure;
3. how directly the epistemic community participated in decision making during the time frame of the case, and to what extent it institutionalized its bureaucratic power; and,
4. if the epistemic community institutionalized its bureaucratic power, to what extent policymakers applied the information that the epistemic community provided during the during the international response.

2.4 Case selection- Inclusion and exclusion criteria

The present research studies the universe of pandemic diseases that were assessed by an Emergency Committee under the International Health Regulations 2005 (IHR 2005) between 2005 and 2015: Influenza A(H1N1) in 2009, MERS in 2012, Ebola 2013-2016, Poliovirus in 2013, and Zika virus 2015-2016. An emergency committee determined if each one of these events[iii] and their health impact[iv] required to consider them (individually) under the category of Public Health Emergency of International Concern (PHEIC). Figure 4 presents a map of recent outbreaks assessed under the IHRs 2005.

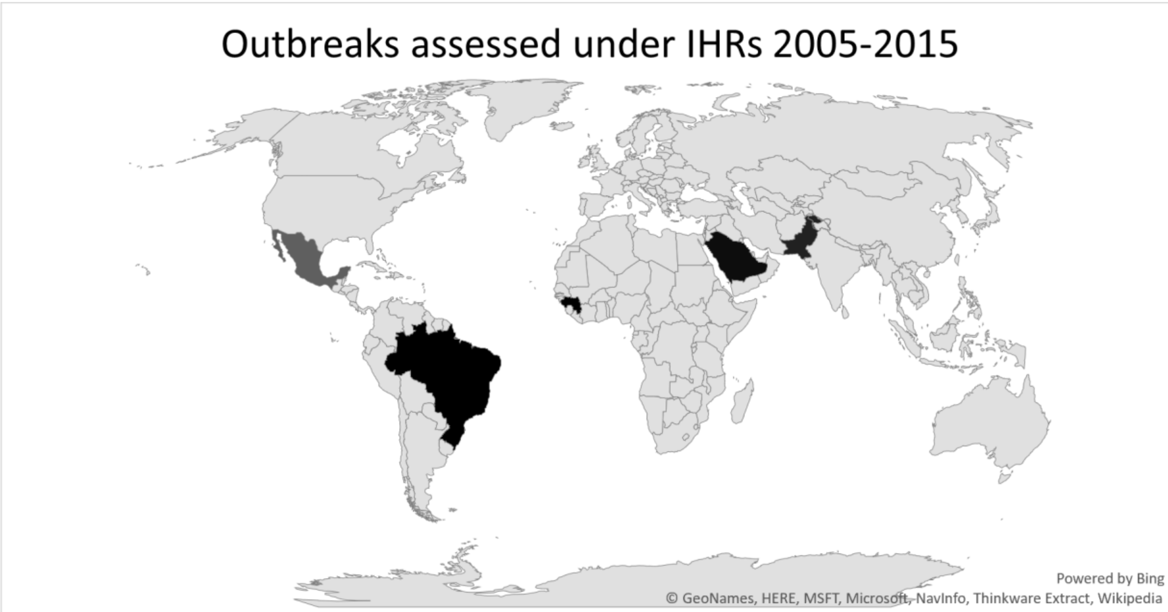

Figure 4. Map of the outbreaks assessed under the IHRs 2005 between 2005 and 2015.

The selection of cases comprises influenza A(H1N1), MERS, Ebola, and Zika virus outbreaks. This study captures variation in the dependent variable by having one case where the level of international cooperation in the response was closer to full cooperation (Influenza H1N1), one case where international cooperation was high (Zika), one medium-low (Ebola) and one case where there has not been an official international response and cooperation has been medium-low (MERS CoV).

The first case, an influenza pandemic, is a well-known virus. Influenza pandemic

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[iii] Defined as "a manifestation of a disease or circumstance that may create a disease" (16)
[iv] These include the diseases listed in Annex 2, IHR 2005 that are subject of notification according to the decision instrument previously described in this prospectus.

outbreaks occur periodically in the world, and research is highly advanced in the area (57). The second case, MERS-CoV, a coronavirus (a type of virus from the same family that caused the SARS epidemic), is a less-known emerging disease and thus lacks a foundation of scientific research. An emergency committee analyzed and reviewed the MERS-CoV outbreak, but it did not declare it as PHEIC even though it has pandemic potential. The third case, Ebola, was first identified in the 1970s and has shown high mortality levels. The 2014 outbreak was initially not considered a PHEIC even when the case mortality rate was high. The last case, Zika, is the only disease transmitted through a vector (a mosquito). It was declared a PHEIC even though the link between the disease and encephalitis in newborns was not clear by the time the WHO made the declaration.

The research excludes the poliovirus outbreak of 2014 (categorized as a PHEIC). The outbreak was small and took place amid a largely successful disease eradication effort with high levels of cooperation. Since 1988, when the WHO launched the Global Polio Eradication Initiative, the polio cases have decreased by 99% (58). On May 5th, 2014, the WHO Director-General announced that an Emergency Committee assessed an outbreak of wild poliovirus in Afghanistan, Cameroon, Equatorial Guinea, Ethiopia, Israel, Nigeria, Pakistan, Somalia, and the Syrian Arab Republic. An emergency committee decided that the outbreak met the criteria to consider it a Public Health Emergency of International Concern (PHEIC). Yet little new action took place, and polio eradication efforts continued. Therefore, this study does not include the polio PHEIC.

2.5 Data collection method

As noted above, process-tracing involves the examination of histories, archival documents, interview transcripts, meeting records, public commentary by researchers, and other sources to collect information on relevant variables (51). Collecting data from multiple sources allows triangulation, which provides a more rigorous process of analysis that increases confidence in the validation of findings (59,60). Therefore, this research included information from different sources. The first group of data came from official reports and primary documents from international organizations. It comprised resolutions, historical records, archival documents, individual reports collected and published by the WHO and other organizations. As well, it included previously published interviews with experts and other stakeholders. The consulted documents were obtained through the WHO and its regional offices' websites, WHO headquarters archives, other international organizations' websites, and official governments' websites. Although official documents and archival sources are subject to selective deposit and selective survival (61), in this case, it was best to analyze official sources. The primary source of information was the WHO since each country must report any disease outbreak under the IHRs.

Academic publications were the second group of data sources, including books, peer-reviewed and other published articles written by members of epistemic communities in recognized journals of public management, public policy, international affairs, medical sciences, microbiology, virology, global health and health policy (such as *The Lancet* or *The BMJ*), among others. The academic literature provided the basis for the theoretical and analytical framework, guiding the research and the tools for analyzing the information and the cases. Scholarly articles were also critical to complete the case studies, providing information that was not clear from other sources but also offering the experts' perspective.

Finally, to complement the information, I conducted 12 confidential interviews with members of epistemic communities who had participated in one or more of the responses to diseases outbreaks included in this research. I identified those actors through publications, documents from international organizations, and reports from governments. Some of the interviewees also provided names of possible candidates and, in some cases, contacted me to arrange an interview. The interviews were conducted in person, by telephone or skype, and they had a duration of between 30 minutes to 60 minutes. The interviews were semi-structured based on the interviewed guide approved by Carleton University's Research Ethics Board (See Appendix A). The guide included questions that helped give a better understanding of the epistemic communities' role in the international response to pandemics.

Even though these questions guided the interviews, participants did not answer all of them. In most cases, interviewees provided answers that combined elements referred to in other questions. Therefore I considered it redundant to ask about something already discussed. During some of the interviews, I introduced some items not included in the guide to make clarifications or to elaborate issues that were relevant for the study.

The number of people included in my sample was small; however, all of them came from different backgrounds, nationalities/regions, and with different positions within organizations and governments. All of them constituted a sample of the type of members in an epistemic community network, with different backgrounds, and roles. Table 1 presents a general description of the interviewees[v].

[v] To keep the anonymity of the interviewees, this table does not disclose any specific information that can be attributed to a specific person.

No. of Interview	Position	Type of organization
Interview 1	Deputy Minister	Government
Interview 2	Director-General	Government
Interview 3	Director Research Centre	Research Institution
Interview 4	Director-General	Government
Interview 5	High-Level Advisor	Private consulting
Interview 6	Senior Consulting Fellow	NGO
Interview 7	Programme Officer	International Organization
Interview 8	Bio Risk Manager	Regional Organization
Interview 9	General Manager	Government
Interview 10	Head of Division	Regional Organization
Interview 11	Director of a Research Centre	University
Interview 12	Consultant/ Former Deputy Minister	Government

Table 1. General description of interviewees.

In the analysis/coding of the data from the interviews, I applied both deductive and inductive analysis. For the deductive analysis, I identified categories a priori based on the theoretical framework (62,63), and based on that, I developed a coding system. The inductive analysis identified common themes that emerged through the interviews. Then, I classified the codes per category, as presented in table 2.

Category	*Codes*
1. Collaboration and development of consensual knowledge	Epistemic community collaboration Agreed definition History of collaboration
2. Structure	Informal/formal communication Interactions with other community members WHO's participation in the epistemic community
3. Institutionalization of bureaucratic power	Bureaucratic power Influence of institutions/norms Expert advisors Evidence-based policymaking Legitimacy Participation in international organizations Direct involvement in national governments Participation in international meetings Members in a key decision-making position Leaders-champions-policy entrepreneurs
4. International response	Characteristics of the Influenza outbreak Characteristics of the Ebola outbreak Characteristics of the Zika outbreak Characteristics of the MERS outbreak Participation of experts in the influenza response

Table 2. Codification of interviews

This information facilitated assessing the strength of the epistemic communities included in this research, specifically by identifying how relevant epistemic networks engaged in the policy-making process. The information provided by the interviews complemented the data obtained from other sources.

2.6 Scope and Limitations

This research was broad and complex, given the type of cases it analyzed, the theoretical framework applied to them, the amount of information that each case comprises, and the research method.

First, an analysis of epistemic communities participating in international cooperation on disease outbreaks offers an opportunity to improve our understanding of the role of professionals working on global health issues. As such, it recognizes them as actors with agency, embedded in an international system of governance managed by sovereign states and international organizations. Research on epistemic communities tends to centre its study on the "power of knowledge" and the assumption that their expertise is their most essential feature. The research, however, acknowledges other characteristics of epistemic communities that make these actors relevant for policymaking. For instance, these groups are social structures that forge relationships necessary to connect their knowledge to the policy process and to make it relevant for decision making. These characteristics are necessary to advance their knowledge into the policy process.

Second, complex webs of professional networks always exist. For individuals engaged in global health, those networks can be quite extensive - including academics, advocates, and policymakers - and span countries. It can be challenging to differentiate between establishing the existence of expert networks to identifying the epistemic community's precise influence on cooperative outcomes.

Third, the research required identifying the epistemic community for each one of the study cases. Mapping the entire network in each case study, however, was extremely complex and outside of the scope of this study given their multisectoral and multi-level components. I solved this limitation by identifying a core group or groups that represent an epistemic community. For all cases, this core group included members of the Emergency Committee (EC) and other experts. According to the IHR 2005, the EC is the principal technical advisor to the WHO for the assessment of a disease outbreak, and its decisions can trigger an official international response. Historically, professionals with expertise in different fields of global health have collaborated with the WHO sometimes as members of governments, other international organizations, research centres, universities, professional associations, or as independent experts. Through the EC and other forums, they connect with the WHO and its regional offices. Not all professionals with expertise in a specific area or their institutions of origin are part of a given epistemic community. As the cases will show, an epistemic community can be a small and closed group, and it does not automatically include all professionals with relevant expertise in the field.

Fourth, the analysis of the influence of the epistemic community in international cooperation needs to connect the members of the epistemic community to the policy process and policy decisions. In some of the cases in this research, making this connection was challenging due to the lack of available information. Given that many members of the epistemic communities hold policymaking positions, many of them did not want to be recognized or could not share some information. Moreover, the WHO produces and keeps most of the records of meetings and information about disease outbreaks and the unfolding events for an international response. Nevertheless, many of these records are not fully available, and the WHO usually only provides summaries of meetings, such as in the case of the EC meetings. The WHO's access to information policy indicates that the organization has the right to reserve any document for 20 years[vi].

Fifth, the research addresses some of the most common problems found in the literature of epistemic communities, such as the analysis of a single case study or that the cases usually present positive outcomes (high cooperation). The study comprised four study cases, all with a different outcome. Having variation in the cases improved the analysis of how and to what extent epistemic communities contributed to this variation. The inclusion of four cases as extensive as the ones chosen in this research, however, creates a problem of limited time and resources for an in-depth and detailed analysis of each one of them. Nonetheless, this study provides a starting point to continue exploring them.

Sixth, the information included sources from different fields such as epidemiology, the biology of infectious diseases, surveillance, laboratory, genetics, vaccine, and drug development, among others. It also required the review of country-specific health reports, international health guidelines, and expert reports on global health produced by international organizations. Since I am not a biologist or health sciences expert, some explanations about the mechanics of diseases and the medical interventions are general and may lack precision.

[vi] Email received on May 3rd, 2017 from Renee Steelant, WHO Records and Archives, referring to WHO Archives access policy which states "WHO archives are accessible to researchers once the records are at least 20 years old".

For that reason, I tried to include as many sources as possible.

Seventh, the theoretical framework outlining the relationship between epistemic communities and global health cooperation is exploratory and complex. However, while recognizing the challenges of establishing the causal role of the epistemic communities in global health cooperation, we should question what would have happened in the absence of epistemic communities in the cases analyzed in this research.

Eight, despite the broad interest in the study of pandemics, the public health perspective dominates the study of pandemics and global health, even though this field offers multiple cases of interest to advance our knowledge in international relations. This research aims to close that gap by presenting a study from a perspective of international affairs, referring specifically to the problem of international cooperation.

Ninth, the research applied a framework based on theories of epistemic communities to examine international cooperation. This approach is not new in the study of international affairs; however, scholars have considered epistemic communities mostly in the context of the environment and social policy. Few studies examine the concept of epistemic communities to explain international cooperation (64) or global health outcomes (65,66,67,49,68,69). In the field of global health, epistemic communities regularly participate in everyday policymaking. Thus, there are many cases to study the relevance of these actors and their influence on policy outcomes. To my knowledge, this is the first study that comprises four cases at once with variation in the level of cooperation. An extended analysis of four cases with different outcomes provides details of how epistemic communities can modify international cooperation, and what characteristics matter the most to shape their impact.

Finally, some studies have already addressed the importance of internal characteristics in the level of influence of an epistemic community (70); as well as the importance of external factors such as the demand of experts (47). Instead of separating the epistemic communities` characteristics from their context, the proposed framework includes both components in a comprehensive model.

Chapter 3: International cooperation

This chapter will explore the concept of international cooperation and examine how international cooperation varies. To this aim, the study introduces indicators for measuring variance in international cooperation in global health. Then, the chapter will turn to a discussion of epistemic communities and how and why their relevance for advancing international cooperation in global health. It will then explain and outline the framework that guides the analysis of the case studies.

3.1 Introducing the problem of international cooperation

International cooperation materializes when actors adjust their behaviour to the actual or anticipated preferences of others, through a process of policy development, implementation, and coordination (71). Cooperation in the international arena, however, is often difficult to achieve. Traditional theories of international relations have focused their attention on providing different explanations to the central question: when and why do countries cooperate?

Realist scholars argue that cooperation is possible when it increases the net benefits to the state (72). International norms and institutions, therefore, reflect and reinforce national interests and national security calculations. As such, countries cooperate when they are better off than without cooperation. Although these theories draw attention to a fundamental problem in international affairs (national interest over collective wellbeing), they fail to recognize that international cooperation in global health always materializes to some degree and that, sometimes, non-cooperative behaviour is inconsistent with the national interest.

Neoliberal institutionalism focuses on institutions as critical mechanisms for cooperation – they establish predictable rules of the game (73) and systems (74) to promote it (75,76,77). In this conception, international institutions work "establishing the ways in which states should cooperate with each other (78)." Institutions guide, enable and constrain the actions of individual actors, such as states (79), by providing information; increasing transparency; reducing incentives to defect either by giving sanctions to violators or by lengthening the "shadow of the future"; reducing uncertainty; and decreasing transaction costs (76). Institutions can increase interdependence, and enable the coordination of policies among states, leading to higher levels of cooperation (76,80,81,82,83,84).

Regardless of a governing framework of international institutions and norms, different levels of international cooperation occur for similar outbreaks. Institutions can modify states' behaviour by enforcing rules (75,85). Variation in international cooperation, therefore, could be a problem of enforcement and implementation. However, most international institutions do not have enforcement mechanisms (organizations on international trade and human rights are the exceptions). In the case of global health, there are no instruments to enforce rules. In the end, national states choose to adhere themselves to certain norms, implement them fully or partially, and whether to adopt them or not at the national level.

Institutional theorists also predict that norms and institutions would induce optimal levels of cooperation by modifying states' behaviour. In global health, the WHO - understood as the organization itself and the collective decision making of its member states - has increased its influence in the development of global health policies, making possible the creation of relevant norms and institutions in different areas (tobacco control, HIV-AIDS, communicable diseases, infectious diseases, among others). In infectious diseases, the WHO guided the development, negotiation, and implementation of the current system for prevention, management, and response to disease outbreaks under the IHRs.

Finally, theories of social learning, policy diffusion, and policy transfer go beyond the existence of institutions to argue that cooperation depends on how each country internalizes norms and shares information, knowledge, and ideas (20). Social constructivism theorists focused on explaining other aspects of international cooperation, such as the nature of agents or subjects, problematizing them, and studying them as variables (86). The study of agents allows moving from the study of norms and institutions as stable social structures to "how actors must operationalize their normative context to take specific actions (87)" since norms should be transformed into specific activities. Therefore, it studies the role of non-state actors such as epistemic communities in shaping cooperative outcomes and increasing levels of cooperation[vii] (20,25,21,22).

3.2 Variation in international cooperation

International cooperation, particularly in global health, is best understood as a phenomenon of multiple levels (88,75,89,81). While the international community usually cooperates to some degree, the intensity of cooperation varies because states cannot always agree on the terms of cooperation, particularly if cooperation has distributional consequences. The highest level of cooperation is difficult to reach since countries must implement specific actions to benefit others, while the advantages of these actions are not

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[vii] Traditional theories of international relations largely assume cooperation is a dichotomy, states either "defect" or "cooperate" (666). The constructivist approach challenges this interpretation, and some authors propose the idea that cooperation has multiple degrees (23,666,93).

reflected directly into their well-being.

Figure 5 shows international cooperation by utilizing the concept of the Pareto frontier. The space between the Pareto frontier and the point of origin are all possible options to reach a cooperative agreement, with the most optimal solutions for each party found on the Pareto Frontier (23). Parties must work together to identify the point on the Pareto frontier of maximum mutual benefit or common interest. Parties do not know the location of the Pareto Frontier, and they do not know what it is “jointly possible” as countries’ preferences are unknown, and they do not openly share the range of probable outcomes (23,90,48). Therefore, inferior results, asymmetric outcomes, and impasses are typical (23).

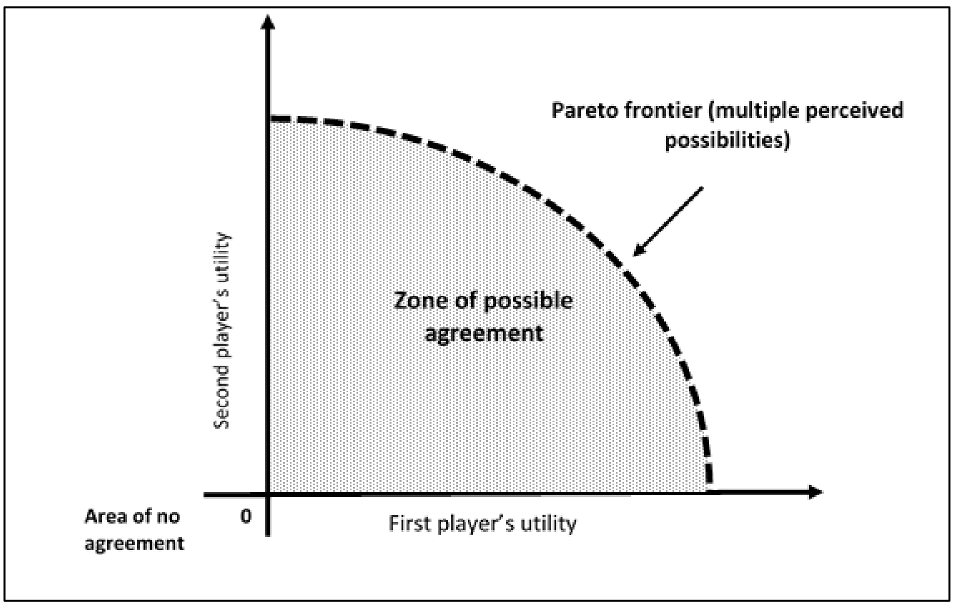

Figure 5. Distributional conflicts outside the Pareto Frontier. Based on Sebenius 1992 (23).

For the analysis of global health, an essential aspect of this model is the existence of suboptimal cooperation. Suboptimal cooperation with distributional conflict is usual in area-issues with a high degree of technical/ scientific or strategic uncertainty (25,90,23,91,92). Technical uncertainty makes it more challenging to understand the existence and nature of a problem, as well as to formulate appropriate solutions to solve it (93). Given the role of global health institutions in facilitating discussion and dialogue, they facilitate repeated interactions. Actors enter a process where they learn from each other over the iterative processes of negotiation and discussion. Knowledge about the other actors and the issues under discussion improves during this constant interaction (23,90), and cooperation, therefore, can evolve over time or emerging distrust can undermine future cooperation.

The Pandemic Influenza Preparedness Framework (PIP) negotiations exemplify the distributional consequences of some global health agreements, the importance of iterative interactions, and the difficulty of reaching full cooperation in global health. From 2006 onwards, the global health community watched with concern as a novel H5N1 influenza virus spread among the bird population in Southeast Asia. Many scientific experts feared that H5N1 could spread quickly and devastate global health like the Spanish Influenza outbreak of 1918.

In 2011, the WHO`s members approved the PIP framework after a controversial negotiation to address how countries could share influenza viruses for research and development (R&D) purposes, including vaccine development technologies and access to vaccines. The negotiation began after Indonesia claimed that developed countries (and their pharmaceutical industries) were taking advantage of the WHO's system. Countries routinely took viral samples from disease outbreaks, specifically influenza, and gave these samples to companies to develop and manufacture vaccines for their citizens and markets. In the case of an outbreak of pandemic influenza, this would provide countries with the possibility of protecting their citizens (94,95). Indonesia argued that countries and industries collecting influenza virus samples to manufacture vaccines for profit should provide benefits to the countries where those viruses originated (96,97,98). Citizens of the originating countries would be first affected by any pandemic outbreak yet would not benefit from vaccines as pharmaceutical companies commercialize them for high-income country markets (94,95).

The distributional conflicts in the negotiation of this agreement included determining who benefits from the acquisition of viral samples; how the pharmaceutical companies access viral samples; how to persuade pharmaceutical companies to share benefits with those affected countries; and, the delimitation of benefits (access to medicines, vaccines, research). In the end, countries found a compromise whereby the originating countries will provide influenza virus samples and receive R&D benefits in return.

The agreement, however, was less than optimal. The final version did not include all the demands made by either developed or developing countries. Further, private actors undertake many R&D activities, yet there are no enforcement mechanisms to make them comply with this framework (99). Nevertheless, reaching an agreement was better than no agreement - not having access to virus samples makes it more difficult to control an outbreak. Although this was not an optimal outcome, it represented a joint gain. It was a move towards more cooperation in a critical area where the exchange of viral samples and biological materials is crucial for controlling disease outbreaks.

The PIP, however, does not represent a situation of full cooperation because it only provided a partial solution to the problem – for instance, it created a framework for the pharmaceutical companies that is not enforceable, and that it depends on the goodwill of all actors involved in the system (100). The agreement also only covered influenza viruses, and there were no discussions about including other pathogens under the same framework (even though the issue of sample sharing goes beyond influenza).

In the PIP negotiation, the outcome, therefore, was cooperative, although it was still far from the Pareto frontier. Indeed, countries found it difficult to reach an ideal outcome because it required a high level of commitment from all the parties involved in the process. The process did not allow direct participation of non-state actors, including scientific experts, as well as representatives from the pharmaceutical sector. In this case, non-state actors participated through national governments and the WHO. The PIP illustrates that international cooperation in global health can vary dramatically and that even a 'cooperative agreement' can be less than what is needed to fully address a pandemic outbreak.

3.2.1 An analytical framework to analyze variation in global health cooperation

The Pareto frontier is a useful conceptual tool that illustrates the existence of "perfect" or full cooperation, and the fact that many international agreements fall below this ideal. The PIP negotiation demonstrates the challenge of reaching that "ideal" cooperative outcome in practice – for a global health issue of high priority. However, what does the spectrum of cooperation look like in practice? How can researchers understand, identify, and operationalize the variation in international cooperation in global health? The present research proposes stages in global health cooperation (101,102,93,103,88,12,104,105). This model presented in figure 6 defines six varying degrees of cooperation, providing concepts, indicators, and an approach to measure this cooperation.

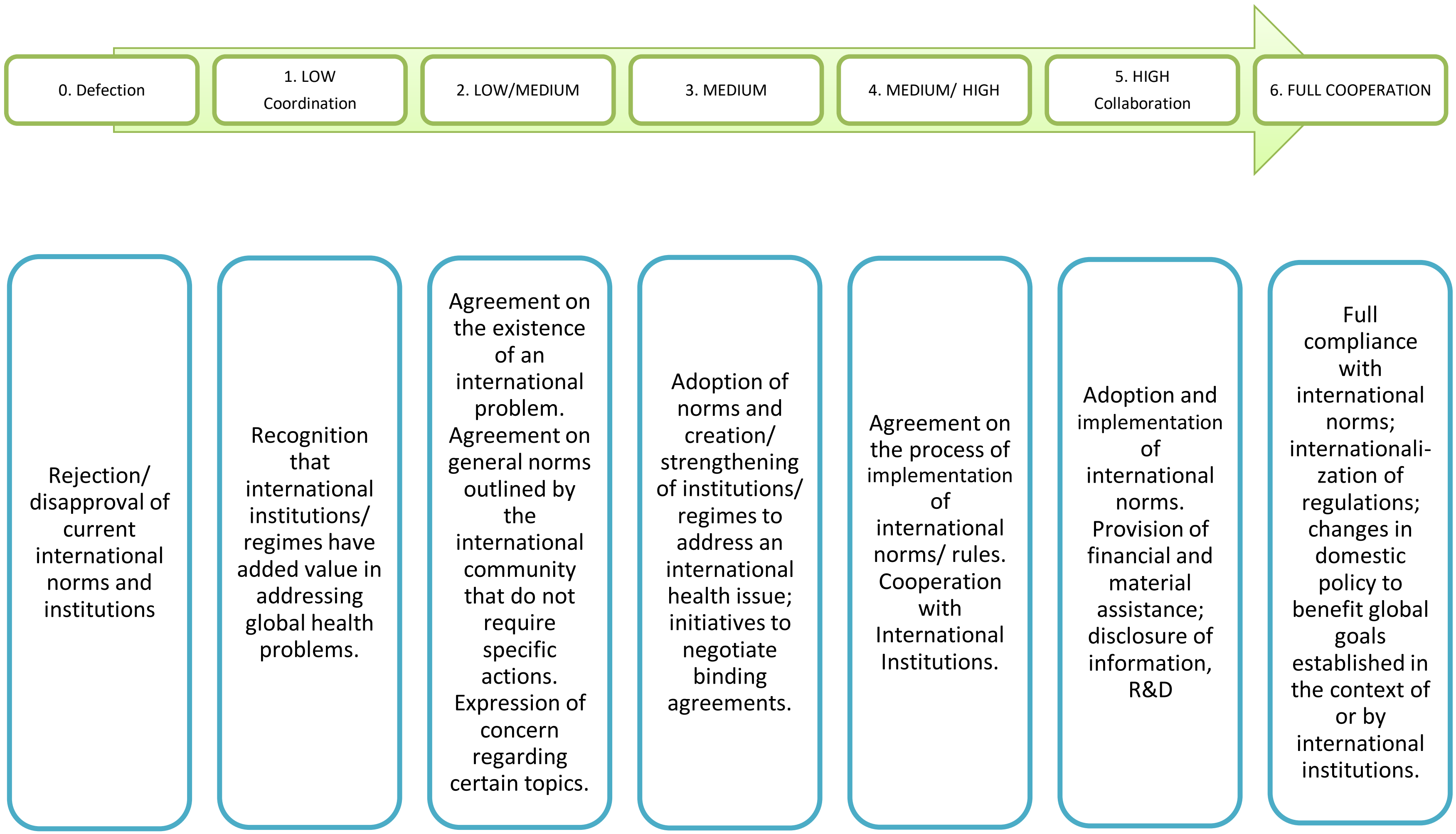

Figure 6. A proposed spectrum of international cooperation in global health.

In general, cooperation in global health is mostly at levels 1 and 2: coordination. Countries created the WHO and other multilateral agencies to solve coordination problems (105,81,88,101,106), facilitating agreements, and mobilizing resources (102). Although international organizations function as a space to meet, set policies, and approve international programs, these are necessary but not sufficient to ensure cooperation (105,107). As they discuss global health issues, states define the problem, identify its relevance, and set the global health agenda (Level One). Members of the WHO, either at the World Health Assembly (WHA)[viii] or the Executive Board (EB)[ix] meetings, draft and propose resolutions (non-binding) to articulate and problematize global health issues and how to address them. In addition to the development of soft law (non-binding agreements), the establishment of institutions and the broad coordination of policy (Level 2) are also consistent characteristics in global health cooperation (108). Governments participate every year at the WHA to determine the policies of the organization, adopt conventions and agreements regarding any issue within the competence of the WHO (109). It was not until 2003 that countries agreed to exercise Article 19 of the World Health Organization's Constitution and approved the

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[viii] The World Health Assembly is the most important body of governance at the World Health Organization where every year on May all its member states gather to discuss topics of international public health. According with the WHO Constitution Article 21 "The Health Assembly shall have authority to adopt regulations concerning: (a) sanitary and quarantine requirements and other procedures designed to prevent the international spread of disease; (b) nomenclatures with respect to diseases, causes of death and public health practices; (c) standards with respect to diagnostic procedures for international use; (d) standards with respect to the safety, purity and potency of biological, pharmaceutical and similar products moving in international commerce; (e) advertising and labelling of biological, pharmaceutical and similar products moving in international commerce."

[ix] The Executive Board is a governance body at the World Health Organization. Thirty-two member states are elected every three years to be members of the EB. The WHO Constitution in its Article 28 determines that "The functions of the Board shall be: (a) to give effect to the decisions and policies of the Health Assembly; (b) to act as the executive organ of the Health Assembly; (c) to perform any other functions entrusted to it by the Health Assembly; (d) to advise the Health Assembly on questions referred to it by that body and on matters assigned to the Organization by conventions, agreements and regulations; (e) to submit advice or proposals to the Health Assembly on its own initiative; (f) to prepare the agenda of meetings of the Health Assembly; (g) to submit to the Health Assembly for consideration and approval a general programme of work covering a specific period; (h) to study all questions within its competence; (i) to take emergency measures within the functions and financial resources of the Organization to deal with events requiring immediate action. In particular it may authorize the Director-General to take the necessary steps to combat epidemics, to participate in the organization of health relief to victims of a calamity and to undertake studies and research the urgency of which has been drawn to the attention of the Board by any Member or by the Director-General.

Framework Convention on Tobacco Control, a binding agreement (108,66) - cooperation at Level 3. Implementation of these agreements requires establishing specific processes and mechanisms, which is cooperation at Level 4.

Provision of financial and technical assistance – particularly direct support to Ministries of Health that necessitate adhering to goals and benchmarks - requires higher levels of commitment and cooperation that will lead to Level 5. In contrast, full cooperation required to reach Level 6, is not easy to attain. It requires adjustments that many actors are unable to reach due to the lack of resources and their inability or unwillingness to reform domestic institutions and norms. To fully comply with international norms, all countries must adopt the same policies to achieve a common goal – such as the full implementation of the IHRs. This degree of policy convergence demands prioritization of international cooperation over national interests.

The different levels create a spectrum of cooperation. Figure 7 illustrates this as an incremental process that materializes over time. The international community can move up from low cooperation (Level 1) to low/medium (Level 2) and continue until reaching full cooperation (Level 6), the desired outcome.

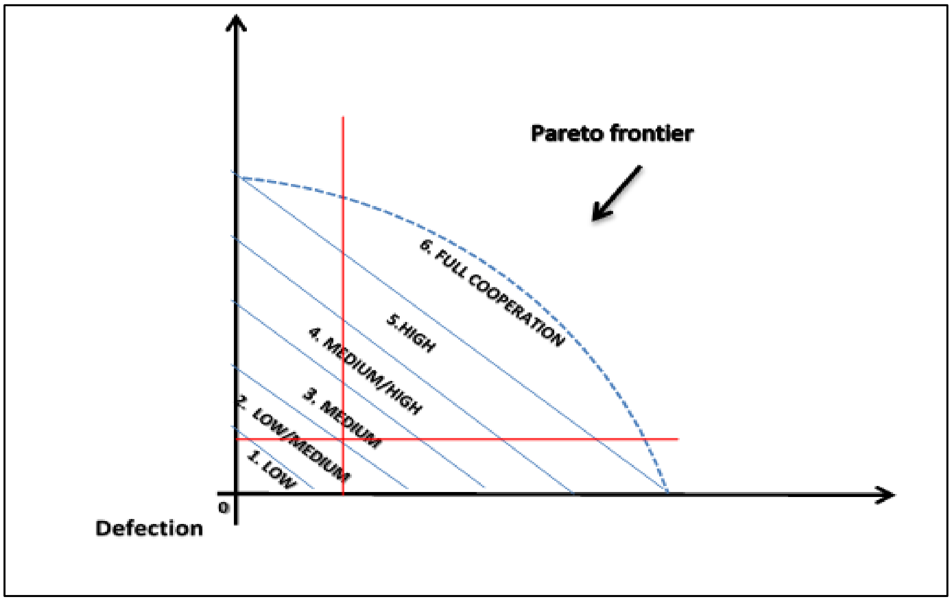

Figure 7. A proposed spectrum of global health cooperation. Based on the Pareto Frontier model on Sebenius 1992 (23).

Under this model, the most common feature of international cooperation is coordination, while collaboration among actors is less common. Full cooperation in global health requires that the international community reacts and responds quickly to health emergencies, and all its members must act together to address endemic health problems. The WHO and non-affected countries must provide financial, material, and human resources to manage the situation, even when this might not directly affect their well-being. That entails the ultimate form of cooperation: nation-states changing their national and local regulations and behaviour to benefit global action (105).

3.2.2 Levels of cooperation in the international response to infectious diseases

This analytical framework for international cooperation characterizes the dynamic nature of global health cooperation. To demonstrate the utility of this framework, I identify these different levels and forms of cooperation in the international response to infectious diseases. International cooperation to control and manage disease outbreaks presents different outcomes with distributional consequences[x] and uneven benefits for all states.

The international response to infectious diseases is a set of activities to manage, control, contain, and eradicate outbreaks. Through the 2005 IHRs and other instruments, the international community has agreed on the basic terms of an international response to an infectious disease outbreak. However, the response is not consistent, with different levels of cooperation. Coordination is the most typical feature, while collaboration among actors is less common.

The coordinated effort requires "the same core competencies and planning on the national level, with the addition of coordination and cooperation of the incident-case country with its immediate neighbors and the global community (1)". Member States will contribute and participate in meetings and committees to discuss the situation and find the best possible solutions. States will follow experts' recommendations issued to manage the disease. These recommendations will require continued surveillance and provision of information to the WHO – such as notification of new cases and other events related to the outbreak. States will also have to adopt other measures, establishing specific national policies that will contribute to reducing the outbreak's impact (16). These include:

- Avoid issuing any policy that could harm other countries unless these measures are specifically recommended and supported by scientific evidence, such as travel alerts, quarantine, or limiting trade;

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[x] Some of these consequences can take the form of differentiated fees paid by various states in order to implement an agreement. This happens as well when investment in certain health capacities favors a group of countries; or in a limited access to certain supplies (medicines, vaccines) for certain countries during emergencies.

- Enforce specific measures at airports, seaports, and other entry points;
- Facilitate and expedite measures for importing-exporting, transporting and handling of viral samples and other biological materials;
- Implement specific medical and non-medical interventions;
- Provide financial, material, and human resources to manage and contain the outbreak – even when the epidemic might not directly affect all Member States' well-being.

The affected countries should be transparent and provide timely information about the state of the epidemic, the number of cases, and their severity (110,111). Transparency and clear communication with the international community enables a more valid assessment of the situation and its consequences, "allowing for a harmonized approach by affected governments, organizations, and communities on disease control and other mitigation strategies (1)". States should be able to openly provide information without fearing any negative impact on trade, travel, and the economy or any other measure that could harm the well-being of the population (98,110,111,112).

Analyzing the different levels of cooperation in the international response to infectious diseases is critical for understanding the factors that can make this international activity consistent. Thus, to establish how this variation in the level of cooperation takes place, the study measures four general dimensions or components of cooperation in the international response. Table 3 explains each one of these dimensions.

Dimensions	Description
I. International Participation	The type of participation that countries have in international fora.
II. International Assistance	All types of activities attributed to international assistance, including ODA.
III. Scientific Response	The actions related to R&D, the disclosure of information, and the participation of experts.
IV. Policy Convergence	The alignment of domestic policy with international agreements and law, as well as the implementation of those policies, agreed at the international level. Member States should ensure that their administrative and legal frameworks allow cooperation (113)

Table 3. International cooperation dimensions in the international response to infectious diseases.

These dimensions connect to specific activities based on the literature of international cooperation and, specifically, documents related to the international response to infectious diseases. Assigning specific actions to those dimensions provides a starting point for measuring the level of cooperation, which facilitates the comparison of cooperation across cases. Table 4 summarized the dimensions and activities with definitions based on the development of recent outbreaks.

INTERVENING DIMENSIONS	ACTIVITY	DEFINITION
I. International Participation	Timely agreement on the existence of a problem at WHO [PROBLEM]	The identification of an outbreak at the local, national, and international levels is fundamental to control infectious diseases and implement rapid measures to control it (114,115). The international community analyzes the outbreak. International institutions are primary locations for decision making (102,116). Each forum will lead to a specific outcome, which will affect the level of cooperation (103). The Member States and the WHO participate in meetings to discuss and agree on the existence of a problem, such as the identification of a public health emergency of international concern. The identification of the problem must be early enough to establish timely measures.
	International response after notification [RESPONSE]	A timely and efficient international response reduces the outbreak's impact on populations (117). Therefore, quick response after notification of an outbreak implies that actions are implemented on-time to limit negative consequences.
	Countries participating in the response [NO. COUNTRIES]	The participation of all countries in health emergencies is required to address the event adequately (118). Affected and non-affected countries require not only to provide assistance but to follow international norms and keep track of the situation. An effective response will include all the international community acting together.
II. International assistance	Technical assistance [TECHNICAL A.]	Technical assistance provides the human resources necessary to identify and attack the problem (105). Many countries experiencing an outbreak do not have enough technical expertise to confront it. They require experts that will provide knowledge to assess an outbreak and the response. Many of the experts come from specific regions and countries (116,119).
	Financial assistance [F. ASSISTANCE]	Financial resources are always necessary to advance international cooperation (49). Most countries have limited resources to manage health emergencies (118). Then, financial assistance is critical to managing the situation (from buying medicines and equipment, to establishing alternative facilities to isolate critical patients) (120). Including resources for capacity building since "an international response relies on national and sub-national capacities; capacities that require sustained commitments, in the form of budget and policy, from international organizations, national leaders and from within the health sector (55)".

Table 4. Activities in the international response to infectious diseases.

INTERVENING DIMENSIONS	ACTIVITY	DEFINITION
II. International assistance	Sharing of treatments [TREATMENTS]	Medicines and vaccines constitute the main treatments. Vaccines are one of the most critical medical interventions to prevent the spread of the disease and mitigate the impact of a pandemic (121,122,94). However, pharmaceutical companies have limited production capacity, and just a few countries have access to this production (122,123,124). Countries and IOs provide essential medicines, such as antiviral during an influenza outbreak (122), and medical equipment necessary to face the outbreak. Therefore, sharing available medicines and vaccines (when available) becomes an essential part of international cooperation during a pandemic since it will allow affected populations to be protected.
	Provision of essential health services and supplies [PROVISION]	Medical assistance is essential during emergencies to provide relief (120), especially in those countries with limited capacity, including inadequate health facilities and a limited number of health workers. These resources are essential to cope with a pandemic, and an emergency can deplete them quickly (125).
III. Scientific response	Sharing of virus samples [SAMPLES]	The provision of viral samples is critical to containing a pandemic and international cooperation (63,64). It is the starting point for the development of vaccines and other medical interventions. However, a legal framework to equitably share these samples is still limited and controversial (126). Sharing a virus will increase the level of cooperation.
	Sharing of epidemiological information and specimens, research capacity building, and dissemination of research [R&D]	Experts and scientists working in the field must share the data collected from the outbreak. Sharing information provides the input to understand an outbreak and formulate a response (127,114). Building capacities for health research, research development, and its dissemination are necessary to improve health interventions and beneficial to manage disease outbreaks (128,129). The development of vaccines for pandemic diseases is part of an effective response (130). The spread of the disease can be slowed down with vaccines (131)As well, the provision of resources to analyse the virus and the situation to establish control and preventive measures. Research findings should be widely disseminated to be useful (132,133). Finally, research must be coordinated and aligned with health systems requirements to be useful for crafting national and international strategies to manage infectious diseases (128).

Table 4. Activities international response to infectious diseases (cont.)

INTERVENING DIMENSIONS	ACTIVITY	DEFINITION
IV. Policy adoption	Surveillance systems [SURVEILLANCE]	The International Health Regulations 2005 defined surveillance as "the systematic, ongoing collection, collation, and analysis of data for public health purposes and the timely dissemination of public health information for assessment and public health response as necessary (WHO 2008: 10)." The existence of surveillance systems is necessary to generate the data to respond to the outbreak (134,135,31,136,137) (138). The data collected during surveillance is subject to interpretation "for use in planning, implementing and evaluating public health policies and practices (123)."
	Notification [NOTIFICATION]	Notification is an essential component of the international response to infectious diseases. *Notification requires* national states to inform the WHO about infectious diseases in their territory, as well as provide all relevant information about the evolution of the outbreak (111,16). The IHRs 2005 specifies that countries should notify "within 24 hours of assessment of public health information (Art. 6 Notification (16))".
	Alignment of domestic policies with international norms [POLICY CONVERGENCE]	International cooperation should translate into changes in national norms and regulations (105,113). Policy convergence can include the convergence of policy goals – to deal with everyday problems; of policy content – such as government policy; of policy instruments – administrative, judicial, among others.; on policy outcomes; of policy style – such as the way policy responses are formulated (139). Policy convergence presumes national states will adopt and change domestic policies to pursue an international goal. In the case of pandemic events, countries are expected to follow those measures and policies dictated by the WHO to assist in containing and controlling the outbreak.

Table 4. Activities international response to infectious diseases (cont.)

Based on these activities, essential during an international response, the research proposes a model for analyzing how cooperation materializes during the international response to pandemics. It defines each level, providing concepts, indicators, and an approach to measure cooperation, which will facilitate recognition of the degrees of cooperation that take place and the numerous instruments created for delivering such cooperation. The model provides parameters to operationalize cooperation during the response to any disease outbreak. Therefore, in table 5, I identified indicators, measures, and sources of information for each indicator.

INTERVENING DIMENSIONS	ACTIVITY	INDICATOR DESCRIPTION	MEASURE	SOURCE
I. International Participation	Timely agreement on the existence of a problem at WHO [PROBLEM]	The type of meetings is relevant since it will condition the result and how it will affect the international community (103,140). The time in which the meeting occurs will also impact the response.	Type of meetings celebrated at WHO and other settings: high level, technical, expert groups, summits, conferences, and if they are celebrated timely.	WHO and other international organizations.
	Timely agreement on the existence of a problem at WHO [PROBLEM]	The outcome of international meetings is important to define actions. An international meeting can generate different outcomes, from general rules and principles (non-binding) to specific policies, guidelines, or treaties (binding) (105).	If there were actions implemented as a result of those meetings	WHO resolutions, reports, and assessments.
	International response after notification or/and assessment [RESPONSE]	Speed during a health emergency is crucial for fast and effective control of the situation and for saving lives (120).	Timeframe after notification: (immediate, moderate, slow, lack of) the number of days between the notification and the beginning of international activities (response).	WHO reports, Journals, documents from other international agencies.
	Countries participating in the response [NO. COUNTRIES]	Level of participation in the international response	The number of participants: the number of countries participating in the international response. High-Moderate-Limited	WHO reports, Country Reports

Table 5. Activities in the international response and indicators

INTERVENING DIMENSIONS	ACTIVITY	INDICATOR DESCRIPTION	MEASURE	SOURCE
II. International Assistance	Technical assistance [TECHNICAL A.]	Scientific and expert collaboration in international cooperation. They participate in diverse activities, doing research, monitoring, or assessing the situation (105), and they complement and provide human capacities that countries do not have.	Type of participation in international missions (as an expert from an IO, from a country; assessing the situation or assisting affected countries).	WHO reports
	Financial assistance [F. ASSISTANCE]	Countries in need should receive financial assistance to cope with the problem they are facing, and this is an essential component of cooperation (105).	Financial resources are provided and made available to affected countries and the WHO	World Health Organization, OECD, World Bank
	Sharing of treatments [TREATMENTS]	The medical and pharmaceutical responses need to be timely. Since the development of vaccines takes time, governments need to have supplies of essential medicines to attend the population already sick (94,117). The global supply of vaccines and medicines is limited during the emergency, and not all vulnerable populations have access to them (117,94).	Type of population getting the vaccines and medicines (vulnerable or non-vulnerable)	Reports
	Provision of essential health services and supplies [PROVISION]	Health experts and personnel may be required to assist national actors and mitigate the outbreak.	How fast was the deployment of assistance once the outbreak started	WHO reports, Journals
		During an emergency, international assistance provides those resources that countries need to respond, from essential items, such as medical supplies, to experts in specific areas.	Type of assistance (doctors, experts, technicians; materials, equipment; medicines)	Newspapers, Grey literature
III. Scientific response	Sharing of virus samples [SAMPLES]	Sharing virus samples	If countries have shared virus samples	WHO

Table 5. Activities in the international response and their indicators (cont.)

INTERVENING DIMENSIONS	ACTIVITY	INDICATOR DESCRIPTION	MEASURE	SOURCE
III. Scientific response	Development of research and dissemination of information [R&D]	Research, in general, constitute the basis for developing adequate interventions and controlling the disease. The faster scientist can understand the disease's mechanics, the better the results (141).	If research is disseminated on time	Journals
		The more advanced the stage of the research is during the outbreak, the higher the possibilities of having a vaccine available on time to contain the outbreak (117).	Phases of the research during the outbreak (never started, started, proves are made, a vaccine is made available)	Academic Journals
IV. Policy adoption	Surveillance Systems [SURVEILLANCE]	International agreements require countries to carry out continue surveillance during an outbreak, new cases, and progress.	If all countries implemented systems to allowed constant notification of cases	WHO reports, Country Reports
	Notification [NOTIFICATION]	Countries have agreed to inform the WHO on time the emergence of a new or non-identified disease that could pose an international risk.	How long did countries wait to notify the WHO after identifying the cases?	WHO, Journals, gray literature
	Alignment of domestic policies with international norms and agreements [POLICY CONVERGENCE]	Adoption of international agreements, policies, and recommendations by all national governments is the goal of international cooperation (105)	How broad were the recommendations adopted and implemented?	WHO
		It refers to the degree of adoption of international policies. Considering that not all policies recommended or agreed at the international level are adopted equally at the national level, the degree of adoption will have an impact on international cooperation (105). The ultimate degree is when policy convergence occurs.	The degree of adoption: from the general acceptance of an agreement to policy convergence.	Country reports, WHO, newspapers, peer-reviewed journals

Table 5. Activities in the international response and their indicators (cont.)

The framework presented above makes it possible to measure levels of cooperation and variation. There have been other attempts to explain and measure the existence of levels or degrees of international cooperation. Some authors classified the different types of international organizations and explained their different characteristics and potential to promote cooperation (103), and studied the different types of coordination mechanisms (meetings), proposing that each one of them leads to a different cooperative outcome – policy coordination (102). Others explicitly examined the diverse forms of international cooperation, acknowledging that each of them represents a certain level of cooperation (105). Some researchers offered an international law perspective, referring to the degree of commitment assumed in international agreements (93). Others have designed empirical models with measures and indicators based on those mechanisms that modify cooperation, building models to examine countries' levels of cooperation outside and inside international organizations (101), developing typologies for explaining successful and unsuccessful multilateral sanctions efforts (88) and presenting an empirical model with "aggregate indices of cooperation (12)."

Taking into consideration these studies, this research acknowledges the importance of distinguishing levels of international cooperation and the relevance of them for theory and policymaking. The information shown below in table 6 presents the proposed model of levels of cooperation for the international response to pandemics, presenting the indicators/measurements associated with the different activities.

ACTIVITY	MEASURE	LEVELS OF COOPERATION						
I. International Participation		0	1	2	3	4	5	6
Agreement on the existence of a problem at WHO [PROBLEM]	*Type of meetings to assess the situation and when they are celebrated*	No meetings on the issue	Informative session once the outbreak has expanded	Technical meetings at the beginning of the event	Expert group when the outbreak has not been controlled	Special meeting to asses the situation once the outbreak has expanded	High-level meeting after the event is detected	Emergency committee after the event is detected
	Meeting's outcome	No outcome	A PHEIC is not called after some meetings even though the outbreak continues	A PHEIC is called after the number of deaths has escalated in different countries	A PHEIC is called after the number of deaths increase in more than one countries, and there is clear evidence of transmission	A PHEIC is called after the number of deaths has increased in at least one country	A PHEIC is called after evaluating the number of deaths and mortality rate trends	A PHEIC is called as result of the first meeting, with or without clear evidence of transmission
International response after notification or/and assessment [RESPONSE]	*Timely response after the outbreak*	Indifference towards the situation	An international response is initially not required even though there is evidence that the outbreak is spreading quickly in several countries	An international response only after several months of showing the disease has spread worldwide	An international response after the spread of the disease is caused by imported cases.	An international response after more than two countries in different regions notify outbreaks	An international response after more than two countries in the same region notify the presence of the virus	An international response immediately after the first affected country notifies the outbreak
Countries participating in the response [NO. COUNTRIES]	*Level of participation*	The international community does not participate	Affected countries and the WHO	Affected countries and countries with expertise and the WHO	Affected countries and other countries in different regions and the WHO	Affected countries and other countries in different regions and the WHO	Countries from all regions (worldwide representation) and the WHO	All or majority of states participate

Table 6. Activities and indicators for each level of international cooperation in the international response.

ACTIVITY	MEASURE	LEVELS OF COOPERATION						
II. International Assistance		0	1	2	3	4	5	6
Technical assistance [TECHNICAL A.]	*Type of participation in international missions*	No participation of experts	WHO sends its experts to assess the situation	Other international experts are summoned to WHOs endeavor	WHO sends experts to assist affected countries	Individual countries offer expertise	An international coalition of experts is organized to assist affected countries	Experts from multiple countries cooperate with affected countries to develop capacities
Financial assistance [F. ASSISTANCE]	*The receiving countries of financial assistance*	No countries offer financial assistance	Financial assistance is not required	WHO regional office would provide financial assistance if resources were available	WHO provides financial assistance	WHO and some countries offer financial assistance to the most affected countries	A few donor countries provide financial assistance	International disbursements to fight the disease
Sharing of treatments [TREATMENTS]	*Type of population getting treatments first*	Developer withholds treatments/ No vaccines have been developed yet	Treatments are provided to people if their governments have access to them regardless of their vulnerability	Treatments are provided only if the WHO acquires them or if the organization has them in its stockpile	Treatments are provided to affected populations if their governments have agreements to supply them	Treatments are provided to populations of those countries that have a stockpile, and that share it with other countries.	Treatments are provided to some affected populations once their governments request them	Treatments are provided to most affected populations immediately
Provision of essential health services and supplies [PROVISION]	*How fast was the deployment of assistance once the outbreak started*	Assistance is not provided at all during the outbreak	Assistance is deployed late, once the medical capacities of the affected countries are exhausted	Assistance is deployed when the affected countries requested	Assistance is deployed weeks after a PHEIC is declared to some countries	Assistance is deployed after days after a PHEIC is declared to most affected countries	Assistance is deployed immediately after a PHEIC is declared	Assistance is deployed immediately to affected countries since the beginning of the outbreak
Provision of essential health services and supplies [PROVISION]	*Type of assistance*	Denial of material assistance	WHO provides personal/ resources to assist those countries in need	Provision of material assistance once the emergency escalates	Some countries provide medical equipment and personnel during the outbreak	Some countries provide medical equipment and personal before the emergency escalates	An international coalition assists before the emergency escalates	International assistance is mobilized immediately the outbreak is notified

Table 6. Activities and indicators for each level of international cooperation in the international response (cont.)

ACTIVITY	MEASURE	LEVELS OF COOPERATION						
III. Scientific response		0	1	2	3	4	5	6
Sharing of virus samples [SAMPLES]	*If countries have shared virus samples*	Affected country/countries refuse(s) to provide samples	Affected countries share samples with their pharmaceutical companies	Affected countries share samples with other countries	Affected countries share samples once the WHO provides certain benefits	Affected countries provide samples after the WHO requires it	At least one of the affected countries voluntarily share samples with the WHO	All affected countries voluntarily share samples with the WHO
Development of research and dissemination of information [R&D]	*If data about the disease and cases are disseminated on time*	Information is withheld	Information is shared only with certain actors or partners	Information is shared with a limited number of experts or countries	Information is shared with WHO and a limited number of experts	Information is disseminated and shared with WHO and research institutions in developed countries	Information is disseminated and shared with WHO and experts from developed and developing countries	Information is fully disseminated since the first cases are detected, and it is made available for everybody
	If research to understand the outbreak is available (never started, started, proves are made, the vaccine is made available)	Research has not been done	Scarce research has been done	Research is done by developed in developed countries	Countries with research institutions do research	Some research is done in all regions	Research is done in developing and developed countries	Research is done internationally and published in journals

Table 6. Activities and indicators for each level of international cooperation in the international response (cont.).

ACTIVITY	MEASURE	LEVELS OF COOPERATION						
IV. Policy Adoption		0	1	2	3	4	5	6
Surveillance [SURVEILLANCE]	*If countries implemented systems to allowed constant notification of possible cases*	No country implements surveillance	The affected country does not implement systems of surveillance	The WHO relies on other sources to gather information about the outbreak	Affected countries implement continuing surveillance	Other countries implement surveillance	Countries from all regions implement surveillance	Affected and non-affected countries implement continuing surveillance
Notification [NOTIFICATION]	*How long did countries wait to notify the WHO after identifying the cases?*	Information about the outbreak is withheld	WHO's involvement prompts notification (the disease might have spread out worldwide at this point)	Notification due to the intervention of other actors (NGOs, experts, etc.)	Notification by affected countries once the disease has spread out in the region	Notification by the first affected country once the disease has spread to another country	Notification after 48hrs that the disease has spread around the country (multiple cases)	Notification with 24 hours of assessment by the affected country (IHR 2005)
Alignment of domestic policies with international norms and agreements [POLICY CONVERGENCE]	*How broad were the recommendations adopted and implemented by the international community?*	All the international community ignores recommendations	Most members of the international community ignore the recommendation and implement actions non-recommended or supported by evidence	Some affected countries accept some measures and implement others without supporting evidence	The international community has partially adopted suggested measures	Some members of the international community accept all measures, and others are ignored based on scientific evidence	The international community has adopted most of the suggested measures	The international community follows all recommendations dictated by the WHO and other international agencies
	The degree of adoption of international norms: from the general acceptance of an agreement to policy convergence.	No country accepts measures established by WHO	A few countries have made partial changes in domestic policies to implement international norms	Some countries have made partial changes in domestic policies to implement international norms	Some countries have made domestic changes for full implementation; some other just partial changes, and other no change at all.	A few countries have made domestic changes to implement international norms fully	Some countries in all regions have made domestic changes to implement international norms fully	All countries have changed domestic policies to implement international norms.

Table 6. Activities and indicators for each level of international cooperation in the international response (cont.)

As noted above, the existence of institutions and norms is insufficient to explain variation in cooperation entirely. The research will examine epistemic communities as complementary explanations for this variation.

3.3 Epistemic communities, concept, and theory

Scholars have used the definition of epistemic communities to conceptualize networks of scientists and experts and how they can influence the policy process. The concept has evolved and adjusted to include elements that can distinguish these actors from other networks. For instance, Ruggie (1975) explained that epistemic communities could arise from bureaucratic positions, technocratic training, and similarities in scientific outlook and shared disciplinary paradigms (142). These communities share intentions, expectations, symbols, behavioural rules, and points of reference (142).

Peter Haas crafted a more specific definition, referring to an epistemic community as "a network of professionals with expertise and competence in a particular domain and an authoritative claim to policy-relevant knowledge within that domain (25)." In his conception, an epistemic community's unique feature is their members sharing of an epistemological worldview, including notions of validity (25). They apply or agree with the scientific methodology used to make causal inferences in their area of expertise and provide information about the underlying causes of a problem (19). Sharing norms and principles, as well as common beliefs, facilitates the articulation of common goals. The definition of those goals helps to promote cooperation. Epistemic community networks' members take this shared common understanding of a problem-issue and seek to translate their beliefs into a dominant social discourse and social practice (143). Epistemic communities, therefore, can become "networks of experts who persuade others of their shared causal beliefs and policy goals by virtue of their professional knowledge (91)". They have the mechanisms to frame the policy debate on some issues, providing justifications for alternatives, and catalyze national or international coalitions to support chosen policies and advocate change (144,145,47).

Epistemic communities differ from other networks of professionals due to their level of expertise over a policy issue (147). For instance, advocacy networks include many other actors whose primary goal is to advance a policy topic by pressuring and persuading political actors through various techniques, including mobilization. Epistemic communities will advocate for a specific issue with the use of scientific and technical arguments. Members of advocacy groups can also be members of an epistemic community, and they will exchange technical knowledge and contribute to technical debates. Epistemic communities are also different from policy networks (147). Policy networks include actors interested in advancing specific issues in the international agenda by creating strategic relations with other individuals with the same interest. However, they do not necessarily share values or epistemology. Epistemic communities will connect with these other networks to reinforce their position and create stronger arguments that can help them to appeal to a broader community.

Some scholars contend that in global health, all these networks should be studied as part of unified global health networks (45), given that all of them participate in the policy process. However, this research considers that in global health, epistemic communities are distinct from other networks because of the inherent demand for evidence-based policies. These experts are the primary providers of information that support global health policies, and, at the same time, their level of expertise makes them suitable to become decision-makers in different organizations (health agencies, international organizations, etc.). Epistemic communities can facilitate diffusion of international cooperation ideas, and, consequently, improve global health outcomes, providing their scientific and expert knowledge and evidence.

Scholars have used the concept of epistemic communities to explain how networks of experts influence international relations and the policymaking process. Contributions using epistemic communities as analytical framework have been in the context of the environment (90,48); security (146,25,143,53,147); development (64); global information policy (148,116) and social policy (149). In the case of global health, some studies examine epistemic communities to explain global health outcomes at the national and international levels, given the demand for evidence-based policies and expert advice, as well as the fact that most national and international health agencies depend on the expertise and scientific knowledge (65,47,66,49,150,69,68,119,151). For instance, the WHO is constantly establishing commissions or expert groups to analyze and explore specific global health problems. These structures are essential for this organization and its role in global health governance since they provide fundamental knowledge for the creation of evidence-based policies found in guidelines and proposals presented by the WHO to its member states. As well, many of the experts collaborating with the WHO also work with their governments in national research institutes, agencies, advisory committees, among others. Their expertise and relations with other professionals and policy actors make it easier for them to establish networks and cut across the rigidity of structures found within international organizations and national governments. They share a common policy goal grounded on scientific knowledge, which provides them with arguments to engage in policymaking (25,47). These characteristics make them powerful agents with access to the decision-making process to influence outcomes.

3.3.1 Towards a theoretical framework to explain international cooperation

The literature on epistemic communities proposes hypotheses to analyze the connection between knowledge, power, and policy-making, treating these actors as independent variables to explain patterns of cooperation and policy change in international politics (25,143,53,23). The theory analyses the role of experts in the international arena and the vital role that these actors have for the formulation of international policies (48,151,145); as well as how they provide expertise and knowledge that will shape policy outcomes.

Epistemic communities' expert knowledge and ability to position themselves within the policymaking process makes these networks different from others. As evidence shows, epistemic communities use their knowledge and expertise over a domain to define problems and present policy options and influence and modify states' behaviour. Research on epistemic communities has also stressed different characteristics that enable them to influence decision-making processes and modify other actors' behaviour, along with conditions that facilitate this influence. Table 7 provides a summary of the central epistemic community's characteristics found in the literature.

These scholars argue that epistemic communities help define the global health issue (143,152,53). The complex and transnational nature of current issues requires specific technical knowledge, thus requiring the engagement of 'experts' who may be members of epistemic communities. As well, more interconnectivity has facilitated their influence and interaction within their networks and with other actors. Therefore, epistemic communities can 'change the game' on the configuration of a set of possible solutions (23).

Characteristics	Definition	Reference
Decision Making under Uncertainty (Scope condition)	Scholars of epistemic communities consider uncertainty as an underlying or scope condition. It occurs when policymakers do not know what to do to solve a problem, given its urgency or technical difficulty.	Haas 1992, 2004; Morin 1992; Morin 2014; Davis Cross 2012; Karlsson 2004; Loblova 2018; Adler 2002; Checkel 1998; Christiansen et al. 1999; Guzzini 2000; Hopf 1998; Ruggie 1998; Sebenius 1992
Access to the policy process	Epistemic communities can have better access to the policy process than other actors. These groups of professionals and experts are usually advisors and providers of evidence for policymaking. However, there are many instances in which governments are not open to this, having complete control over information and limiting their role.	Haas 2004; Morin 2014 (26,148)
Position in the policymaking process	Epistemic communities' members are either part of the policy process or have direct access to it through different institutional mechanisms, such as expert groups, advisory groups, international conferences, etc.	Haas 2004; Antoniades 2003; Davis Cross 2013; Cogburn 2005; Karlsson 2004
Political Context (Scope condition)	The knowledge and expertise that epistemic communities have are more relevant if they can influence politics. Even though this is more difficult to achieve, scholars agree on these groups' potential to persuade politicians. Their potential is more likely when their knowledge helps to justify specific political programs, and it can be translated into the dominant social discourse (Antoniades 2003) since Science can also be political by itself (Haas 2004)	Haas 2004; Miles 1998; Nelkin 1979; Antoniades 2003; Jasanoff et al. 1995; Miller and Edwards 2001; Adler 1992
Knowledge claims	Authoritative claim to knowledge was one of the central characteristics in Hass' (1992) definition of an epistemic community. Most scholars consider an epistemic community-relevant because of its expert knowledge.	Haas 1992; Antoniades 2003; Adler 1992; Sebenious 1992; Clark and Majone 1985; Davis Cross 2012; Stone 2002; 2008; Cogburn 2005
Interconnections with other groups	Other groups or networks have an interest in influencing the policy process (NGOs, policy networks, advocacy networks). Epistemic communities can work with them to increase each other's influence.	Haas 2004; Davis Cross 2013; Stone 2008 (91,26,149)

Table 7. Main characteristics of epistemic communities, a literature review.

Characteristics	Definition	Reference
Connectivity - transmission of knowledge	Epistemic communities are considered knowledge networks (Haas, 2004; Antoniades, 2003). As such, they can have multiple connections in a loose structure that facilitates the transmission of information among its members, exchange points of view, and diffuse ideas. However, there are different types of networks, organized in different forms that affect their ability to transmit their knowledge within the network and to the outside.	Morin 2014; Haas 2004; Antoniades 2003; Adler and Haas 1992; Zollman 2007; Cogburn 2005; Sebenius 1992; Adler 1992; Zollman 2013; Petersen 2016
Membership	Experts in the same field are usually members of the same community. However, other professionals with different backgrounds and in different positions can be part of the same community as well. Therefore, national and international civil servants, scientists, diplomats, scholars, can be members of an epistemic community. They can work at universities, research institutions, or the private sector. They also come from different nationalities. Epistemic communities that are genuinely global can have better results due to the number of connections.	Ruggie 1975; Davis Cross 2013; Morin 2014; Antoniades 2003; Adler 1992
Cohesiveness	The epistemic community's cohesiveness means that all its members shared professional norms, knowledge, and have a common understanding of problems and possible solutions. They agree with a policy goal and frequently socialize their knowledge. The more internally cohesive an epistemic community is, the more able to influence policymaking as a unit (Davis Cross 2013)	Davis Cross 2013; Morin 2014; Loblova 2018; Karlsson 2004; Sebenius 1992; Adler 1992; Petersen 2016
Legitimacy	The legitimacy of epistemic communities is important for influencing the policy-making process. Even though science can have a political motivation, evidence-based knowledge is considered accurate and legitimate. Legitimacy makes others accept the epistemic community's knowledge.	Haas 2004; Botcheva 2001; Andresen et al. 2000; Clark and Majone 1985; Adler 1992; Miller and Fox 2001
Coherence with existing norms	An epistemic community shares a clear and shared understanding of the laws and institutions regulating the issue of interest.	Morin 2014: Adler 1992; Jordan and Greenway 1998
Path dependency	The continued involvement in policy debates on the same topic can create path dependency that will favor their future participation.	Morin 2014

Table 7. Main characteristics of epistemic communities, a literature review (cont.).

Peter Haas' concept and contributions are the primary references in these studies of epistemic communities. The number of scholars, however, applying and testing his original approach has been relatively small[xi]. Therefore, this research centres its analysis using Haas' original framework. From Haas' work, two central elements emerge as the most important: first, the scope conditions of uncertainty and subsequent need for expert knowledge which favors the participation and influence of epistemic communities; and second, the epistemic community's characteristics that can modify the level of cooperation. The first characteristic is epistemic communities' capability to set up a policy goal and to produce consensual knowledge and information required by policymakers. The second is their ability to disseminate their information and knowledge for reaching policymakers. The third is the epistemic community's access to the policymaking process and its capability to institutionalize and consolidate its bureaucratic power at the national and international levels and shape the policy preferences of policymakers (institutionalizing the epistemic community's influence) (25,47,153,154,155). These characteristics are the basis for establishing a framework to analyze global health and the international response to disease outbreaks.

3.3.1.1 Knowledge

The authoritative claim on knowledge makes epistemic communities influential in policy-making (143,90,23). However, not all knowledge is relevant. Scientific claims perceived by the policymakers as legitimate, objective, and isolated from the political space are more likely to be adopted (90,94,156,157).

An epistemic community needs to produce "usable knowledge" to be able to

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[xi] Anthony R. Zito (2018) examined the studies of epistemic communities published in peer-reviewed journals and found that out of 212 documents only 11 of them followed Haas original conceptualization (154).

influence the policy process (90). To identify "usable knowledge," Clark and Majone (1985) present four criteria to differentiate it from other knowledge: adequacy, value, legitimacy, and effectiveness. Adequate knowledge includes all the relevant "facts." Value refers to the contribution to further understanding of the scientific/health problem. Legitimacy relates to the acceptance by others of the epistemic community's policy advice. Effectiveness refers to the ability of the community to shape the agenda or influence the debate (158). Thus, epistemic communities influence policy processes when they can develop "usable knowledge," and the decision-makers feel compelled to apply it (90,140).

Epistemic communities are also "de facto natural coalitions" (23). Knowledge developed by epistemic communities helps policymakers to understand and expand the range of possible outcomes, making it possible to expand the area of possible agreement. Epistemic communities also alter the process of learning since the members of a coalition would share a common policy project. They can reduce the conflict of interest regarding this area, making cooperation achievable and more likely to persist in the long term (23). Treaties based on scientific knowledge and that involved the participation of epistemic communities tend to be adopted and ratified faster and last longer (66,48).

3.3.1.2 Socialization of ideas

Epistemic communities produce ideas and knowledge that they must share among the members of the community and outside the community. The diffusion of these ideas can occur through publications in academic, peer-reviewed journals, participation in conferences, research collaboration, and other forms of communication (159,25).

According to Haas, epistemic communities are "channels through which new ideas circulate from societies to governments as well as from country to country (25)." Members of an epistemic community transmit their shared understanding of a problem through accessing the policy process and persuading decisionmakers to adopt their expert ideas. Epistemic communities, therefore, are a specific type of knowledge networks (53,25). A network is a “set of actors (nodes) that are linked by various relationships (ties) (160)”. Actors in a network are individuals, organizations, or units within organizations. Relationships can be personal, functional between units within an organization or strategic relationships between organizations (64,161,162,163,160,164,165).

The concept of network is useful to understand how epistemic communities communicate, exchange information, and connect with other actors. Network structures facilitate the transmission of information and knowledge through interpersonal ties (166,167). They create communication linkages that forge a new communications structure that connects different people and groups in the organization regardless of their formal position or roles (163).

Epistemic communities connect policy actors and institutions and transmit information for policymaking (49,48,168). As knowledge networks, they are mechanisms through which organizations share and transfer both explicit and implicit knowledge (163). Network structures facilitate the diffusion of knowledge within the network and outside the network, through publications, conferences, the internet. The network structure facilitates the transmission and dissemination of information among the epistemic community’s members, influencing how it transmits knowledge and how it associates with relevant policy actors. It enables multiple connections, making it more feasible to associate with different epistemic communities and other groups interested in the same topic. They connect with NGOs, governments, international organizations, and their secretariats. These actors have an impact on how epistemic communities influence the policy process since they provide access to policymakers (49). The structure also enables the epistemic community to develop more ties, increases socialization as well as interactions among them that will help the group to cooperate and influence effective cooperative outcomes (152,64). Therefore, they can reach actors directly involved in the policymaking process and become part of it as well.

Epistemic communities are networks with a wide variety of members that connect policy entrepreneurs, experts, and professionals in other areas but with common knowledge over the topic of interest. Policy entrepreneurs may be international bureaucrats, national officials, civil servants, recognized people in business, scholars, or policy activists (169,170,171). Due to their position and resources, they can influence policymaking, facilitating the diffusion of individual policies and the adoption of innovative solutions (172). In global health, policy entrepreneurs have played a crucial role in influencing international cooperation, framing agendas, and persuading policymakers to adopt specific policies (171). They differ from other members due to their strong leadership and their capacity to insert themselves into the policy-making process.

3.3.1.3 Institutionalization of an epistemic community's bureaucratic power

Epistemic communities are relevant to the policy-making process, given that the complexity and variety of issues in international affairs have increased. As a result, governments, delegations, and international secretariats incorporate more experts (48). Thus, epistemic communities have privileged access to the process and, commonly, their members are already part of those structures, "shaping their preferences from within (47)", with a capacity to influence the process as national or international bureaucrats, diplomats or policy-makers (143,23,91,48,49). The epistemic community's network structure also facilitates access to the policy process. This is a common feature in global health since experts and scientists are part of epistemic communities working at the national and international levels. Since the transfer of ideas occurs through international task forces, committees, or expert groups (173), an epistemic community's influence increases just by belonging to any of these mechanisms (49).

As actors get immersed in the process, epistemic communities can consolidate bureaucratic power and institutionalize their influence (143,25), convincing decisionmakers that their ideas offer the best course of action to follow and providing coherence to the process. Regular participation in these policy networks helps to strengthen epistemic community members' ties (152,46). In global health, the World Health Organization (WHO) has provided a policy space for these actors, by integrating hundreds of professionals with specialized knowledge in its different areas, such as expert committees, task forces, specialized consultations, or as advisors.

3.3.1.4 Scope Conditions

The literature identifies uncertainty as an essential factor impacting on the ability of epistemic communities to influence a policy process. Different types of uncertainty influence how policymakers respond to a situation, and the kind of expertise required to understand a specific problem and solve it (19,174).

With the emergence and re-emergence of infectious diseases, crises become common and usually with high levels of uncertainty (175). Information regarding the situation is scarce, as well as data to formulate the appropriate policy choices for containing an outbreak. Current norms and institutions may be insufficient to galvanize international cooperation. Such emergencies affect political leaders' capacity to formulate policies since they do not know the immediate and long-term consequences of the events. Information to estimate risk and calculate costs are scarce, increasing the demand for technical expertise and specialized knowledge (143,25,90,145,49,176,91).

Under uncertainty, therefore, epistemic communities act as sources of information or consultants to define the scope of the problem and possible solutions. In these positions, members of the epistemic community can influence the policy process and actors' interests; they can mobilize support for ideas and influence agenda-setting (143,177). Although uncertainty creates a space for epistemic community activity, the degree of uncertainty does not necessarily correlate with an epistemic community's capacity to influence the process (91).

3.3.1.4.1 Politics and epistemic communities

More governments, delegations, and international secretariats have incorporated more experts in their decision-making processes (28). Some countries have also moved towards the professionalization of their civil services, increasing the number of expert scientists and technicians working for their governments. Science and technical knowledge, however, are not necessary apolitical, and sometimes they reflect political priorities and biases (55,98,181). Politics often use scientific knowledge to justify political programs and choices (55,181). The more the interaction between experts and politicians to address current problems requiring a high level of technical knowledge, the higher the probability that politics and partisan issues will affect the epistemic communities' participation and influence. Because members of epistemic communities participate in the policymaking process, it is difficult to isolate these networks from political interests since "there are seldom purely technical or purely political issues (180)". Hence, the distributional consequences of science-based advice are themselves political (95,182,183).

Additionally, there are constant disagreements among experts about knowledge claims, and knowledge is continuously contested. Disagreements create and sustain rivalry among epistemic communities (48,50,26,182). Science embodies implicit values of control; therefore, decisions made with scientific support may reflect some hidden values (26).

3.3.2 Operationalizing epistemic communities

Skeptics of the role and influence of epistemic communities and knowledge networks argue that there is little research that shows their causal role (47). To deal with this problem, epistemic communities scholars have proposed other approaches such as a clear distinction between external and internal characteristics of epistemic communities (70); defining a causal mechanism (47), and applying concepts of social network theory to explain specific attributes of these actors (64). In addition to the problems with the methodology, a considerable number of researchers apply this approach only to single cases or successful ones (47,178,53), and the definition of an epistemic community is interpreted narrowly, referring most of the time only to scientists and technicians (91,148).

To address these problems, first, this research adopts a broader definition of the "epistemic community network." In global health, an epistemic community network includes one or more groups of professionals embedded in the system of global health governance (dominated by the World Health Organization and nation-states), which members connect and interrelate throughout their common interest and understanding of a particular problem, sharing epistemological beliefs and principles. Epistemic communities in global health include WHO officials and other UN bureaucrats that are experts in their field; scientists and experts working in universities and research institutions, from disciplines relevant to public health (epidemiologists, biologist, clinical laboratory scientist, public health experts among others); domestic bureaucrats (from health agencies and others agencies); and health attaches (diplomats specialized on global health). The concept adopted in this research, therefore, emphasizes three aspects:

1. An epistemic community network is not always one single group; it can be multiple groups that share a common interest, epistemological and scientific notions, beliefs, and principles, a common policy goal. The issue-problem is their unifier.
2. Members of an epistemic community network are not only scientists or technicians; they are experts in different areas that contribute in various ways to solve the issue-problem.
3. An epistemic community network is embedded in a system of governance - organizations, norms, institutions, states. Even if the epistemic community's members are not part of the system itself, they act through it.

Second, the research introduces a measurement of epistemic communities to test the assumptions made by Peter Haas's original theory about the conditions of knowledge, dissemination, and institutionalization of bureaucratic power, as outlined in table 8 (25).

Condition	Definition
Knowledge	To influence any policy process, an epistemic community works together as a unit and develops clear policy goals, beliefs, and understanding of an issue. Members of the epistemic community have a shared understanding and agreement on problems and solutions. This condition answers the questions: has the epistemic community developed coherent, consensual, and useful knowledge to guide the policy process? Based on this, does it have a policy goal?
Socialization of ideas	The epistemic community disseminates its knowledge and ideas to reach policymakers. The community exchanges information and gets to know each other's position. As a network, the epistemic community transmits the information within its members. This structure creates channels to communicate its knowledge and information to other actors, through their connections and using other mechanisms such as publications and conferences. This condition answers the question; Has the epistemic community socialized its knowledge and made it accessible to policymakers?
Institutionalization of bureaucratic power	Epistemic communities institutionalize bureaucratic power by either influencing policymakers with their ideas or directly accessing the policy process, getting immersed in it as part of governments, delegations, and international secretariats (48). The influence of ideas occurs when these experts are called into international task forces, committees, or expert groups (173), an epistemic community's influence increases just by belonging to any of these mechanisms (49). Direct capacity to influence the process occurs when they are included as national or international bureaucrats, diplomats, or policymakers (23,143,53,49,48). This condition answers to the questions: does the epistemic community have access to the policy process? How much are they immersed in the process?

Table 8. Epistemic communities' framework

Uncertainty is not measured in this framework since it is a contextual characteristic found equally in all cases studied in this research. The proposal measures the conditions that make an epistemic community capable of modifying cooperative outcomes. These elements are interconnected among themselves, and the output of their interconnections translates into an epistemic community's capacity to influence the policy process. These conditions, however, are not identical in all epistemic communities. Besides, given that epistemic communities are neither isolated nor independent actors, any changes in the system they are embedded in will also influence them, causing possible modifications in these characteristics. Figure 8 shows these characteristics link to global health cooperation.

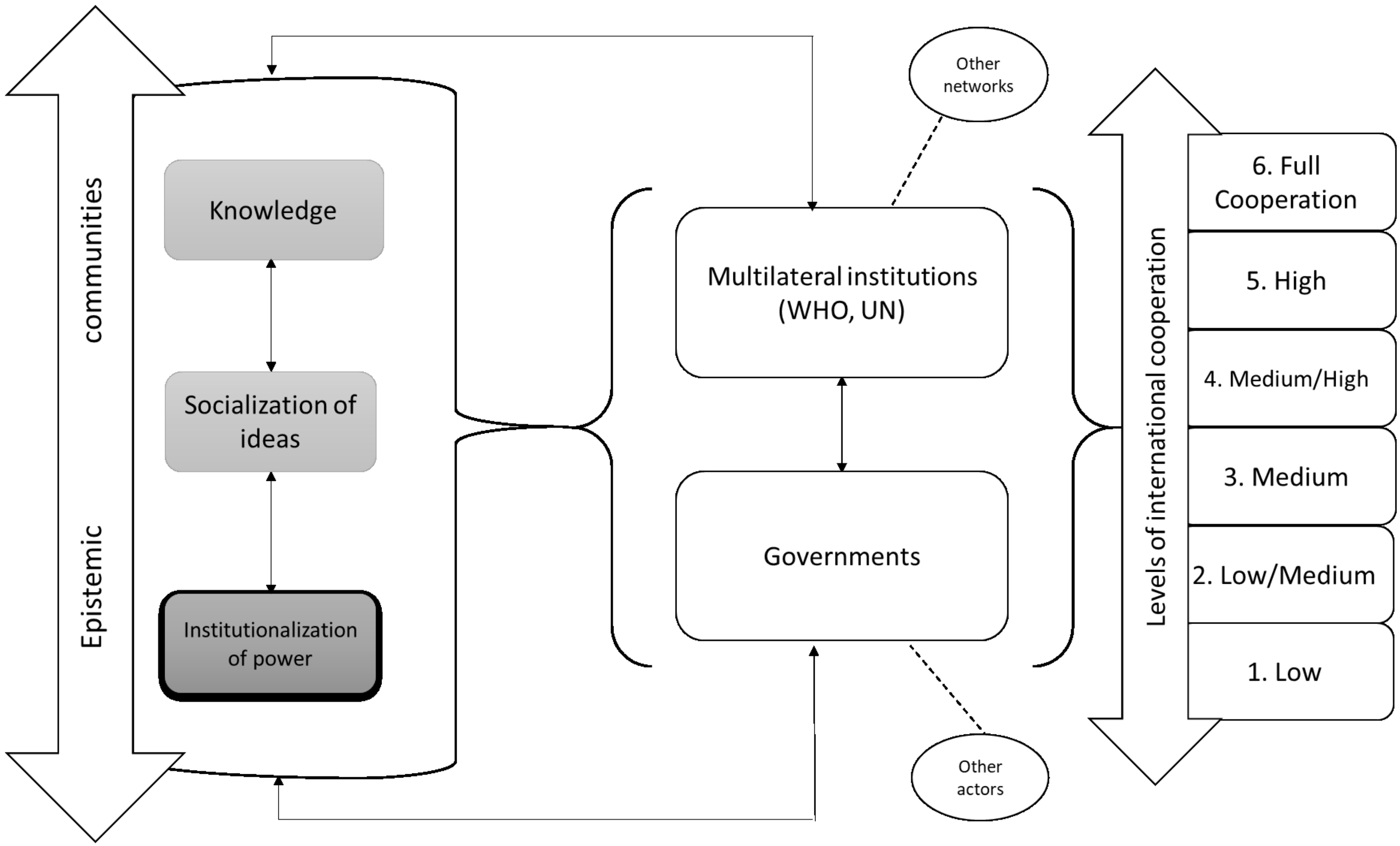

Figure 8. Proposed framework for the analysis of an epistemic community's strength

Epistemic communities are embedded in an international system where international organizations and national governments are the main actors. The combination and interaction of these characteristics will translate into the epistemic community's ability to influence the level of international cooperation (outcome). This research, therefore, hypothesizes that variance in these conditions affects the epistemic community's ability to influence cooperation.

The framework simplifies factors presented in the literature of epistemic communities and categorizes those initially identified by Haas. The analysis does not ignore other characteristics found in the epistemic community's extensive literature, but it argues that Haas' framework is the most parsimonious and therefore easiest to operationalize. It recognizes that Haas' theory does not explicitly refer to the variation in epistemic communities' characteristics. Epistemic communities, however, are not equal. Some of them have built more policy-oriented knowledge than others. They are better established with clear policy goals and have institutionalized their bureaucratic power. The framework will guide the research under the general argument that the presence of multiple epistemic communities bestowed with differences in their characteristics cause various levels of international cooperation when they participate in phenomena with similar characteristics.

With the definition of epistemic communities' characteristics that influence policymaking, I have identified indicators for measuring these conditions. Table 9 presents those indicators.

Condition	Indicator	Description
1. Knowledge	Agreement on a common definition of the problem and feasible solutions (consensual knowledge)	The literature on epistemic communities emphasizes the importance of “consensual knowledge” and a common understanding of the problem, to influence policy-making (143,26,179). Therefore, an explicit agreement on problems and solutions makes a more cohesive community. This information and knowledge should be useful and clear for policymaking.
	Clear identification of a common policy goal	All the members agree with a common policy goal. If there is no such agreement, it is harder to influence the policy process (143). Sometimes knowledge remains contested and creates disagreements that can weaken the epistemic community’s position (180,148).
2. Socialization of ideas	Structure	The way their members communicate with each other and with policymakers can affect the network’s ability to influence the policymaking process. Therefore, it is necessary to identify who interacts with whom, how extensive is the network, who are the networks’ more important actors (policy entrepreneurs or champions) (64). The looser the network structure, the more capable its members, are of reaching and communicating with each other and with other actors. Multiple connections (nodes) inside the network influence cooperation. The broader the network (international and at different levels), the more capable it would be to have global influence. The more connections, the better the network will be transmitting its information (64). The more frequent members of the epistemic community interact, the stronger their ties (64). These interactions are usually through meetings, sharing information, collaborating.
	Dissemination mechanisms	The epistemic community must disseminate its knowledge and ideas to reach policymakers and compel them to adopt their views. To do this, members of the epistemic community usually publish in most important and influential academic and policy journals. When members of an epistemic community make available their ideas, it is easier for policymakers and key actors to access them and adopt them. Sometimes members of the network prefer not to share their information and ideas when they are needed the most. When experts withhold information, the epistemic community’s position debilitates, damaging the prospects of cooperation.

Table 9. Indicators for measuring epistemic communities' characteristics.

Condition	Indicator	Description
2. Dissemination	Participation in international meetings	The international community gets together and analyzes the situation. These settings are, then, primary locations for decision making (102,116). They are also "places" where people connect and participate. Each type of forum will lead to a specific outcome that will affect the level of cooperation (103). Participation in multiple international conferences organized to discuss the topic with the involvement of decision-makers and experts improves these interconnections.
3.Institutionalization of bureaucratic power	Participation in the policy process	In global health, international organizations and governments usually organize experts' groups to provide advice and recommendations that can be adopted and implemented in norms and implemented in specific policies; these are spaces for members of epistemic communities' networks to understand better the problems faced at the global level and connect their knowledge with the policy process
	Members of the epistemic community in decision-making positions	Since global health policy requires expert and technical knowledge, it is common that members of the epistemic community will be in policymaking and decision-making positions. When most members of the epistemic community have direct access to the policy process as part of a government or an international organization, the position of the network strengthens. When an epistemic community has members in prominent positions or as policy entrepreneurs, they can help to advance the ideas of community and increased the possibility that the epistemic community's ideas will be accepted.

Table 9. Indicators for measuring epistemic communities' characteristics (cont.)

With these indicators, it is possible to examine the epistemic community's characteristics and analyze its level of influence in international cooperation. An epistemic community is more likely to influence higher levels of international cooperation when it has developed consensual knowledge that clarifies the problem, proposes feasible policy solutions, and agrees international cooperation is necessary to address the situation (25). Its influence also increases when it has a structure that connects its members inside and outside the community and disseminates to policymakers a resonant, evidence-based scientific advice, and reaches a highly institutionalized bureaucratic power with clear connections with the policy process.

3.4 Testing the theoretical framework in global health

To explore the hypothesis that epistemic communities influence international cooperation and induce variation, I will briefly introduce the case of tobacco control as a plausibility probe of my proposed framework.

This case presents a policy issue considered a success story in global health cooperation, which also underlines the importance of evidence-based information to persuade policymakers.

3.4.1 Tobacco control and the Framework Convention

Scholars often mention tobacco control as a model of global health cooperation (66,181,182,183), due to more governments issuing tobacco control policies around the world since 1976, in compliance with international norms (182). Furthermore, after the adoption in 2005 of the "Framework Convention on Tobacco Control (FCTC)," more countries have implemented international regulations and changed national legislation and policies to comply with the agreement (184).

The successful creation of an international legal framework that has effectively influenced stronger national norms to control the industry was the consequence of clear scientific evidence on the effects of tobacco on health. Researchers provided clear evidence of a link between smoking and cancer, as well as other diseases that, in the long term, can create high costs for health systems. The evidence permitted advancing a research agenda that became the foundation of an epistemic community concerned with the consequences of tobacco. The network of professionals applied their knowledge to convince relevant institutions and national governments that coordinated and cooperative international action could reduce tobacco consumption (66,181,185,182,107).

Despite the scientific evidence, these experts had to evolve as a unified and cohesive group, able to provide stronger arguments and to gain political spaces to promote its policy goal. In 1964, the epistemic community gathered for the first time in the World Conference on Tobacco or Health (WCTH). Afterward, the US General Surgeon published the first official report on the health consequences of smoking (186). In 1970, the WHO introduced the report *Limitation of smoking* to the 45th meeting of the Executive Board. A group of experts prepared the document[xii], and all of them were active members of the epistemic community. After this meeting, the 23rd WHA issued the resolution WHA23.32 *Health Consequences of Smoking* (based on the report), calling member states to issue policies for limiting smoking (187).

The epistemic community´s pivotal moment was the approval of the Framework Convention on Tobacco Control (FCTC). The FCTC is the first binding agreement in the field of global health. The creation of the treaty was based mainly on scientific evidence about the effects of tobacco in both smokers and non-smokers (188,181,189). The designers of this proposal were two experts from the global epistemic community: Ruth Roemer and Allyn L. Taylor (185). They introduced their conceptualization of a legal document to promote tobacco control at the 1st All-Africa Conference on Tobacco or Health in 1993. There, they presented compelling evidence on the harmful effects of tobacco on health, as well as the options for cost-effective interventions to control the problem (181). The idea of

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[xii] Dr. Charles Fletcher from the Royal Postgraduate Medical School; Dr. Daniel Horn, Director National Clearinghouse for Smoking and Health; Dr. Berit As., Institute of Psychology, University of Olso; and Dr. Ramstrom, National Smoking and Health Association, Sweden (187)

creating an international instrument to control tobacco became a resolution adopted at the 9th World Conference on Tobacco or Health (WCTH) in 1994 (185).

The network strengthened its links with government officials and international organizations. Their members convinced these officials of the advantages of coordinated global action to reduce the burden of disease, and the feasibility of implementing specific health interventions (190,181,191,190,188). They persuaded Jean Lariviere, a senior medical adviser at Health Canada, and a delegate to the WHO in 1995 (185) to support global action. He drafted the resolution presented at the 95th WHO Executive Board meeting, which was also co-sponsored by the representatives of Finland, Mexico, and Tanzania. Participants in those delegations would later become active participants in the community and would help to mobilize support at the WHO (185). By 1995, the World Health Assembly approved the resolution WHA48.1, which started the international discussion to create an international instrument (185). This process facilitated the epistemic community's involvement with policymakers. Members of the epistemic community institutionalized their expert advice, working as part of expert committees[xiii], and providing background information to the WHO (181). The Framework Convention's negotiation began in 1996 (resolution WHA49.17), and countries adopted the FCTC in May 2003, with 168 state parties.

The epistemic community was also crucial to ratify and implement the FCTC. States participating in international tobacco control networks were the first to ratify the FCTC, making this treaty "among the most widely ratified in existence (66)". According to the Secretariat of the FCTC, by July 2017, 181 states had ratified this agreement (184).

[xiii] This was the case with the Committee of Experts on Tobacco Industry Documents and the Scientific Advisory Committee on Tobacco Product Regulation.

To understand why the epistemic community was able to influence higher levels of cooperation in tobacco control, it is necessary to analyze the epistemic community's characteristics. Table 10 identifies the epistemic community shared policy goal, normative beliefs, causal beliefs, epistemological criteria, and notions of validity.

	Tobacco Epistemic Community
Policy goal	They agreed that it was necessary to establish an international mechanism to reduce tobacco consumption based on scientific evidence
Epistemological beliefs	They agreed that tobacco consumption was the cause of other conditions (187,192)
Normative-principled beliefs	They had as their normative belief to reduce the number of deaths due to chronic disease caused by tobacco consumption
Causal beliefs	They agreed on the causal mechanism that reduction of tobacco consumption would lead to a decrease in other diseases.
Notions of validity	They established norms, standards, and practices for research on tobacco and its effects on health

Table 10. The epistemic community in tobacco control. Based on multiple sources.

The epistemic community had the knowledge and information to provide strong evidence in favour of a global instrument. The epistemic community convinced governments and international policymakers that this issue required high levels of international cooperation for effective intervention. The network succeeded in advocating for a global framework treaty, and it has continued working to reach full implementation.

This epistemic community was able to influence cooperation due to a clear definition and identification of the problem, as well as its members' consensual agreement on these. Its structure was well-integrated inside and outside the network, creating coherence and reliable interconnections with the decision-making process. The epistemic community members were able to institutionalize their bureaucratic power and influence the policy process. Table 11 describes these features.

Characteristic	Evidence	
Knowledge	Agreement on a common definition of a problem and solutions (consensual knowledge)	The research identifies an epistemic community since 1964, at the first World Conference on Tobacco or Health (WCTH). There was an agreement that tobacco consumption has severe effects on health. Since the 1960s, scholars have cumulated evidence of the impact of smoking on health. The document, *Smoking, and Health: Report of the Advisory Committee of the Surgeon General of the Public Health Service (1964) presented by* Luther L. Terry, M.D., Surgeon General of the United States. The report declares that after reviewing more than "7,000 articles in the biomedical literature relating to smoking and disease that were available at the time, the Advisory Committee concluded that cigarette smoking is: • Associated with 70% higher all-cause mortality rates among men • A cause of lung cancer and laryngeal cancer in men • A probable cause of lung cancer in women (193)". After this, in the 1970s, other reports produced by the Office of the Surgeon General in the US provided more evidence of the consequences of smoking (194). These documents were the basis for building consensual knowledge in the epistemic community. The need for global action was for the first time included in 1970, in the document WHA23.32 Health Consequences of Smoking prepared for the 23rd World Health Assembly (195).
	Common policy goal	They agreed on a policy goal: to create an effective international instrument to curb the global epidemic of tobacco consumption. The epistemic community adopted the proposal presented at the 1st All-Africa Conference on Tobacco or Health at the 9th WCTH in 1994 (185).
Socialization of ideas	Structure	The network has international representation, and professionals from different areas are part of it. For instance, the first World Conference on Smoking and Health was held in 1967 with 500 participants from all over the world (196). Since then, the participants have increased. The group has its most prominent interaction every three years at the World Conference on Tobacco or Health; their last meeting was in March 2018 in South Africa (197). The epistemic community has constant interactions and through different events, such as the WHO Conference of the Parties of the FCTC in which many of these experts participate as delegates every two years.

Table 11. Analysis of the tobacco control epistemic community's strength.

Characteristic	Evidence	
Socialization of ideas	Diffusion mechanisms	The epistemic community started an international movement for the creation of an international instrument to control tobacco consumption worldwide, with publications and proposals in international conferences that would later influence the starting of an international process (a compilation of this literature can be found in *The Health Consequences of Smoking – 50 years of Progress. A report of the Surgeon General* (186)). Some relevant publications are: Mihajlov VS. 1989. International health law: current status and prospects. Round table: future of international law. International Digest of Health Legislation, 1989, 40:9-16, where he discusses the feasibility of a framework convention on tobacco control. Ruth Roemer and Allyn L. Taylor introduced their conceptualization of a legal document to promote tobacco control at the 1st All-Africa Conference on Tobacco or Health in 1993 (Roemer et al. 2005). The report would later become the basis for the background document for the WHO negotiation, introducing the idea of an international treaty (192). The World Bank would later publish the study, Jha. P. ed. 1999. “Curbing the epidemic: the economics of tobacco control,” a document that brought together experts ‘analysis of the economic consequences of smoking and which provided stronger economic arguments (192). After the FCTC was adopted, there has also an increase of technical publications at the global and regional levels produced by the FCTC Secretariat and WHO (198).
	Participation in international meetings	During the process of negotiation of the FCTC, it opened public hearings, with the participation of over 500 stakeholders, which included associations of health professionals all over the world (199). Experts also participated in the process of providing knowledge during the policymaking process, for instance: First meeting Working Group on the WHO FCTC (1999): as providers of technical information (A/FCTC/WG1/7), it included technical briefings from experts in international law, public health, and health economics. Second meeting, Working Group on the WHO FCTC (2000): review recommendations made in: WHO International Conference on Tobacco and Health, “Making a difference in tobacco and health – avoiding the tobacco epidemic in women and youth,” Kobe, Japan, 14-18 November 1999. WHO International Conference on Global Tobacco Control Law, “Towards a WHO framework convention on tobacco control,” New Delhi, India, 7-9 January 2000. “Advancing knowledge on regulating tobacco products,” Oslo, Norway, 9-11 February 2000

Table 11. Analysis of the tobacco control epistemic community (cont.)

Characteristic		Evidence
Institutionalization of bureaucratic power	Participation in the policy process	According to the WHO, the FCTC "is an evidence-based treaty," and the epistemic community proposals were the base for the discussion of the FCTC, such as document WHA23.32 Health Consequences of Smoking prepared for the 23the World Assembly. Resolution WHA48.1, which started the international debate for a future instrument on tobacco control, proposed at the 9th World Conference on Tobacco or Health 1999 (192). The WHO created a working group to assess the available evidence and to elaborate a proposal for a treaty (Document WHA52.18). After the FCTC was adopted and entered into force, it created the Conference of the Parties of the FCTC to assess scientific and evidence-based proposals for changes in international norms. Experts have been part of different groups, including: WHO Expert Committee on Smoking Control (1979), chaired by Sir George Godber, UK Committee of Experts on Tobacco Industry (1999), chaired by Thomas Zelther, Director of the Swiss Federal Office of Public Health Scientific Advisory Committee on Tobacco Product Regulation Expert Group on reporting arrangements (2015) Global Progress Report Independent Expert Group to conduct an impact assessment of the WHO FCTC (2016), which the University of Waterloo published (200) Expert Group on Tobacco Advertising, Promotion and Sponsorship: Depiction of Tobacco in Entertainment Media (2016)
	Experts or professionals from the epistemic community in decision-making positions	Some of the most famous names are (201): Dr. Ruth Romer and Dr. Ally Taylor (drafted the background paper for the negotiations of the FCTC). Mr. Neil Collishaw (was Chief of the Tobacco Unit at the WHO, worked at Health Canada and helped to promote the idea of an FCTC, inviting Taylor to join the WHO) Dr. Judith Mackay (Director of the Asian Consultancy for Tobacco Control and WHO consultant). She drafted along with Romer the resolution presented at the 9th Conference on Tobacco and Health in 1994 calling to governments for international action). Dr. Dereck Yach (Chairperson of the 1993 All Africa Tobacco Control Conference, later appointed as leader of the Tobacco Free Initiative established by Dr. Brundtland) (107). Dr. Jean Lariviere, Senior Medical Advisor at Health Canada, who supported Roemer and Collishaw to introduce the at WHO a proposal to develop the FCTC. Dr. Gro Harlem Brundtland, DG-WHO, she established tobacco control as a priority for the WHO

Table 11. Analysis of the tobacco control epistemic community (cont.).

The participation of experts, members of an epistemic community, and the research on the health effects of tobacco consumption contributed to the creation and implementation of norms to regulate it. Members of the epistemic community shared common values such as the prevention of tobacco-induced morbidity and mortality, industry accountability, social justice, commitment to scientific truth, altruism, or duty (182). They also had a common understanding of the problem, which facilitated the creation of consensual knowledge. They agreed on the negative consequences of tobacco on smokers and second-hand smoke (182). They shared a comprehensive public health view rather than only a medical view (182); which was reinforced by economic analyses on the consequences of smoking to health systems[xiv]. These created strong and compelling arguments that convinced decision-makers of the importance of tobacco control.

The group of experts provided scientific evidence that legitimized decisions and including the creation of stronger regulations (such as the FCTC). The network of professionals, scientists, researchers, advocates, expert government officials, and international bureaucrats proved the problem was broader than medical and epidemiological. Having access to policymakers and bureaucrats increased the community's access to the central bodies of international and domestic decision-making. Direct contact with the policy process led to the institutionalization of their scientific advice, which opened spaces for shaping states' interests (25). Members of the epistemic community were part of the committees and expert groups created to provide advice on specific aspects, mostly at the WHO. The WHO expert's committees and advisory groups' recommendations were the backgrounds in the adoption of the World Health Assembly resolutions on tobacco control

[xiv] In 1999 the World Bank presented the report '*Curbing the Epidemic'*, providing the economic justification for FCTC (182).

(182). They have been vital in influencing compliance among states and increasing cooperation since many state parties kept observing international norms (185)[xv].

The evolution in tobacco control norms and their implementation demonstrate changes in levels of international cooperation, as well as the critical role played by scientific knowledge and epistemic communities. The Tobacco Control Epistemic community's members provided the necessary information for decision-making through several channels. Figure 9 presents the levels of cooperation in tobacco control and the transition from one level to another.

[xv] According to the WHO, around 79% have strengthened their legislation and national programs (713). An example of this level of success has been the banning of smoking in public places, which is now a global policy. In addition, between 2006 and 2013 around 170 countries have been constantly paying voluntary assessed contributions to support the FCTC (712). The Global Progress Report on the Framework Convention also indicates that the average rate of implementation of treaty provisions across all substantive articles incremented from 52% by 2010 to 56% in 2012 (713). Finally, it points out that 159 state parties have submitted at least one implementation report since 2005 (713).

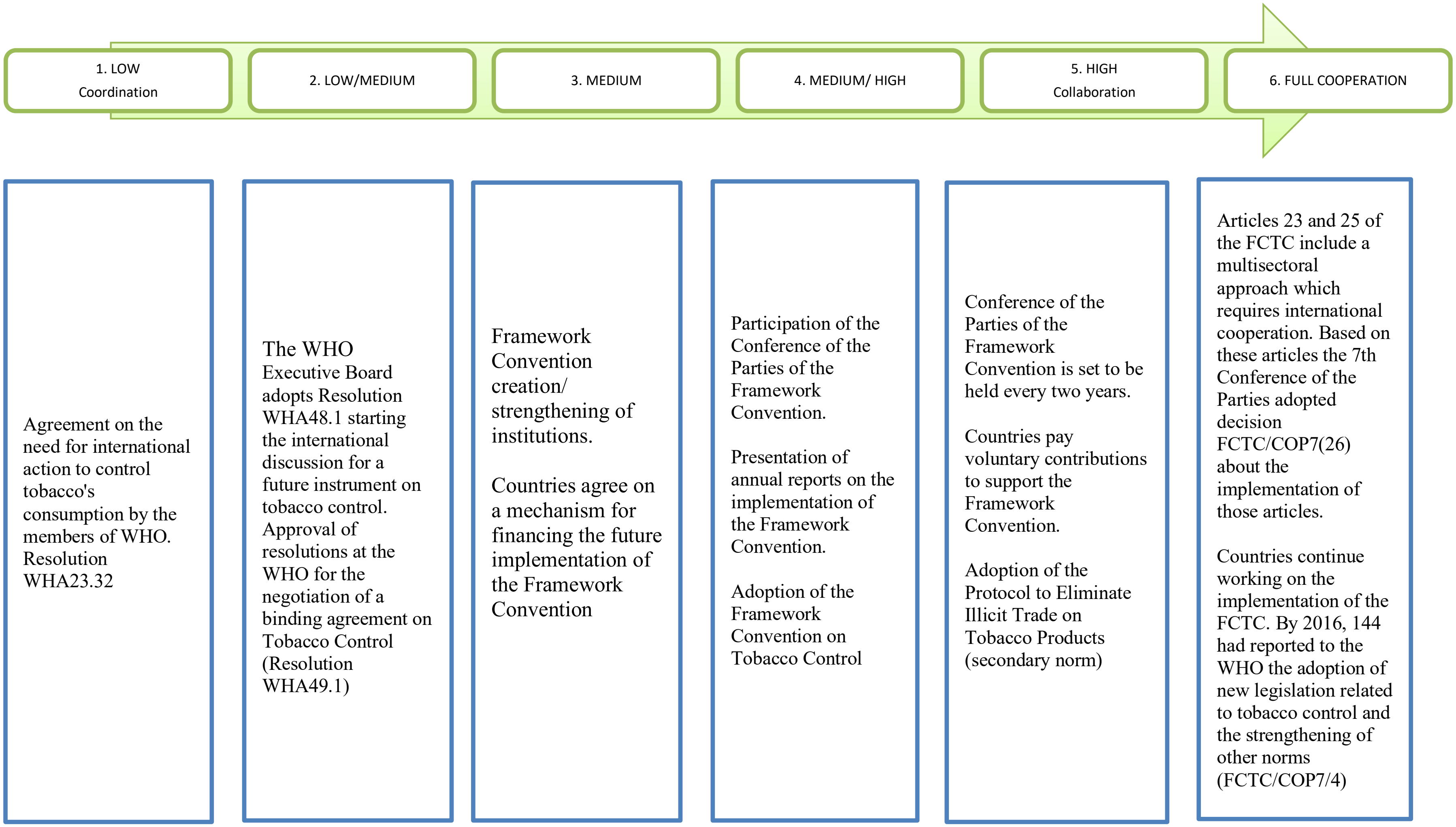

Figure 9. Levels of Cooperation Tobacco Control

Since its inception, the tobacco control epistemic community was dense and cohesive, benefiting from its members' regular interactions. The WCTH has been a crucial setting in the creation of linkages. Moreover, the participation of these experts in other international meetings (in the context of the WHO and other organizations) allowed more interactions.

These elements indicate that the epistemic community influenced international cooperation, increasing it to a level closer to full cooperation. If there had not been a robust epistemic community network, the FCTC would not have been successfully negotiated, given the tobacco industry's pressure and the opposition of some countries with high revenues from tobacco trade.

Chapter 4: International cooperation and the international response to infectious diseases

Emerging infectious diseases (EIDs) and re-emerging infectious diseases (REIDs) cause most pandemic outbreaks, which quickly spread over a wide geographic area and severely affect population health in a short period (202,203). These diseases are caused by known or unknown pathogens or by microorganisms usually found in animals. There are also common diseases that have increased in incidence[xvi] (204,202,205,206,27,7,4,6), or the vector or host range has geographically expanded[xvii] (207). Transmission of many EIDs and REIDs is usually from animals to humans, or they are common to both (known as zoonotic diseases) (208,209,204).

Different factors contribute to the spread of EIDs such as technological and communication processes triggered by globalization (210,121,206,211,212,213,214,204,108,215). Table 12 presents a summary of these factors.

Cause	Explanation
New technologies	Changes in food chains
Changes in ecosystems and land use	Agricultural practices, small farms, and increased closeness between humans and animals. Deforestation
Globalization: Travel and international commerce	Increasing flows of people and merchandise worldwide
Climate change	Expansion of the ecosystems of some vectors (such as the case of Malaria, dengue, and yellow fever)
Wars, terrorism, and massive migration	Sanitation problems, hunger, famine; limited or lack of access to health facilities, health personnel, and materials
Demographic and population changes	Urban concentration, migration from rural areas to cities
Socio-cultural changes	Sexual practices and use of drugs
Weakened human immune system	Antibiotic resistance due to overconsumption
Microbial adaptation	Adaptation to antibiotics and other products developed to control diseases (insecticides)

Table 12. The causes of the EIDs. Adapted from Foladori (2005:147) and (210,121)

[xvi] Lashley (2003) mentions the cases of diphtheria and pertussis and includes as references to support this claim Lashley and Durham2002; Lederberg and others 1992 (206).
[xvii] Zika Virus outbreak in the Americas is an example.

In particular, current patterns of international trade and travel have increased the transmission of diseases across countries (216,213,217,218,219). Due to new means of transportation, the growing number of urban areas increase contact among people and to animal reservoirs and vectors (220). These contextual factors operate in all cases.

Globalization has not only affected the transmission of diseases, but it has also modified their management (221), producing changes in health systems and the way national states craft and implement health policies (107,222,223). States cannot depend exclusively on domestic policies to address infectious diseases, and during pandemics, other governments need to execute complementary actions to get effective results. Medical and non-medical interventions enforced by only one or two countries cannot effectively control an outbreak. Instead, individual responses will likely increase the risk (33,27,4,6,7,8). Furthermore, the complexity and inter-sectoral characteristics of the intervening variables during outbreaks make it necessary to work with other sectors such as animal health, education, economy, tourism, or trade. Health policy has become global (213), and governments have adjusted themselves to the requirements of globalization (222), making international cooperation a necessary and critical instrument to control and manage these outbreaks. Yet, as outlined above, cooperation is not always optimal.

4.1 Cooperation in the management of pandemics

Different factors can influence international cooperation in the response to pandemic outbreaks. These include a large number of issues and actors that have the potential to affect the level of international cooperation in global health (224,225). Figure 10 represents these factors and their connection to the process of international cooperation, showing its multi-dimensional nature. Therefore, to understand this cooperation, it is necessary, first, to know the characteristics of the diseases (scientific knowledge) as well as the factors that make some geographic areas more vulnerable than others (globalization of diseases) as well as characteristics that increase vulnerability (social inequalities). For implementing collective action, it is necessary to recognise the resources governments and population have access to (financial resources), and how national institutions work and their characteristics (health systems, domestic politics). Finally, globalization and multiple international factors (globalization of diseases, international traveling, trade, and production, security) will inevitably shape cooperation.

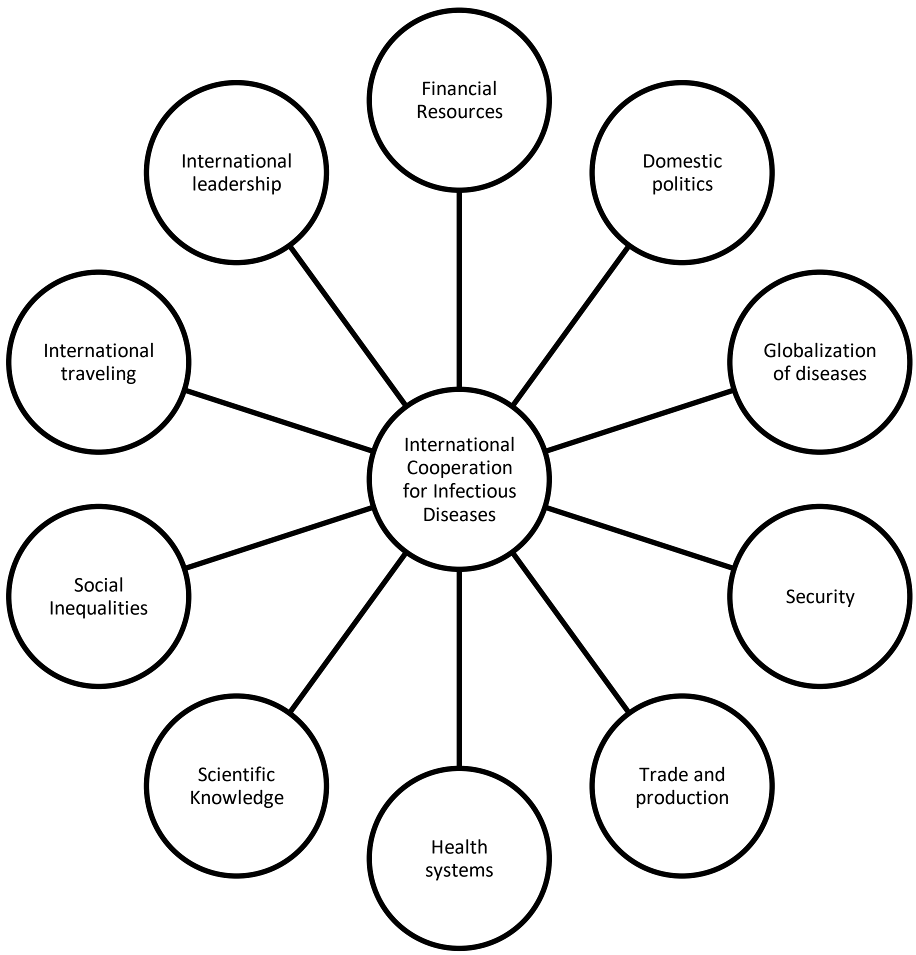

Figure 10. Factors influencing international cooperation to manage infectious diseases.

In general, international cooperation to control and manage infectious diseases begins with the analysis of the viruses and germs producing an outbreak (209,202,121,226,227,228,229,230). The level of deaths produced by the disease in a specific period and a geographical area (mortality), as well as the prevalence of the disease in the population (morbidity), will give a first indication of the status of an epidemic. As a result, any health intervention requiring international collaboration could be the consequence of assessing case fatality ratios and reproductive ratios. The case fatality rate or ratio is the estimated percentage of the population that can die from a disease (231). The reproductive ratio or reproduction number is commonly used to measure the pandemic potential of a disease. It "measures the speed at which a disease is capable of spreading in the population (232) ".The value of $R_0 > 1$ usually indicates pandemic potential (233,234)[xviii]. Would this be enough to make countries cooperate?

Historically, only smallpox, a disease with high reproductive and fatality ratios, was eradicated through an international vaccination campaign with a high level of international collaboration managed by the Global Smallpox Eradication Program (235). Nonetheless, these indicators did not seem to drive the response of disease outbreaks recently assessed by the WHO Emergency Committee. Ebola and MERS have the highest case fatality rates, as table 13 shows, and their international responses have been either late (Ebola) or limited (MERS).

[xviii] Diseases with a $R_0 > 1$ do not necessarily become pandemic. The reproductive ration indicates their capability to spread fast and cause pandemics. It is expected that, in the presence of a disease with pandemic potential, there would be a risk assessment of the global situation based on complementary data (epidemiological, biological, among others) (440).

Disease	Case fatality rate	Reproductive ratio
Ebola	50-90%	1.3-3.65
SARS	10%	2-4
MERS	45%	0.3-1.5
H1N1 (2009)	0.5%	1.3-2.9
Zika	8.3%	1-4.3

Table 13. Case fatality rate and the reproductive ratio of selected diseases. Multiple sources.

The nature of the disease is central to determine further action to control and manage an outbreak. However, this aspect by itself cannot influence cooperation as diseases with high fatality rates and reproductive ratios do not necessarily prompt more cooperation- as is evident by the West Africa Ebola Outbreak. The complexity of a disease outbreak response requires analyzing multiple factors that go beyond the disease itself.

The analysis of international cooperation also requires understanding the role of domestic politics (236,237). Some scholars have tried to incorporate the different actors and dynamics that comprise the nation-state into the analysis of international cooperation. For instance, Putnam proposed the "two-level game" approach in which he studied the influence of national politics in negotiation processes (236), and how they affect the adoption and implementation of any international treaty. In global health, this has been a central issue for the functioning of the IHRs 2005. Domestic politics has caused delays in the implementation of the IHRs 2005. The agreement recognized gaps in capabilities among developed and developing countries. It also underscores the importance of building capacities for surveillance and notification, as well as to strengthen health systems for the response in developing countries. Financial and human resources in these countries, however, are indispensable to close the gaps, but the IHRs did not detail mechanisms to increase investment or funding.

Many developing countries have not improved their health systems nor build capacities to improve the response to pandemics, and they are still highly dependent on international cooperation. Problems include the lack of political will, and commitment to global public health by national governments, barriers to sharing public health information among countries, and constraints imposed by donor agencies on funded projects (238). Lastly, developing countries may face other problems, such as war, famine, and ecological destruction (239). In the case of the Ebola outbreak of 2014, the outbreak originated in countries with weak health systems and a lack of capacity to respond (240). The international community did not mobilize immediately to help these countries, even though NGOs were requesting this assistance (241). Therefore, the assumption that those in need would be the recipients of international cooperation in a prompt manner does not necessarily happen in reality, given their lack of domestic capacity.

Others assume that the inclusion of some EIDS and REIDS in the agendas of trade and security can increase international cooperation. For instance, the field of *Global Health Security* centres around the principle that infectious diseases are a security imperative, conceptualizing diseases as transnational security threats[xix] (27,28,29,30,31,32,33,34,35,36). Under this notion, diseases are common threats to international and national security[xxi], affecting not only individuals but health systems, infrastructure, as well as the economy[xxii] through their impact on international trade, financial systems, travel, and commerce

[xix] The conceptualization of diseases as threats was reinforced by fears for future bioterrorist attacks (33,28,36,35,27,34).
[xxi] Ulman 1983 defines it as: "A threat to national security is an action or sequence of events that 1) threatens drastically and over a relatively brief span of time to degrade the quality of life for the inhabitants of a state, or (2) threatens significantly to narrow the range of policy choices available to the government of a state or to private, non-governmental entities (persons, groups, corporations) within the state (710).
[xxii] As an example, the economic cost of the H1N1 outbreak in Mexico was estimated at 0.33% of the annual GDP (57)

(30,8,205,242,243,122,31,244). Some scholars argue that infectious diseases can undermine a state's capacity (239). Others focus on biological agents that cause diseases that are categorized as biological weapons, given their potential to create damage to a large population (28).

At the policy level, the term ″Global Health Security″ has been more frequently referenced since the WHO embraced it in 2007. More recently, in 2014, over 50 partners, including countries and international organizations, launched the Global Health Security Agenda, making a stronger commitment to address health threats (245,246). Global health security emphasizes the importance of collaboration to manage health events such as global outbreaks of infectious diseases. It is difficult, however, to establish whether states are more likely to agree to international mobilizations and coordination because infectious diseases represent public health threats (30,8), or if their cooperative behaviour is driven by a convergence of national and international interest to combat a disease outbreak (30). It is unclear how countries agree on which diseases represent a threat for international and national security, or if there is an accepted definition of health security (247,32). Thus, the idea of naming diseases "threats" is controversial, and in some cases, national security prerogatives are still more important than international security.

In the case of commercial interests, disease outbreaks have affected trade for a long time (40), and countries have tried to reduce health measures that create trade disruptions (222). Hence, improving international cooperation is the best option for everyone. After all, reducing the impact of disease outbreaks in international trade is one of the main functions of global health governance for infectious diseases (175)[xxiii]. Nonetheless, restrictions on trade and travel are common policy responses during outbreaks. For instance, in the SARS outbreak, China denounced at the World Trade Organization the imposition of trade restrictions on Chinese agricultural products, even though there was no evidence of SARS transmission through food (248). Thus, even though there is an international interest in continuing normal trade relations, this interest frequently does not overcome the fear of the disease spreading to other populations through the importation of goods.

In addition to these factors, the WHO's capabilities influence international cooperation. Issues such as the availability of human and financial resources, leadership, and the WHO`s organizational structure, as well as its relations with its Member States, can affect the level of cooperation during the international response (224). National governments provide the money to establish the WHO's budget through assessed contributions, and additional donations from countries and other voluntary contributions (249). The funding of the agency, however, has been affected by budgetary cuts and financial pressures since the financial crisis of 2008 (250). Insufficient resources affect the WHO's investment in programs, the personnel necessary to implement them, as well as its international operations (249). Thus, not having enough human and financial resources can condition the WHO's effective response to disease outbreaks.

Other constraints are due to the WHO's structure. The WHO's headquarters (in Geneva) formulates policy, sets the budget, and defines policy direction. Six Regional

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[xxiii] The IHRs in their Second Article state that their main purpose and scope is "to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate […] which avoid unnecessary interference with international traffic and trade (16)"

Offices support program implementation, coordination and can also contribute to policy formulation. The State Members elect the WHO Director-General and Regional Directors, appointments that have become more political rather than based on public health imperatives (249). The organization also has some country representatives in developing countries. These country directors support the WHO's activities providing technical advice and acting as consultants in some cases. Regional offices appoint the people in these positions, who usually have little authority and scarce resources (249). This structure is "hierarchical at the top and resource-constrained at the bottom (249)", which can affect the WHO's operations. The leadership of the WHO in technical issues is usually affected by its interactions with its Member States, its dependence on assessed contributions, and political interference. These factors combine and create conditions that affect the international response.

4.1.1. The international system for the management of disease outbreaks and its relevance to international cooperation

The creation of institutions such as WHO and other international organizations, have increased the level of trust and interactions among countries, as well as the design of a payoff structure that has potentially benefited international cooperation. For instance, the WHO has created incentives for improving international cooperation during pandemic outbreaks by improving reciprocity and promoting the creation of mechanisms such as the IHRs 2005 and the Pandemic Influenza Preparedness Framework (PIP).

The system started with the establishment of the World Health Organization (WHO) in 1948[xxiv] and the first International Sanitary Regulations (ISR) of 1951. These institutions

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[xxiv] The WHO Constitution was signed on June 1946. It entered into forced on April, 1948 (11).

and norms have evolved[xxv] , and in 1969, the WHO and its members renamed the ISR as the International Health Regulations (IHR), which were modified twice, first in 1973 and then in 1981 (98,177). Despite the amendments to the norms, low levels of compliance and problems with disease notification were frequent, due to the fear of sanctions – such as quarantines, trade-related bans and restrictions in commercial relationships (98,177). Additionally, the regulations addressed only a limited number of diseases, while emerging infectious diseases, such as SARS and H5N1, were creating new threats that these outdated regulations were unable to manage (205,8).

4.1.1.1 The SARS' outbreak and the reform of the IHRs

The Severe Acute Respiratory Syndrome (SARS) epidemic in 2003 was the first EID of the XXI century. The SARS outbreak proved that the IHRs of 1969 were inadequate to manage and respond to pandemics (251,252). The disease spread rapidly due to a combination of factors. The government of China did not recognize or address the outbreak when the virus emerged, leading to late notification. The delay limited the WHO's ability to issue warnings to the international community and postponed the participation of the Global Outbreak and Response Network (GOARN), the network of experts coordinated by the WHO to assess and respond to outbreaks (253,254). The WHO only mobilized to assist China once the virus had already spread throughout several countries. Once China accepted experts from GOARN and the WHO, they were able to determine the virus' transmission mechanisms and

[xxv] In 1969 the ISR were renamed the International Health Regulations (IHRs) introducing broader requirements on all member states to manage and control of infectious diseases. This norm was primarily modified to monitor and control six serious infectious diseases: cholera, plague, yellow fever, smallpox, relapsing fever and typhusInvalid source specified.. Under the 1969 IHRs, governments had to notify the WHO of any outbreak of these diseases within their territory Invalid source specified.. These regulations were two times modified: in 1973, to change provisions regarding cholera, as well as to exclude relapsing fever and typhus Invalid source specified.; and in 1981, to exclude smallpox from the list of notifiable diseases Invalid source specified.

to establish medical measures (252). The late response, however, limited the assessment of cases and investigation of the event, resulting in 776 deaths and significant economic impact.

A man in Foshan City, Guangdong, was the first case, identified on November 16, 2002. The international transmission started in Guangdong when a doctor infected other guests from different places, including visitors from Canada and the USA (255,256). Due to the severity of the symptoms, doctors called the head of the local WHO office, Dr. Carlo Urbani. After doctors were unable to determine the cause of the disease, Dr. Urbani informed WHO headquarters on March 6, 2003, about the severity of the situation (256,255). The WHO issued a global alert on March 12, 2003, four months after the first case (255,256).

Experts named the disease "SARS," a new type of coronavirus associated with upper respiratory illness (257,252). Table 14 illustrates the main characteristics of the outbreak. Between November 2002 and July 2003, the virus spread to 26 countries with 8096 reported cases and a death toll of 774 people (122,252) (See Appendix B).

	SARS 2003
Virus	Coronavirus
Case Fatality Rate	11%
Reproductive ratio	2-4
Type of transmission	Human to human
No. of cases	8096[xxvi]
No. of affected countries	26
Treatment	Unknown
Vaccines	Ongoing research

Table 14. Main characteristics of the SARS outbreak. Various sources.

The outbreak severely impacted Canada, given the failure of China to share information on time and the overall uncertainty concerning the situation (258). The flow of information was slow, and for days, many health providers were not aware of the situation

[xxvi] Number of cases between November 2002 and July 2003 (122,252)

beyond their hospitals. Health systems were unprepared, the virus was quickly spreading, and health care workers exposed to severely ill patients (255).

The WHO issued a series of travel alerts, affecting countries dealing with the outbreak (255,259). Tourism and services sectors suffered damage in countries such as Canada, Singapore, Hong Kong, and China. The calculated global economic loss from SARS was around $US 40 billion in 2003 (259)[xxvii]. Some scholars estimate that the outbreak cost Canada about 1.2 billion dollars (260).

After health experts identified the disease, containment of the outbreak was possible in less than four months (261). International collaboration was fundamental to stop the contagion (261,251), as well as the participation of GOARN and its network of experts. Nonetheless, the international response to the outbreak was sub-optimal. Governments scrutinized global health governance, particularly the WHO, and the international norms surrounding infectious disease outbreaks. The WHO member states agreed to transform the system of governance for pandemic outbreaks, and, after a series of negotiations, they approved the updated International Health Regulations in 2005 (IHR 2005), which entered into force in June 2007.

4.1.1.2 The updated IHR 2005 and the new governance for pandemics

The IHR 2005 is legally binding under international law (262,98), as the WHO Constitution of 1948 is an international treaty, and the IHRs are a mandate under this agreement[xxviii]. These norms are central to global efforts in disease surveillance,

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[xxvii] W. J. McKibbin has presented estimations closer to $US 80m billion (711).

[xxviii] The Articles 21 and 22 establish the authority of the World Health Assembly to adopt sanitary regulations as well as the obligation for member states to follow them. Article 21 establishes that "The Health Assembly shall have authority to adopt regulations concerning: a) sanitary and quarantine requirements and other procedures designed to prevent the international spread of disease; (…)". Article 22 also

preparedness, and response to outbreaks (8,263,98,177,264,265,266). A fundamental change in them was the addition of the "all-hazards" approach. Instead of having specific diseases listed in the regulations, now state parties must notify WHO of all infectious disease outbreaks and health events (98,16). The response to a disease outbreak depends on the assessment of the epidemic. For this reason, the new IHRs incorporate a guide for notification, as well as an expert-led process to evaluate an epidemic. These mechanisms intend to improve the international management and control of disease outbreaks by providing better guidance for national governments and the WHO.

The regulations define two categories of notifiable events (16,267). The first category considers critical diseases that can cause a "serious public health impact." These diseases are smallpox, poliomyelitis (due to wild-type poliovirus), human influenza (new subtypes), and severe acute respiratory syndrome (SARS). Member States are required to notify the WHO of an outbreak of these diseases in their territory, regardless of the number of people infected or the severity of the cases. These diseases represent a similar international health risk, most of them emerging or re-emerging infectious diseases (EIDs-REIDs), with pandemic potential[xxix] (208,209,204,123).

The second category incorporates other diseases that might be subject to notification if they satisfy the criteria established in the decision instrument[xxx]. The instrument is a guide

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stipulates: "Regulations adopted pursuant to article 21 shall come into force for all members after due notice has been given of their adoption by the World Health Assembly (…)" (16).

[xxix] SARS and influenza viruses are zoonoses, which means they are transmitted from animals to humans.

[xxx] These criteria require governments to answer four general questions (16):
-Is the public health impact of the event serious?
-Is the event unusual or unexpected?
- Is there any significant risk of international spread?
- Is there any significant risk of international travel or trade restrictions?

for the assessment of other events[xxxi] and includes outbreaks of diseases such as Ebola, Cholera, Plague, West Nile fever, among others. Countries must follow this instrument to assess whether they should notify an outbreak or not.

Once a State notifies the organization about a disease, the WHO and its member states should follow the guidelines established in the IHRs to be able to determine the severity of the outbreak. Under these regulations, severe outbreaks or the emergence of viruses with pandemic potential might constitute "a public health emergency of international concern" (PHEIC). The term PHEIC provides, for the first time, an attempt to categorize all those health events that might have an impact on global health, and that might require an immediate and coordinated international response. The decision to call an event PHEIC will be the responsibility of the WHO-DG, under the advice of an Emergency Committee.

The 2005 IHRs were intended to transform the system of global governance to manage pandemics. They created a structure to improve international coordination and collaboration during outbreaks as well as to reduce the negative consequences of diseases with pandemic potential (whether in the loss of human lives, the economy, health systems, society, etc.). Ten years after the regulations entered into force, however, these norms and institutions do not consistently lead to international cooperation.

The emergence of an infectious disease with pandemic potential requires not only clear regulations and institutions. It requires diplomats, politicians, bureaucrats, scientists and health experts around the world to work together through these governance mechanisms to confirm the outbreak, undertake surveillance, investigate cases, collect data, identify the

[xxxi] This category also includes chemical, biological, radiological events that might have a public health impact. However, they also have to go through an assessment under the referred criteria in order to determine their severity (16).

population at risk through contact-tracing, identify pathogens, develop therapies and apply of control and prevention measures (268,94,269,253). These actors became members of epistemic communities and increased their bureaucratic power due to their participation in the WHO and its expert groups. These communities influence and connect with the WHO facilitating the implementation of WHO policy goals and improving international cooperation.

4.2 Epistemic communities in the international response to a disease outbreak

International response to a disease outbreak requires the implementation of medical and non-medical measures to manage and control the epidemic. Health experts become essential in the application of these actions since all WHO state members have agreed on scientific advice[xxxii] to determine the implementation of measures (16)

The WHO requires scientific knowledge to create and support norms, using expert groups and funding research to generate it. Through these activities, the WHO establishes and coordinates coalitions of professionals in an issue-area, which become epistemic communities (25,24).

4.2.1 Epistemic communities and the International Health Regulations

The IHRs 2005 established guidelines for the surveillance, report, notification, and management of outbreaks that can have a global impact. Even though the IHRs do not explicitly mention epistemic communities as key actors in the international system, they allocate a primary role to experts, scientific advice and evidence in all the tasks required for the implementation of the IHRs during the international response to an outbreak.

[xxxii] This specific reference is part of the International Health Regulations 2005, Part VIII General Provisions, Art. 43. Additional Health Measures.

The regulations assign experts as advisors to the WHO DG to determine whether some outbreaks constitute a “Public Health Emergency of International Concern.” The decision of declaring if an event fits into this category or not is the primary responsibility of the WHO DG. The IHR 2005, Article 12, establishes that the WHO DG, before any declaration, should consider the advice of an “Emergency Committee.” An Emergency Committee (EC) is a group of experts that will assess the situation and provide recommendations to the WHO DG about those steps and measures that countries should follow and apply during an outbreak (16). The regulations state in Article 47 that the WHO-DG should establish a “Roster of Experts” in all relevant fields of expertise for the implementation of the IHRs 2005 (16). These experts will be called to participate in an EC when needed. Article 49 specifies that the WHO-DG should select from the roster of experts the people to incorporate an EC based on “their field of expertise and experience most relevant to the specific event that is occurring (16)”. An EC may also include experts appointed by request of the most affected countries and for other international organizations. The EC will hold regular meetings for a continuing assessment of the situation during the outbreak until it decides to call off the emergency or the WHO DG considers the EC’s advice is no longer necessary.

When the EC’s members agree that the assessed outbreak meets the PHEICs conditions, the WHO DG will release a statement with recommendations and specific policies that affected and non-affected countries should implement. Therefore, the EC experts’ participation becomes critical since their knowledge and recommendations will determine how coordinated international action can control the outbreak (16). All countries are expected to comply and implement these recommendations (16). Under the updated

IHRs, the EC will consider formally calling for a coordinated international response only for those outbreaks defined as PHEICs. Nonetheless, if an outbreak is deemed not having the characteristics of a PHEIC, an international response is still possible. This response, however, it would likely include only affected countries, the WHO, and a smaller number of international partners (see MERS case).

Additionally, the IHRs 2005 in its Article 12 indicates that the WHO and its DG should consider scientific principles, available scientific evidence and information in the assessment of an outbreak, and all different components of the response (16). Therefore, groups of professionals with expertise in a specific issue-area, their knowledge, and information regarding the disease and the outbreak, are evidently at the centre of the response. These experts can also be incorporated into an epistemic community.

Some members of the epistemic community participate directly in the ground, overlapping their participation as experts and as frontline health workers through the Global Alert and Response Network (GOARN). The GOARN is an operational structure created in 2000 and coordinated by the WHO. It operates as a loose network that coordinates academics, universities, government scientists, non-governmental organizations, health associations, and health experts (270). GOARN members directly analyze events and deploy experts for the assessment, identification, and analysis of the outbreak (110). After an initial investigation, GOARN members provide advice on how to respond to the outbreak. The network coordinates more than 200 research institutions and specialist networks (see Appendix C). The GOARN Operational Support Team coordinates and supports the network's activities, and headquarters are in Geneva. The network also has a Steering Committee, which "is a representative body of 21 partner institutions that oversee the planning, implementation, and evaluation of the Network activities and strategic goals (271)". Not all the members of this network will participate in the response to all outbreaks; neither all of their members are part of a specific epistemic community. GOARN's member's participation, as well as the involvement of one particular epistemic community, will, therefore, depend on the type of outbreak.

4.2.2 Epistemic communities' capabilities to influence international cooperation in the response to infectious diseases.

An epistemic community's capacity and ability to influence cooperation during its participation in the international response to an individual disease outbreak will depend upon the epistemic community's characteristics. This research will assess the characteristics of an epistemic community, using the proposed indicators and adapting them to the requirements for an international response to disease outbreaks. The study first identifies if there was an epistemic community during the outbreak. For all these cases, the WHO established an Emergency Committee, and it deployed members of the GOARN. Therefore, these are the starting points for the identification of such an epistemic community.

In some cases, however, there are epistemic communities' networks established before the outbreak. This characteristic may increase the epistemic community to influence the international response. The interviewees agreed with the importance of history and past relationships, mostly because these factors help to build trust among members of the epistemic communities, which is fundamental for communication during the response (Interviews 5, 12). Table 15 presents the characteristics and the relevant indicators for the analysis of the epistemic community and in the international response to infectious diseases.

Characteristic	Indicator	Description
1. Knowledge	Agreement on a common definition of the problem and possible solutions	Agreement on a problem and solutions also improves the cohesiveness of the epistemic community and its position in the policymaking process (Interview 12). In this research, given that all the cases studied have been assessed by the emergency committee established by the WHO, consensual knowledge is measured on the definition of the problem: whether the disease was considered a PHEIC or not and under which circumstances.
	Clear identification of a common policy goal	It should be determined whether the network has worked together previously and has a clearly stated this goal or if this was something that developed during the outbreak. It is also possible that the network did not formulate a policy goal. However, having in advance something established helps to deal better with the situation during an emergency (Interview 12).
2.Socialization of ideas	Structure	There should be an identifiable network, with one central group or many that are connected through the same goal and shared knowledge. There should be evidence of interactions during the outbreak; these interactions could be through meetings, conferences, the internet, that are necessary to build the network (Interview 10, 6). The size of the network refers to how broad is its representations (international and at different levels), to understand the scope of its influence and diffusion of its ideas (Nodes). The denser a network, the better the cooperation and communication (272).
	Dissemination mechanisms	Global health policy usually requires these networks of experts to participate in the definition of norms and regulations (Interview 5, 10). Although governments and decision-makers are supposed to adopt measures based on scientific evidence and followed the advice of experts, this does not always occur ((98,273). The network should have the ability to understand the policy environment to make policymakers adopt their proposed measures in working documents (guidelines, action plans) and international organizations' decisions (resolutions). During the outbreak, members of the epistemic community publish in the most prestigious academic journals (and influential) such as the Lancet, BMJ, Nature, Science, among others. Dissemination implies that their knowledge is available, and it can be used during the event. If the dissemination makes their knowledge available to the right audiences, It will likely be used to address the situation. It is also possible that experts withhold information affecting the epistemic community effectiveness (Interview 5).

Table 15. Epistemic communities' characteristics and indicators for the analysis of their participation in the international response.

Characteristic	Indicator	Description
2.Socialization of ideas	Participation in the international response	In this topic, the active and direct participation in the field, participating in the investigation and analysis of the event. The epistemic community's participation directly in the response facilitates communication with other actors (Interview 5,12), to get information and to transmit the epistemic community's knowledge.
3.Institutionalization of bureaucratic power	Participation in the policy process.	To be able to influence the policy process and the actions during the response, members of the epistemic community should participate in the international decision-making process. They should be part of key bodies such as the Emergency Committee, Experts Groups, Advisory Groups, and participate in international meetings organized to discuss the outbreak where they can exchange information with decision-makers and other experts. These participations are relevant for influencing the policy process and building collaboration since people "learn to work with each other" (Interview 12).
	Experts and other professionals from the epistemic community in decision-making positions	The presence of members of the epistemic community in crucial decision- making positions intervening in the international response will increase the epistemic community's ability to influence the process. Professionals that are part of international networks are more influential than those that are just at the national level because they understand better another context and the international dimension of them (interview 12). This includes policy entrepreneurs, champions, and other important actors endorsing proposals by the epistemic community and/or sponsoring them (Interview 6, 10, 11). Members of the epistemic community should be identified as participants in expert groups created to discuss policy options and discuss the event. They can also be part of national delegations participating in international conferences. Participation in these bodies may have occurred before the outbreak (Interview 10, 12).

Table 15. Characteristics epistemic communities (cont.).

Based on the Pareto frontier model, I argue that when a robust epistemic community participates in the international response and influence this process, they would move the outcome -international cooperation- closer to the Pareto Frontier.

Chapter 5: The A(H1N1) Influenza outbreak 2009

5.1 Introduction

Influenza pandemics have a high political profile. The certainty that a new and deadly outbreak will occur has created a context in which policymakers try to predict possible scenarios to manage it and control it. Despite the knowledge that experts have accumulated about the disease, a new influenza virus can emerge and create a situation with high levels of uncertainty (274). Governments and international organizations would likely deal with circumstances in which information to understand the behaviour of the new strain, as well as data to formulate the appropriate policy choices for containing the outbreak, would be scarce (see Box 1 Influenza pandemic).

Box 1. Influenza Pandemic

Nature of the disease

The global fear of a new outbreak of pandemic influenza, as well as the design of policies for preparedness and response to it, are based on scientific evidence and historical experience. Scientifically defined as a respiratory infection, influenza is "characterized by the rapid onset of symptoms (117)". In 1957, scientists for the first-time categorized influenza viruses, dividing them into three types: A, B, and C.

The type A virus can infect humans and animal species, which implies a higher number of "pathogen reservoirs (117)". Researchers determined that influenza sub-type A appeared due to two surface glycoprotein receptors – the sixteen *haemagglutinin* (HA 1-16) from a pool of influenza virus found in birds and three *haemagglutinin* (HI to H3) found in human virus – and nine neuraminidases (NA 1-9) (275). The A-type is a highly unstable virus that can mutate in minor ways (known as an antigenic drift), which means that the HA gene mutates. Type A viruses can also mutate in major ways (known as an antigenic shift), which refers to the process of avian gene segments from the circulating avian virus combining with the human-adapted virus to create an avian/human combination. These processes are "genetic reassortments which occur when human influenza and animal influenza viruses co-infect a human or an animal (such as pigs) (276,117)". Genetic re-assortment has provoked the most notable pandemics of the 20th century.

Global Threat

According to the US Department of Health and Human Security, when a new influenza A virus emerges, a flu pandemic can quickly occur because the population has little to no immunity against it, and it spreads quickly from person to person worldwide (277).

Box 1. Influenza Pandemic (cont.)

Studies have found that the A-type of influenza viruses, and their antigenic shifts, have been the cause of influenza pandemics registered over centuries (275), from the 1889 pandemic (caused by the H2 subtype) to the 1898 outbreak (caused by an H3) during the nineteenth century. While deadly, those outbreaks were minor in comparison to the worst pandemic ever recorded, the highly virulent 1918 "Spanish Flu" caused by an H1N1 virus, which the WHO estimates killed 40 to 50 million people worldwide (175,278). After that, the world experienced an H2N2 pandemic virus in 1957-1958, an H3N2 virus pandemic in 1968-1969, and an H1N1 outbreak in 1977 (279).

Type A(H1N1) virus of 2009 resulted from several viruses circulating among pigs (the H3N2 virus from North America), the classical swine H1N1, and the Eurasian avian-like swine H1N1 virus (280).

Influenza viruses circulating in animals represent a threat to human health because humans can become ill when infected with viruses from animal sources (also known as the human-animal interface). The primary risk factor for human infection is direct or indirect exposure to infected live or dead animals or contaminated environments. The significant threat to human health from such avian-influence strains, therefore, lies in the potential of the virus to mutate into a form capable of sustained person to person transmission. In the case of the currently active H5N1, the virus managed to infect humans, improving its potential for mutation opportunities (278). Nevertheless, the spread of H5N1 has not yet reached pandemic proportions as the virus has not been efficient enough to become "a virulent pathogen capable of sustained human-to-human transmission (117)".

The medical community has tried to predict the likelihood of a new pandemic outbreak for decades, given all these circumstances. However, there is still no certainty of when a new pandemic will occur (281,282,283,284,285,286,287)

In this context, international cooperation is fundamental to prevent, control, contain, and manage an influenza outbreak with pandemic potential. Therefore, it is not surprising that in 2009, the international community mobilized and collaborate in almost all the areas to manage the outbreak of the A(H1N1) influenza virus and reduce as much as possible the number of people affected by the disease.

Different factors could have influenced this level of cooperation, from the type of disease, the newly approve IHR 2005, the WHO, international trade, and national security interests, to the location where the outbreak started. The fact that it was an influenza outbreak may have been central to determine further actions to control and manage the epidemic.

Influenza viruses are well known for their pandemic potential. The disease is endemic in multiple species; they spread fast and easily from animals to humans and humans to humans (288). There are numerous mechanisms to manage influenza outbreaks that have been in place since the 1950s. Years before the 2009 outbreak, the international community had expected an outbreak of the highly pathogenic H5N1 avian influenza, which influenced more worldwide preparation and improvement of the mechanisms to respond to an influenza pandemic (250).

The location where the outbreak originated also contributed to a rapid response given the importance of North America and the established national and regional capacities for responding. Everybody was expecting the outbreak to start in Asia due to the presence of the H5N1. Instead, the outbreak began in Mexico and the USA (289). These countries notified the outbreak on time, showing the importance of transparency, rapid information sharing, and collaboration (290).

Influenza pandemic is also one of the main drivers of the health security agenda. The disease is considered as a security threat (278,141,291). This categorization helped to increase its political profile and allowed the involvement of other actors in the creation of global strategies to prevent and respond to outbreaks (292,293). As well, influenza and other infectious diseases are subject of interest for the international trade agenda, and countries have tried to create better ways to deal with them without disturbing international trade (175). The interest in influenza pandemics due to trade and security, however, had more of a negative effect on the 2009 influenza outbreak. Countries acted following their national interest, establishing quarantines, limiting the transit of travelers, and affecting their human rights (289).

Finally, the outbreak of 2009 was the first to be assessed under the IHRs 2005. The USA and Mexico followed the regulations, notifying the WHO, and the organization immediately called an Emergency Committee to evaluate the situation (294). The WHO acted upon the rules, plans, and methodologies established and approved by its member states. The response, however, ended up being criticized by countries who claimed the WHO overreacted, judging the severity of the virus higher than it was (289).

The combination of these factors shaped the level of cooperation during the international response. The political relevance of pandemic influenza, however, requires defining plans and policies supported by scientific evidence to outline interventions that will effectively reduce the damage (134,141,94). Across all these factors, there was a constant demand for knowledge and expertise for the management of the disease and the creation of global policies. The WHO consistently recognized the importance of having technical and scientific knowledge up-to-date to guide the response (250).

The influenza epistemic community provided this knowledge and expertise needed to respond effectively to the potential threat posed by the novel virus. This group of experts had an authoritative claim on knowledge about the disease and its pandemic potential. Members of the community also occupied decision-making positions, and the community had built a network of highly connected. Therefore, analyzing the participation of the influenza epistemic community and its role in the international response to the outbreak will provide more information about how they influenced cooperation. Figure 11 summarizes the influenza epistemic community's characteristics and its influence in the international response.

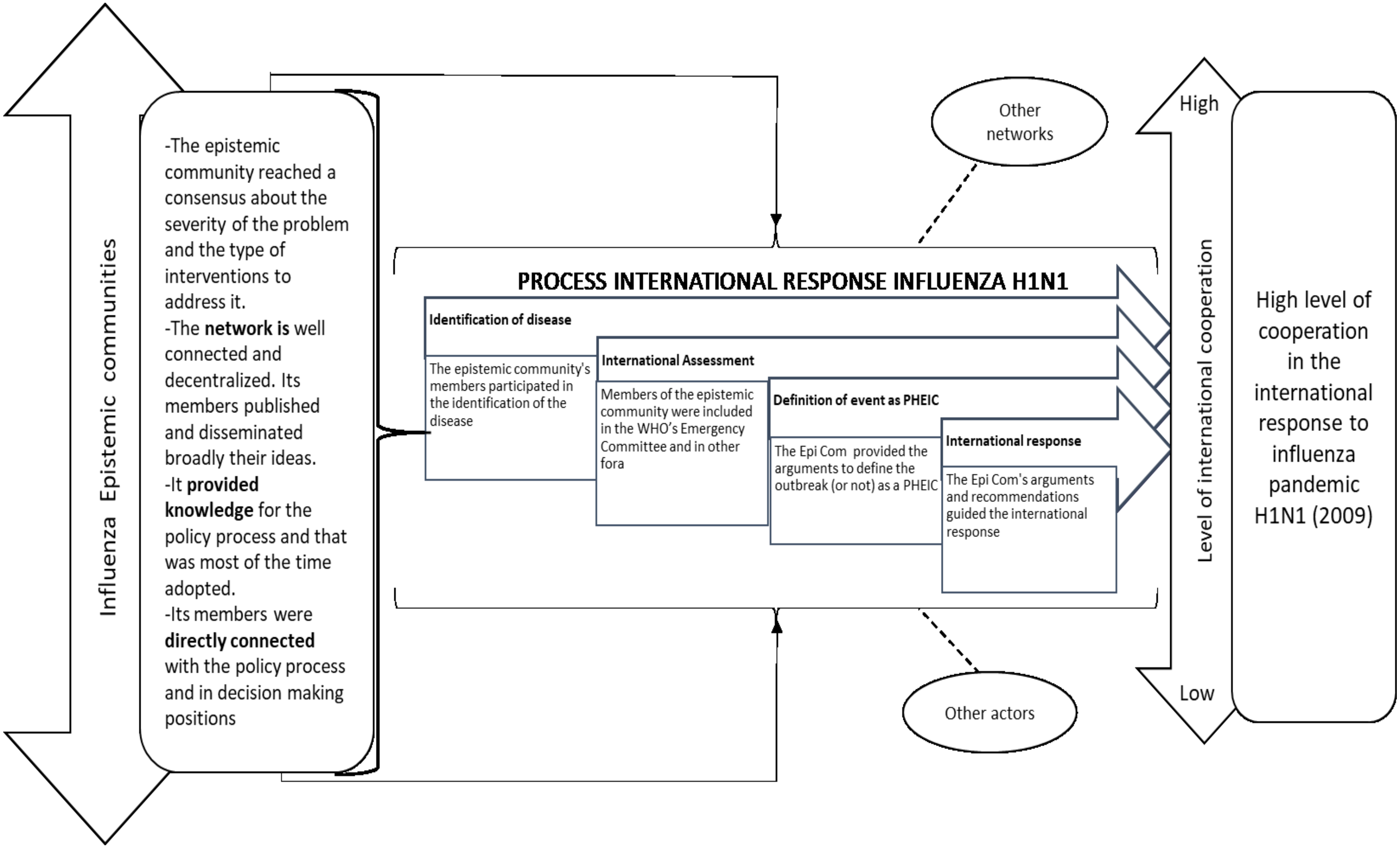

Figure 11. Relationship between a strong epistemic community and the level of cooperation in the influenza pandemic outbreak.

This chapter presents an analysis of the influenza epistemic community and its participation in the international response to the A(H1N1) influenza pandemic. The document first explains the events in 2009 briefly, then it identifies and presents the characteristics of the influenza epistemic community, and it finally analysis the international response to the pandemic and the participation of the epistemic community.

5.2 Influenza pandemic cooperation and the evolution of an epistemic community

Given the burden that an influenza pandemic represents for governments and the certainty that a new pandemic could occur any time, the international community created mechanisms to deal with its potential effects in the 19th century, although the system was consolidated in the 20th century. The Office International d'Hygiene Publique (OIHP), established in 1907, was the first international institution to publish recommendations to manage a pandemic (295). Later in the 1940s, the World Health Organization, after replacing the OIHP, included influenza as a core issue in its directives. The WHO organized groups of experts to produce information and analyses that the WHO would adapt to its policy-making process. The experts' groups would also create documents that would become the basis for international guidelines and programs[xxxiv]. The organization established the first specialized committees related to the influenza pandemic in the late 1940s and early 1950s[xxxv]. These were the Expert Committee on International Epidemic Control and the Expert Committee on International Epidemiology and Quarantine (WHO Files)[xxxvi]. In 1950, the 3rd World Health

[xxxiv] The WHO Constitution Art.2 establishes as part of the organization's functions "d) to furnish appropriate technical assistance and, in emergencies, necessary aid upon the request or acceptance of Governments" as well as "j) to promote co-operation among scientific and professional groups which contribute to the advancement of health (109)".
[xxxv] The researcher had direct access to the WHO Catalogue of the Material, First generation and second generation of files, during her field work in headquarters of the WHO in Geneva, Switzerland from May 22nd to the 25th in 2017
[xxxvi] This information is found in headquarters of the WHO in Geneva, Switzerland (Field research from May 22nd to the 25th in 2017).

Assembly (WHA) requested an Expert Committee on Influenza to draft guidelines for the WHO (94). The panel was created in 1952 to review the WHO Influenza Programme and to make “suggestions for more effective international collaboration (296)".

At the same time, active scientific research on influenza viruses started. In 1931 Dr. Richard Shope and Dr. Paul Lewis isolated and identified the porcine influenza virus, and, in 1933, Dr. Wilson Smith, Dr. Christopher Andrewes, and Dr. Patrick Laidlaw isolated and identified the human virus, named influenza A (141). Their contributions made it possible to develop the first vaccine in 1940 (141).

While scientific research was underway, the WHO was building a system of influenza governance based on scientific evidence and expertise. In the 1940s, it established the Regional Influenza Centres and a network of WHO Influenza Centres. In 1947, the World Influenza Centre (WIC) was based in London as a research centre on influenza (141,134,94), and as the main body responsible for concentrating and distributing all the epidemiological information collected from the influenza centres (296). The WIC worked as part of the WHO Influenza Programme, helping to set-up a plan against the recurrence of future pandemics, developing control methods to limit the impact during an epidemic and to reduce as much as possible the economic impacts of the disease as well as of future pandemics (296). The creation of the program increased the number of experts at the WHO (296). The international network of laboratories and scientists directly collaborated with the WHO, sharing information on the latest influenza-related scientific discoveries. The network became the foundation of international efforts to control and mitigate the health impacts of influenza (141). The Global Influenza Surveillance Network (GISN) was central for the system of influenza governance at the WHO, and it evolved into the current Global Influenza

Surveillance and Response System (GISRS).

The GISN formerly comprised 40 laboratories (297,298) including laboratories designated as “WHO influenza centres” with experts in 42 countries (now National Influenza Centres or NICs). Dr. Andrewes, from the WIC, was appointed as the head of the first international influenza centre (296,94). This network was the beginning of an influenza epistemic community, given that it connected for the first time to the most prominent experts worldwide. The experts worked together in influenza research, making it possible to incorporate their knowledge into the international policy-making process (see Appendix D). By 1954, the number of centres increased to over 50 in 42 countries, and in 1977 the GISN reached 98 NICs in 70 countries (297,299). In 2011, 135 institutions in 105 countries composed the GISN. After the approval of the Pandemic Influenza Preparedness (PIP) Framework in May 2011, the network changed its name to Global Influenza Surveillance and Response System (GISRS) and currently comprises 148 National Influenza Centres, 6 WHO Collaborating Centres for Influenza, 4 WHO Essential Regulatory Laboratories and 13 WHO H5 Reference Laboratories (300). The GISRS is the most important network for influenza surveillance, connecting a broad group of experts (295). Figure 12 presents a map of the geographical distribution of GISRS.

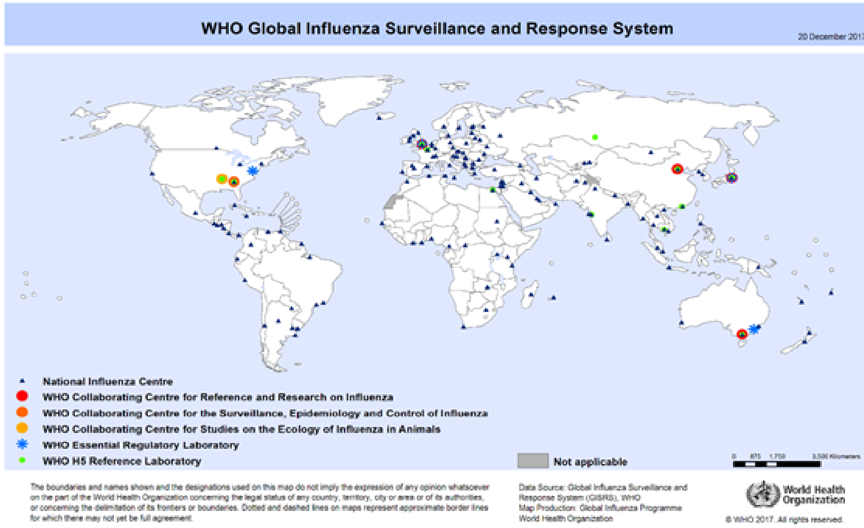

Figure 12. WHO Global Influenza Surveillance and Response System. Source: WHO (301)

The WHO's Expert Committee on Influenza and the Influenza Programme allowed public health professionals to become key advisors at the national and international levels. These experts have continuously collaborated in establishing and delineating global health policies in influenza prevention and control.

Therefore, it is possible to identify an epistemic community since the creation of the Expert Committee on Influenza in the 1950s and the GISRS. Members interact through different channels, mainly the WHO meetings (302). These experts are also part of smaller and regional networks, attending and contributing to academic conferences, and other expert meetings. They are part of national delegations participating in international summits and negotiations such as the World Health Assembly and the annual Consultation on the Composition of the Influenza Vaccine Table 16 presents some of the most recent meetings where members of GSIRS and the epistemic community have participated.

Meeting	Date/Place
GISRS 65 years. The anniversary meeting had as a goal to develop an updated framework and global strategy on influenza.	July 2017 Geneva, Switzerland
Sustainable local production of influenza vaccines for pandemic preparedness: synergies with other international efforts and improvement of the current tool.	14-15 June 2017
WHO Expert Working Group Meeting on RSV Surveillance based on the GISRS Platform.	2-3 February 2016
Meetings of the PIP Advisory Group Meeting.	Since 2014
Negotiations of the Pandemic Influenza Preparedness Framework for the Sharing of Influenza Viruses and Access to Vaccines and Other Benefits (PIP Framework).	Between 2007 and 2011
Pandemic Preparedness and Response Guidance Revision Working Group (as part of the Global Influenza Programme).	2007 Geneva, Switzerland
Pandemic Influenza Preparedness Planning WHO/European Commission Workshop.	24–26 October 2005

Table 16. Recent meetings GISRS.

The epistemic community institutionalizes its experts' advice, gaining access to privileged information, and increasing its direct influence on the international policy process. For this community, constant interaction and continuous work on the topic have helped to build professional and personal relationships, which are very important for the epistemic community's collaboration (Interviews 1,2,3,5,12). These experts are also part of the academic and scientific community, and as such, they publish in the most influential journals of science and public health, and the community actively engages in discussions about the topic within the academy and policymaking.

5.2.1 The fear of a new pandemic: H5N1

The outbreak of the H5N1 virus in Asia strengthened the role of the epistemic community in pandemic influenza[xxxvii]. The H5N1 avian influenza virus appeared for the first time in mainland China in 1996, infecting domestic poultry. By 1997, the disease spread out

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[xxxvii] That same year another virus H7N7 was also detected in Netherlands, causing alarm due to its potential for human to human transmission (322) .

to Hong Kong to farm chickens. It was the first time the virus transferred from animal to human, infecting 18 people and killing 6 of them (303,278). The outbreak alarmed the health community due to the assumption that a new pandemic would occur by the end of the 20th century. The outbreak renewed the interest in the WHO’s Influenza Programme (141,297), given the high fatality rate of H5N1 (around 33 percent) (117). One of the most prominent actors during this pandemic was Margaret Chan, who was serving as the Director of the Hong Kong Department of Health, and who later would become the WHO’s Director-General. After this event, the virus went undetected for a few years, re-emerging in 2003 during the SARS outbreak.

Since 2003 the H5N1 strain has been spreading through wild, migratory birds and domestic poultry populations into Europe, India, Middle East, and Africa (303,304). So far, it has shown a limited ability for human transmission, but reporting of cases has continued for over a decade. Between 2003 and February 2019, there were 860 confirmed cases and 454 deaths, across 16 countries (305,306). Some of the events have been isolated incidents. However, countries such as Egypt, Indonesia, and Vietnam went through a state of emergency due to their limited ability to contain the outbreak in their territory. Table 17 summarizes the number of cases and deaths per country.

Country	No. of cases	No. of deaths
Azerbaijan	8	5
Bangladesh	8	1
Cambodia	56	37
Canada	1	1
China	53	31
Djibouti	1	0
Egypt	359	120
Indonesia	200	168
Iraq	3	2
Lao People's Democratic Republic	2	2
Myanmar	1	0
Nigeria	1	1
Pakistan	3	1
Thailand	25	17
Turkey	12	4
Viet Nam	127	64
Total	860	454

Table 17. Influenza H5N1 cases in humans.
Source: WHO/GIP, data in HQ as of 12 February 2019 (World Health Organization, the cumulative number of confirmed human cases for avian influenza A(H5N1)) (305,306).

The spread of H5N1 continues without reaching pandemic proportions yet since the virus is still incapable of sustained human-to-human transmission (206,117,276). The fear of a pandemic remains due to estimations and concerns that it might cause a global death toll in the range of 2-million to 50-million people (307). Table 18 presents the main characteristics of the disease outbreak.

Disease	Avian Influenza
Virus	H5N1
Case fatality rate	Between 30-80% (308)
Transmission	Airborne (transmitted throughout air) Animal to human mostly Human to human is still inefficient
Number of cases	860
Outbreak duration	Since 1996
No. of countries infected	16 countries
Treatment	Experimental
Status of vaccines	Ongoing research

Table 18. Main characteristics H5N1 outbreak.

Even though influenza H5N1 was not a pandemic yet, there was an international response after Hong Kong notified WHO of the outbreak in 2003 (309). Many countries have enforced new systems of surveillance, complying with WHO guidelines[xxxviii] (175). In 2005, the WHO published the first document assessing the outbreak (310), giving steps towards more coordinated actions to fight the disease. The fear that this outbreak could escalate into a global pandemic also strengthened the influenza epistemic community. In 2004, the WHO created the WHO H5 Reference Laboratory Network as part of the GISRS, to increase surveillance of avian influenza (311). The network currently has 13 laboratories around the world.

The fear of a global spread of the disease when the disease re-emerged in 2003 increased because the outbreak fulfilled two out of three conditions for the occurrence of a pandemic (312,313)[xxxix]. This possibility motivated the creation of additional international, regional, and domestic mechanisms to manage the disease. Experts in epidemiology, emergency management, infectious diseases, surveillance, and laboratory specialists all became essential for policymaking. The relevance of the topic facilitated to incorporate more epistemic community members into relevant positions. For instance, in September 2005, the United Nations Secretary-General appointed the first UN System Influenza Coordinator "to support national, regional, and global efforts to address the threats posed by animal and pandemic influenza (314)". David Nabarro, the selected expert for this position, has been one of the most influential advocates for international collaboration to control this disease. He

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[xxxviii] The WHO released its first official pandemic influenza preparedness guidelines in 1999 (141). It provided a planning tool for countries to adpat and to be ready for future influenza pandemics (175). The guidelines emphasized the importance of creating national preparedness plans (322). The WHO modified the guidelines in 2005 and 2009, but, since the first version, the organization envisioned to create a global system ready to work in case of an outbreak.

[xxxix] These conditions are:

(i) The emergence of a novel virus
(ii) the new virus can replicate and cause diseases in humans,
(iii) the new virus is transmitted efficiently from human-to-human (313).

acted as a policy entrepreneur, promoting cooperation and calling for more investments in the area. As such, he was a key promoter of the international pledging conferences.

Other international organizations also incorporated programs and surveillance areas to prevent and manage future pandemic influenza, such as the Food and Agriculture Organization (FAO), the World Bank, the International Monetary Fund (IMF), the World Organization for Animal Health (OIE) (117,297). Along with this, other regional and sub-regional networks were created, including pandemic influenza as an essential topic in their agendas. Some of these are:

- The Global Health Security Initiative (GHSI) constituted in 2001 by the G-7 (Canada, Germany, France, Italy, Japan, the United States, and the United Kingdom) plus Mexico, the European Commission and WHO as an observer.
- The International Partnership on Avian and Pandemic Influenza (IPAPI), announced by the US President George W. Bush at the United Nations General Assembly on September 14, 2005.
- The North American Plan for Avian and Pandemic Influenza (NAPAPI) created in 2007 by the USA, Canada, and Mexico as part of the former Security and Prosperity Partnership (SPP).
- The APEC Health Working Group (HWG).
- The ASEAN Foundation Communication and Information Systems for the Control of Avian Influenza (CISCAI).

These networks incorporate professionals and experts in the different areas related to the containment, control, and management of influenza, institutionalizing their expert advice. Furthermore, these mechanisms have strengthened the epistemic community by providing a place for more interactions and exchange of information (Interviews 1, 2, and 3).

The fear of an H5N1 outbreak also increased the organization of international meetings outside the WHO, including multiple high-level meetings and expert forums related to avian influenza (Appendix E. Pledging Conferences on Avian and Human Influenza). The meetings were used by the epistemic community to mobilize financial and institutional resources to combat and control the spread of the disease to humans, as well as to promote more research and development[xl]. These meetings increased collaboration with policymakers to establish measures of control and management.

The outbreak of H5N1 allowed other epistemic communities to get involved, given that influenza pandemic has been considered an issue of national security, and the animal-human interface (animal to human transmission) has become more relevant to control and prevent zoonotic diseases in human populations. As an example, in July 2006 the WHO, the World Organization for Animal Health (OIE) and the Food and Agriculture Organization of the United Nations (FAO) launched the Global Early Warning System for Major Animal Diseases, including Zoonoses (GLEWS). The partnership created a network of experts on Animal Influenza from OIE and FAO working with WHO (175). Other fields have also included influenza in their agendas (303).

5.3 Influenza Outbreak H1N1-2009

In 2009, the WHO enforced for the first time the updated International Health Regulations (IHRs 2005) to respond to the outbreak of influenza A(H1N1). On April 12 (in compliance with these regulations), the Mexican government reported to the WHO Regional Office of the Americas [the Pan-American Health Organization (PAHO)] an increasing occurrence of cases showing a severe respiratory disease (274,315). Around the same time, the Centers for Disease Control and Prevention (CDC) in the United States announced that the US flu season exhibited some unique characteristics (316). Figure 13 shows the most important events during the first weeks of the outbreak.

[xl] According to the US Department of State as of December 2007, international pledges of avian and pandemic influenza assistance totaled US $2.7 billion.

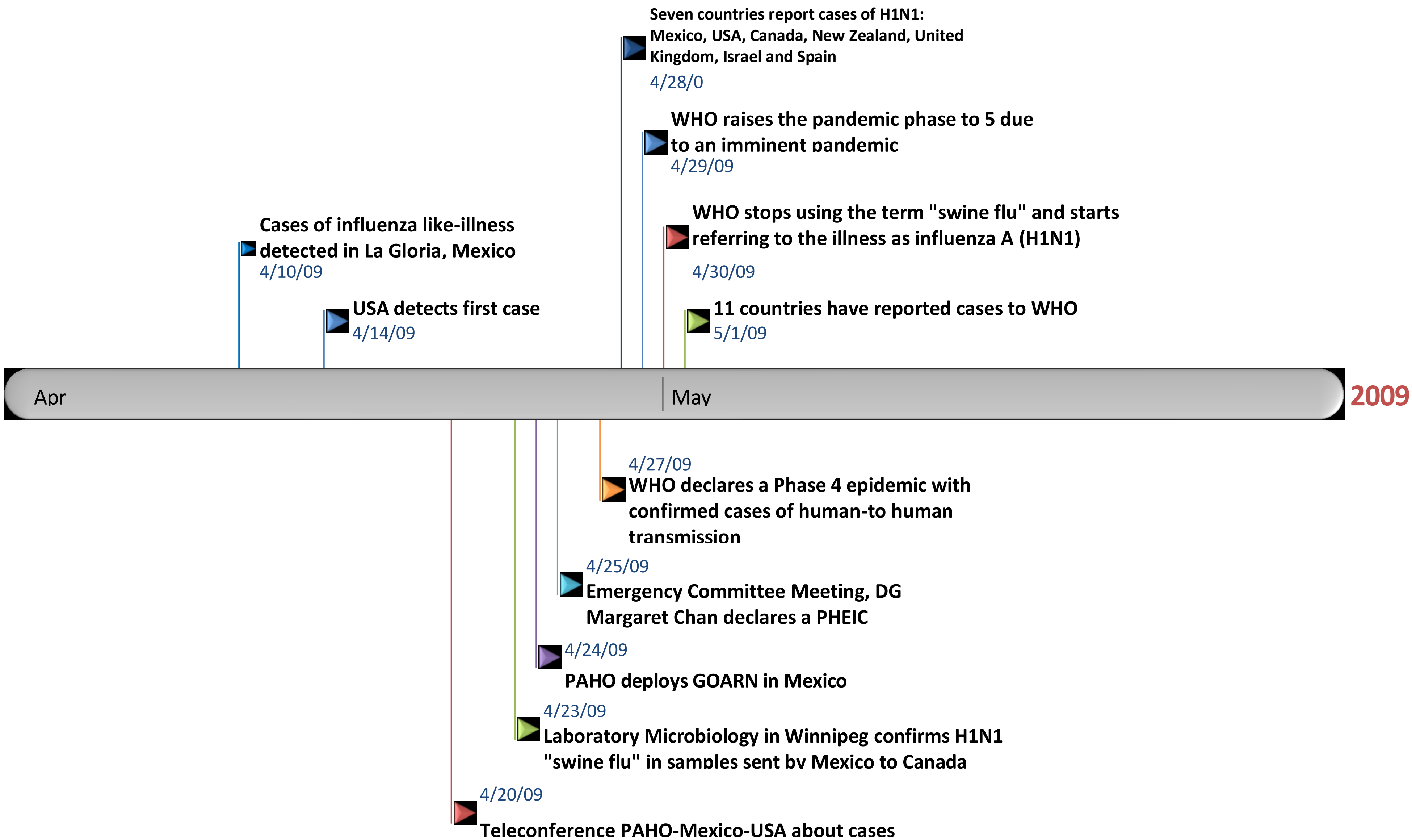

Figure 13. Timeline of events firsts weeks H1N1 outbreak. Sources: CDC Europe; Nature 2009; WHO 2011.

Early in 2009, the Mexican National System of Epidemiological Surveillance detected an abnormal influenza season and cases of severe pneumonia in some communities. Reports of an increasing number of young people with influenza-like symptoms admitted to hospitals led to discovering an influenza A type virus (317,318,315). The events activated the National Plan for Preparedness and Response during Influenza Pandemics, sending a national alert that increased epidemiological surveillance by requesting to all contact points to report any influenza-like case (317). The alert established a mandatory collection of samples and information at the local level. Data was necessary to understand the circumstances of the epidemic at the national level and to provide public health authorities with scientific evidence to asses the situation and establish measures to manage the outbreak (317,319).

The new influenza strain spread quickly among the population, and the WHO declared the pandemic a Public Health Emergency of International Concern (PHEIC) on April 25, 2009 (175). After this announcement, several countries reported more cases. Table 19 presents the characteristics of the 2009 influenza outbreak.

	H1N1 2009
Virus	Influenza
Death Rate	1%-2%
Reproductive Ratio	Between 1 and 2
Type of transmission	Airborne Human to human
No. of cases	More than 340,000 (Oct. 2009)
No. of countries	214 (Oct. 2010)
Treatment	Tamiflu
Vaccines	Available after six months

Table 19. Characteristics influenza 2009 A(H1N1) outbreak.

Mathematical models predicted that the outbreak could cause between 10 to 200 million cases (175). Young people, pregnant women, women who had recently given birth, and Indigenous people were at higher risk of severe illness and death (175). By August 2010, around 214 countries had reported more than 340,000 laboratory-confirmed cases of pandemic influenza A(H1N1) and over 18,449 deaths (320). Table 20 summarizes the number of deaths per region.

Region	No. of deaths*
WHO Regional Office for Africa (AFRO)	168
WHO Regional Office for the Americas (AMRO)	8533**
WHO Regional Office for the Eastern Mediterranean (EMRO)	1019
WHO Regional Office for South-East Asia (SEARO)	1992
WHO Regional for the Western Pacific (WPRO)	1858
WHO Regional Office for Europe (EURO)	4879**
Total	18449

*The number of deaths is estimated by the World Health Organization as of August 2010.
**The numbers might be underrepresented since not all cases were reported.
Table 20. Distribution of deaths by region 2009 A(H1N1) influenza outbreak. Source. WHO, GOARN.

After the PHEIC declaration, the WHO started to mobilize international action. The response was the result not only the implementation of new instruments for responding to pandemics, but it was also a consequence of previous planning and international coordination created as part of continuous international work in the field (321), and in which the epistemic community played a key role.

5.4 The Influenza epistemic community

Pandemic outbreaks require policymakers to confront the lack of knowledge of the scope of the problem and the expected outcomes, increasing their demand for technical expertise and specialized knowledge (143,297,49,25,26,176,145,53). During a pandemic influenza outbreak, experts' knowledge and information are the primary sources to create policies to manage and control the disease (297).

Many members of the influenza epistemic community were working in governments and international organizations during the emergency (94). All collaborated during the response, providing on-time information, evidence, and technical advice to formulate medical and non-medical interventions.

It is necessary to identify the epistemic community, its members, and their resources, to analyze how much influence an epistemic community had in the level of cooperation seen during the international response to the influenza outbreak of 2009. In the case of an influenza pandemic, such identification requires us to review its evolution along with the mechanisms that have become available for the participation of experts in the definition of national and international policies to manage and control the disease.

Although this research refers to a single community for pandemic influenza, numerous subgroups of actors across countries and regions participate in this community. However, all of them can be considered as part of one global epistemic community because they share a common interest, normative beliefs, causal beliefs, epistemological criteria. Table 21 summarizes these elements.

Common interest	To reduce the burden of seasonal and pandemic influenza.
Epistemological belief	Although members of the epistemic community have different backgrounds, they agree that the scientific method should guide evidence to create policies (evidence-based policies). They agree that influenza pandemics are unpredictable and recurrent. Therefore, the possibility of having a new pandemic influenza outbreak is real (Interview 1, 2, 5, 11) (322). Due to the unpredictable and uncertainty that influenza pandemics can be, they agree that learning from past pandemics is vital to be prepared and to manage a future outbreak.
Normative-principled beliefs	To reduce the number of deaths and human suffering due to pandemic influenza.
Causal beliefs	To find the best methods to identify new influenza viruses as well as the best interventions to reduce deaths and other costs associated with a pandemic, including the development of a vaccine (Interview 2).
Notions of validity	They have established norms, standards, and practices for the identification of influenza viruses as well as standard methods to carry out research and development of medical and non-medical interventions.

Table 21. The influenza pandemic epistemic community.

These are the unifying elements of all the experts working together to manage, control, and prevent future pandemic influenza outbreaks.

5.4.1 Characterizing the influenza epistemic community

There is *evidence of an epistemic community on influenza since the 1950s*. As a group, it has evolved, increasing its membership and connectivity inside and expanding its influence outside the network. The epistemic community has improved the universal knowledge about the disease and has been working on researching and developing the best medical and non-medical measures to control it.

This section applies the conceptual framework presented in Chapter 3 and measures three conditions of epistemic communities that are interrelated among themselves (knowledge, dissemination, the institutionalization of bureaucratic power), which will determine the influenza epistemic community's influence on the level of cooperation during the international response

5.4.1.1 Knowledge

The first condition refers to the knowledge created by the epistemic community, if the knowledge is consensual and if it has established a policy goal. The consensus in this community comes from decades of researching and examining influenza pandemics. Evidence-based medicine has allowed the epistemic community to create shared principled beliefs, causal beliefs, and common notions of validity in the management of influenza pandemic (94).

Dr. Andrewes published an extensive analysis of influenza outbreaks in Europe between 1948-1949. The document identified the different types of influenza viruses and their subgroups, and it established the difficulty of creating a single vaccine due to the heterogeneity of the strains (323). Another expert, Dr. T. Francis, reported on a vaccination campaign against influenza, also showing that vaccines failed to protect when they were made from different strains (324). The evidence collected in this research established the fundamentals to understand the behaviour of influenza viruses, the potential development and use of vaccines, and the management of outbreaks.

The WHO Influenza Programme, created in 1952, adopted the epistemic community's initial scientific consensus. M. M. Payne (as part of the Division of Communicable Disease at WHO) described that these experts' research helped to understand the "root of the problem (296)." These experts were also members of the WHO Influenza Centres (296) and their conclusions shaped the WHO Influenza Programme, including the importance of surveillance to detect early in the outbreak strains with pandemic potential (296). Thus, since the 1950s, scientific evidence and consensus have guided the development of international policies to fight influenza pandemics.

The study of influenza pandemics through history also established the *consensual agreement* that influenza viruses are unpredictable, that influenza pandemics will occur periodically, and that the global population is at risk (325,326,327,328,329,330). Therefore, early in the outbreak, measures must be implemented to contain and manage it.

The epistemic community has acted together, developing strategies and guidelines to identify, prevent, manage, and control an outbreak. This knowledge has expanded widely, and influenza is one of the few diseases with pandemic potential recognized broadly in the medical field, since "every practitioner knows what the flu is (Interview 5)." The epistemic community's work is relevant because it is possible to work in preparedness at all levels, which facilitates the implementation of measures during a pandemic outbreak (interview 12).

The Influenza epistemic community, guided by the previously established consensual knowledge, recognized early that the 2009 outbreak was caused by an unknown strain

[A(H1N1)], and therefore its behaviour, virulence, transmission capacity, origin and susceptibility to medicines were all unknown factors (317,331,332). Due to these characteristics, the epistemic community agreed on the pandemic potential of the disease and the need to implement a quick global response (175,317). This rationality guided the initial actions taken in the influenza outbreak.

The epistemic community's continuous collaboration also resulted in *establishing an explicit policy goal during the pandemic outbreak*: the creation of mechanisms for containing the influenza virus and limiting its worldwide spread (333,334,335). Its members underlined that containment and limiting the spread of the virus is necessary to develop a vaccine, which is the only known medical intervention that will effectively stop an outbreak (Interview 2,8). Thus, the network established a common goal due to its shared understanding of the problem and its consensual knowledge.

The evolution of the epistemic community's collaboration, the study of past pandemics, and the interest in preventing a new deadly pandemic brought the development of consensual knowledge and the establishment of a clear policy goal.

5.4.1.2 Socialization of ideas

The epistemic community's ability to influence the international response also requires disseminating *its consensual knowledge through channels that are accessible for policymaking*. Moreover, dissemination of accurate data and scientific evidence during outbreaks is essential for guiding an international response. Thus, most of the activities that guided the response to the influenza outbreak were possible due to the availability of scientific evidence. Members of the epistemic community had access to different mechanisms to transmit, share, and socialize their ideas, such as:

- Publications in scientific journals
- Participation in international conferences
- Providing evidence for technical guides
- Doing the research, analyzing the virus, collecting samples and producing epidemiological and laboratory data

Influenza experts have also developed a system for sharing data. The Consortium for the Standardization of Influenza Seroepidemiology coordinates the global community of researchers on influenza and in 2006, agreed on data sharing norms that facilitate on-time dissemination of data (110). In this case, the epistemic community tried to be as fast as possible in the provision of information that could improve the response and speed up the manufacture of a vaccine.

Several scientific journals also published about influenza during the outbreak. Using the search engine "google scholar," and searching for the words "h1n1 influenza outbreak 2009", the webpage reported 58,000 results. When in the web site, the time interval was specified to show only publications from the year 2009, the results changed to 4,700 (accessed April 10, 2018). Although these numbers may not be accurate, they provide an approximation of how experts disseminated their research and knowledge during the outbreak. Journals that published some of the most consulted studies included the *American Journal of Public Health,* the *British Medical Journal, Emerging Infectious Diseases*, *Clinical Infectious Diseases*, *Journal of Infectious Diseases,* the *Lancet*, *MMWR*, *Nature*, the *New England Journal of Medicine*, *PLoS One*, and *Science.*

The availability of producing and disseminating information per se does not influence the process if policymakers do not incorporate this knowledge into norms and regulations. In this case, the WHO has been the main channel for this, using many of the epistemic community's studies as the primary reference into working documents and policy papers that were published to guide the national and international responses (336).

The epistemic community also has a network *structure* that enables sharing its epistemic principles, values, and beliefs, and shared knowledge about the problem and solutions. The epistemic community includes people with technical and scientific expertise from all parts of the world, and different backgrounds, as well as experience in other areas relevant for influenza pandemic management (animal health, environment, food security, security, economy) (Interviews 2 and 9). In the 2009 A(H1N1) outbreak, it is possible to identify an epistemic community network at different levels and divided into subgroups *participating in the response*. Therefore, the analysis of the structure and integration of the network reveals three levels: global, regional or sub-regional, and national.

The global level. At this level, the epistemic community network collaborates directly with the WHO, as members of expert committees, government representatives, diplomats, and the organization's personnel. This research identifies its three main components: the GISRS, the GOARN, and the Global Initiative on Sharing All Influenza Data (GISAID)[xli]. These networks connected directly with the Influenza Emergency Committee. The principal component in the influenza pandemic epistemic community is the GISRS. In 2009, there were 136 National Influenza Centres (NICs) in 106 countries, including the WHO Collaborating Centres (274). Figure 14 presents the global distribution of the network.

[xli] There may have been other international networks of professionals and experts in influenza that participated in the outbreak. Because tracking all of the possible participants is not feasible, I have chosen those that have been better documented and that had the characteristics to be identified as part of the epistemic community.

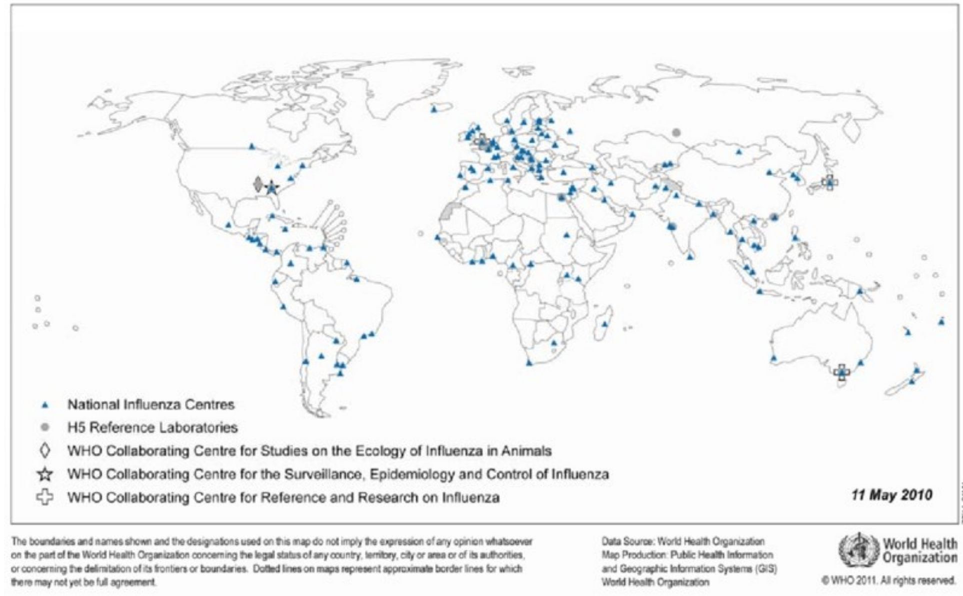

Figure 14. GISRS geographical distribution Influenza A(H1N1) outbreak. Source: WHO, 2010, (337).

The members of the GISRS meet twice a year primarily to analyze the information regarding the strains of the influenza virus detected during the year and to recommend the composition for the seasonal vaccine (338). Even though the people leading the centres change due to different circumstances, “several generations of scientists (338)” have been part of this network. The network’s primary responsibility was researching and developing vaccines; however, it became the most important source of data about all the aspects related to the virus, information that was disseminated worldwide (339).

The next component is the GOARN, which included members of the GISRS and other experts worldwide. The GOARN coordinated the international response mobilizing technical resources, institutional mechanisms, and deployed experts where they were required (274,340). These experts were deployed in different locations to assist the most vulnerable countries, with a total of 218 deployments (341). Whereas not all members of the epistemic community participated in GOARN, the network allowed the direct participation of some of them in some of the activities of the response.

A third element is the Global Initiative on Sharing All Influenza Data (GISAID), a public-private partnership. GISAID was launched in May 2008 in the World Health Assembly as an alternative mechanism for sharing viruses (for research and development of vaccines), given the previous controversies among states about the existing global system[xlii]. Two central bodies govern the initiative, a Scientific Advisory Council and Database Technical Group (342).

Finally, a fourth element is the Emergency Committee (EC). The WHO-DG organized an Emergency Committee (EC), as mandated by the IHRs 2005. The Influenza EC made decisions based on scientific evidence with political and financial consequences (274).

The regional and sub-regional levels. These are groups organized by regions or subregions, working in smaller networks that facilitate and expedite cooperation and exchange of information. In some cases, these networks have achieved a degree of integration within national health systems, allowing their counterparts in other countries to increase their knowledge about how the other national systems work and the resources they have available to confront an influenza pandemic. Some of these are also the networks created by the WHO regional offices. Therefore, they have their mechanisms and channels to connect at the global level and create synergies. Table 22 presents some of these networks.

[xlii] This initiative is part of the mechanisms created to solve the controversy started by Indonesia about virus sharing and its benefits that led to the PIP negotiation.

Network	Type	No. of Members
European Union Early Warning and Response System (EUEWRS)	Public-Governments and International Organizations	29
Pacific Public Health Surveillance Network (PPHSN)	Public-Private	21
EpiNorth, Europe	Public-Governments and International Organizations	10
Global Health Security Initiative (GHSI)	Public-Governments and International Organizations	10
EpiSouth, Europe	Public-Governments and International Organizations	
Southeast European Health Network (SEEHN)	Public-Governments and International Organizations	8
Middle East Consortium of Infectious Disease Surveillance (MECIDS)	Public-Private	6
Mercado Común del Sur (UNASUR)	Public-Governments and International Organizations	5
North American Plan for Avian and Pandemic Influenza (NAPAPI)	Public-Governments	3
APEC Health Working Group (HWG)	Public-Governments and International Organizations	20
ASEAN Foundation Communication and Information Systems for the Control of Avian Influenza (CISCAI) and Health Group (ASEAN H)	Public-Governments and International Organizations	10
Southeast European Centre for Surveillance and Control of Infectious Diseases (SECID)	Public-Private	19
Mekong Basin Disease Surveillance Consortium (MBDS)	Public-Private	6
South African Centre for Infectious Disease Surveillance (SACIDS)	Public-Private	8
East African Integrated Disease Surveillance Network (EAIDSNet)	Public-Private	5
Asian Partnership on Emerging Infectious Diseases Research (APEIR)	Public-Private	6

Table 22. Influenza networks.

The WHO has six regional offices that are an essential component of the regional segment. These offices are important actors connecting within regions and with other networks. Table 23 includes the name of the office and the number of members.

Regional Office WHO	No. of Country Members
Regional Office for Africa (AFRO)	48
Regional Office for the Americas (AMRO-PAHO)	39
Regional Office for South-East Asia (SEARO)	12
Regional Office for Europe (EURO)	53
Regional Office for the Eastern Mediterranean (EMRO)	23
Regional Office for the Western Pacific (WPRO)	34

Table 23. WHO Regional Offices.

During the influenza outbreak, the epistemic community worked through these networks, promoting collaboration among countries during the outbreak in places like North America, Asia, Middle East, and the European Union. Figure 15 presents the influenza networks' global membership by state.

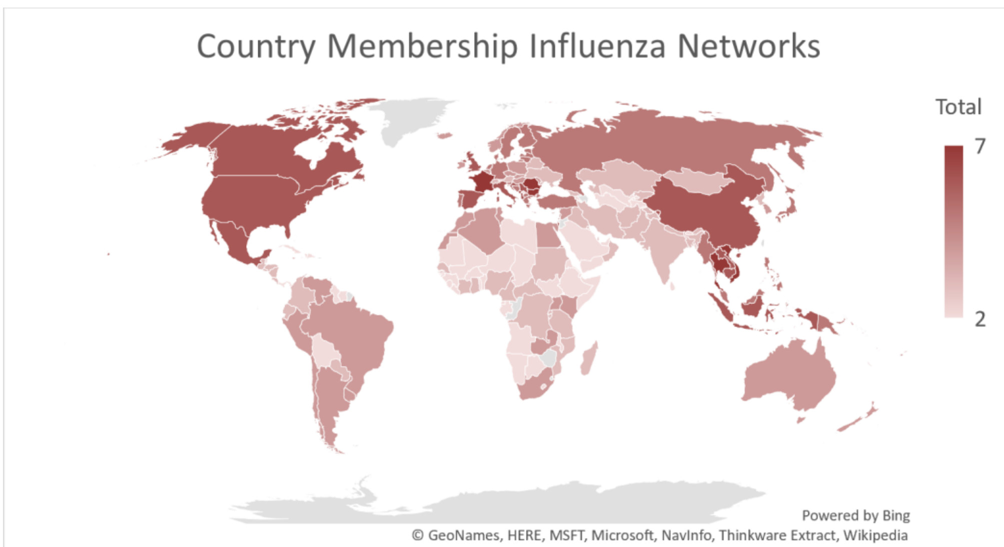

Figure 15. Geographical distribution of influenza networks' members

These networks were created after the H5N1 outbreak and strengthened the areas of preparedness and response to human and animal influenza.

The national-local level. The national-local level is composed mostly of professionals working for a local, state, or provincial Ministry of Health. These experts are epidemiologists, clinicians, laboratories, among others. They were key actors in the onset of the H1N1 outbreak, identifying influenza-like illness cases and notifying them to the national level (318,317,343,344,345,346). They managed and guided local and national responses and provided information about the outbreak.

In some cases, they were connected through national networks of surveillance, providing information to the national level. Local and national experts connect with the global level through two main mechanisms: international norms guiding pandemic preparedness planning and the National Influenza Centres (NICs) as part of the WHO Global Influenza Surveillance Network. The WHO encouraged the development of those national networks.

Influenza pandemic planning has been a slow process at the national level. However, all countries understand to some extent what to do during an outbreak (Interviews 1 and 2). In general, family doctors and nurses know what influenza is, the symptoms associated with it, and how to identify cases (Interview 2). Health services have protocols in place to address an epidemic associated with influenza. Because national planning has followed international guidelines, there is some degree of coherence and consistency in the way countries respond to an outbreak.

The WHO's Guidelines for National and Regional Planning have provided direction to states on how to prepare for pandemic influenza. They recommended establishing multidisciplinary National Pandemic Planning Committees to work together and develop a national strategy for a future influenza pandemic (347). In 2005, the updated guidelines incorporated lessons from SARS' experience (348). According to the WHO, before the H1N1 2009 influenza outbreak, 68 countries had developed a national plan under these guidelines (349).

These three levels form the influenza epistemic community. Its members interact and connect through different formal and informal mechanisms. Figure 16 represents the structure of the epistemic community and its interactions.

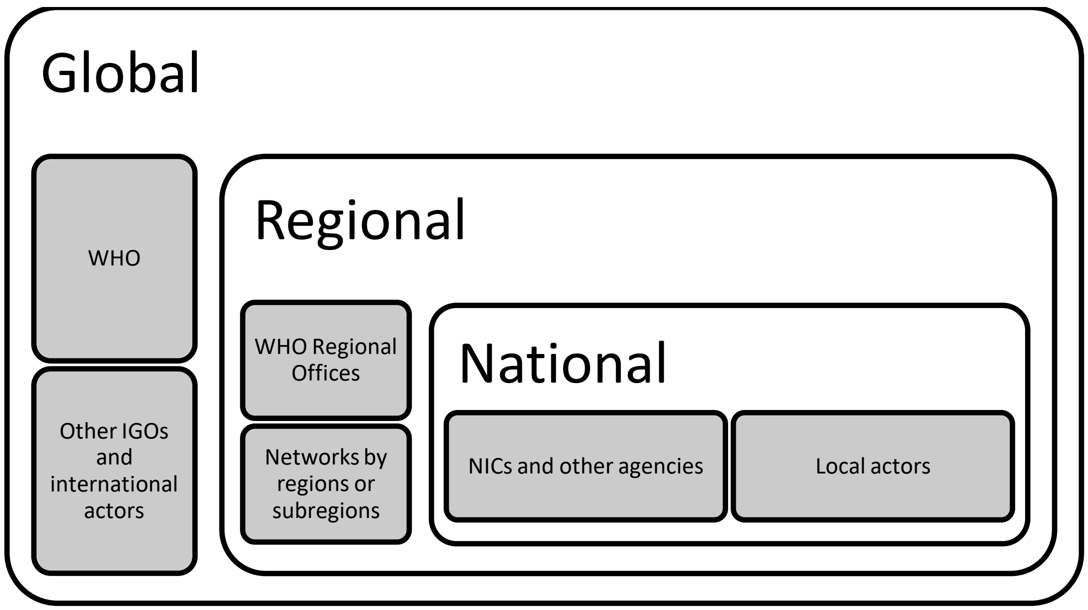

Figure 16. Structure, connections, and interactions of the influenza epistemic community.

The structure, therefore, facilitates communication, the transmission of knowledge and information within the epistemic community and with other actors.

5.4.1.3 Institutionalization of bureaucratic power

Even though there are mechanisms and opportunities for influencing decision-making as well as the implementation and formation of norms, the possibility of having direct participation in the policy process and institutionalize its bureaucratic power are fundamental for an epistemic community. The influenza epistemic community structure also facilitates its participation in the policy process and to amass bureaucratic power.

At the global level, the epistemic community's *participation in the policy process* is mainly through the Emergency Committee. The Influenza EC's Members were selected by the WHO based on their expertise and experience relevant to the event in areas such as acute respiratory syndromes, influenza, virology, epidemiology, laboratory practices, outbreak modelling, antiviral drugs, drug resistance, infection control, vaccines, airports, ports, aviation and maritime issues (175). The members of the EC were direct or indirect members of the other three networks (representing themselves or their institutions). Table 24 presents the list of members of the Emergency Committee and their connection to the other three groups.

Country	Member	Position	Institution	EC Influenza	GISN 2010	GOARN	GISAID
Pakistan	Muhammad Akbar Chaudhry	Principal, Professor of Medicine	Fatima Jinnah Medical College	1			
UK	**Neil Morris Ferguson**	**Department of Infectious Disease Epidemiology**	**Imperial College Faculty of Medicine**	**1**		**1**	
USA	**Nancy Cox**	**Director Influenza Division**	**Centers for Disease Control and Prevention**	**1**	**1**	**1**	**1**
Australia	John Mackenzie	Emergency Committee Chair, Professor of Tropical Infectious Diseases	Division of Health Sciences, Curtin University	1			
Senegal	**André Basse**	**Counsellor**	**Embassy of Senegal in France**	**1**	**1**	**1**	
Canada	Claude Thibeault	Consultant in Aviation Medicine and Occupational Health and Medical Adviser	International Air Transport Association (IATA)	1			
Canada	Anthony Evans	Chief, Aviation Medicine Section	International Civil Aviation Organization (ICAO)	1			
Chile	**Fernando Otaiza**	**National Infection Control Program**	**Ministry of Health**	**1**	**1**	**1**	
Ghana	Lawson Ahadzie	Former Head of Surveillance Department	Ministry of Health	1			
Mexico	**Rogelio Pérez Padilla**	**Instituto Nacional de Enfermedades Respiratorias "Ismael Cosío Villegas"**	**Ministry of Health**	**1**	**1**	**1**	
Thailand	Supamit Chunssuttiwat	Department of Disease Control, Ministry of Public Health	Ministry of Public Health	1			
UK	**John Wood**	**Division of Virology**	**National Institute for Biological Standards and Control**	**1**	**1**		
Japan	**Masato Tashiro**	**WHO Collaborating Centre for Reference and Research on Influenza**	**National Institute of Infectious Diseases**	**1**	**1**		**1**
UK	**Maria Zambon**	**Respiratory Virus Unit, Virus Reference Department**	**Public Health England**	**1**	**1**	**1**	
China	Wing Hong Seto		Queen Mary Hospital	1			
USA	Arnold Monto		University of Michigan	1			

EC Influenza: Emergency Committee Influenza; GISN 2010: Global Influenza Surveillance Network 2010; GOARN: Global Alert and Response Network; GISAID: Global Initiative on Sharing All Influenza Data.

Table 24. List Emergency Committee members and overlapping with other groups.

The centre of the global epistemic community was the Emergency Committee (EC) due to its connections with other groups, and that it was the main body advising the WHO during the outbreak. The Influenza EC held nine meetings during the outbreak and the aftermath. Each session required experts and government representatives to analyze the facts and assess the situation to determine actions to follow. In these meetings, other experts, officers from affected countries, and WHO's staff also participated, and consultations with headquarters and ministries would have occurred.

At the regional level, the identified regional and sub-regional hubs also connect the influenza epistemic community with the policy process. Members of these networks include government (Ministers of Health and Animal Health), international organizations, research institutions, universities, funding agencies. Therefore, experts have direct access to policymakers, strengthening personal and institutional linkages amongst those working in the health community and for increasing international cooperation (Interviews 1, 2, 12). Experts from these networks and countries, along with other professionals worldwide, worked together in the areas of surveillance, preparedness, and response to influenza pandemics. Therefore, they create connections at the institutional and personal levels.

At the national level, the National Influenza Centres (NICs), as part of the WHO GISRS, are a link between the national and international levels. During the onset of the outbreak, the epistemic community worked together to identify the virus and formulate measures for control, management, and containment. At the centre of this response was the NICs, which had the tools to detect the virus and notify it.

These centres are established by national governments to provide epidemiological surveillance and collect samples of influenza viruses. As part of the WHO GISRS, governments should provide the WHO with information about any influenza activity in the country and facilitate viruses' samples (350). To fulfill their duties with the organization, NICs rely on a national network of influenza surveillance, which provides the information they need to report to the global level.

During the 2009 outbreak, through these structures, the influenza epistemic community had direct participation in the policy decision making at the international, regional and national levels, providing the knowledge and analyzing the evidence to establish those measures that would help to manage the outbreak.

Members of the community have also long participated in expert groups and multiple international forums organized by governments and international organizations before, during, and after the outbreak, to assess the situation and to analyze the international response. The GISRS and NICs, along with the WHO Strategic Advisory Group of Experts on Immunization (SAGE) have traditionally provided advice to the WHO. These groups are the backbone of the Global Influenza Program (302). Using these groups as the pillars for the expert advice, the WHO organized the first group of experts in April 2009 to develop guidelines for clinical management of patients (336). This group interacted with policymakers through different meetings (336):

- WHO ad hoc scientific teleconference on the current influenza A(H1N1) situation 29 April 2009;
- WHO Technical Consultation on the Severity of Disease Caused by the new influenza A (H1N1) virus infections, May 5, 2009;
- WHO Strategic Advisory Group of Experts on Immunization (SAGE) held an extraordinary meeting on 7 July 2009 in Geneva, Switzerland (351);

- Joint Scientific Consultation on potential risks of pandemic (H1N1) 2009 influenza virus at the human-animal interface (WHO-FAO-OIE), June 3, 2009;
- WHO Scientific Consultation on the suspension of classes and restriction of mass gatherings to mitigate the impact of epidemics caused by the new influenza A (H1N1) (teleconference), June 24, 2009;
- Modelling Network Meeting, July 2009, Geneva, Switzerland (WHO 2009:1) Weekly Epidemiological Records;
- Infection Prevention and Control Network Meeting to share information on the revision of Infection Control guidance for H1N1. September 8-9, 2009;
- Global teleconference on virological monitoring of the pandemic H1N1 virus with GISN members, regional offices, and other experts. October 7, 2009;
- WHO Global Consultation on the Clinical Aspects of Pandemic H1N1 Influenza. October 14-16, 2009 Washington D.C. PAHO with the participation of more than 100 experts in different areas;
- Technical consultation with WHO CCs to update them on H1N1 virus characterization; antiviral susceptibility monitoring; diagnostic kit and protocols development, availability, and distribution; and vaccine viruses and reagents, their development, availability, and distribution, November 3, 2009;
- 2009 meeting of National Influenza Centres, December 1-4, 2009, Geneva, Switzerland;
- WHO Consultation on the suspension of classes and restriction of mass gatherings to mitigate the impact of epidemics caused by influenza A (H1N1), teleconference, May 2009 (352).

These meetings were necessary to establish guidelines, make recommendations, provide updates on research and development, and deliver information that guided the Emergency Committee, the WHO and its member states during the response. Therefore, the epistemic community had a direct influence on the process and gained institutional power to provide advice.

Other consultations also increased the influence of the epistemic community members creating spaces where they interact with other key players and provided information and advice. In these fora, they were part of national delegations and international organizations, which gave them increased access to the response and the decision made in this area. Table 25 presents some of the most critical meetings.

Meeting	Date and location	Description
The High-level Consultation on Influenza A(H1N1)	May 2009, Geneva, Switzerland	It was held during the 62^{nd} World Health Assembly.
The Special Meeting on Pandemic (H1N1)	September 2009, Brussels, Belgium	
The Influenza A(H1N1) Lessons Learned on Influenza organized by the Minister of Health of Canada, Secretary of Health of the USA, and Secretary of Health of Mexico.	July 1-3, 2009, Cancun, Mexico	The conference had a high-level meeting with the participation of 40 countries and a conference with experts in different areas (surveillance, laboratory, vaccines, prevention, among others) (353).
The academic journal *The Lancet* organized an international conference, after the International Scientific Symposium on Influenza A (H1N1) Pandemic Response and Preparedness, organized by the Ministry of Health, China.	August 22-23, 2009, Beijing, China	The conference had more than 900 delegates from 20 countries, and its main goal was to update scientific knowledge about both seasonal and pandemic influenza (354).

Table 25. Meetings Influenza A(H1N1) 2009

These meetings increased the epistemic community access to the policy process, and its members influence the definition of measures.

After analysing all the previous characteristics, it is possible to conclude that during the Influenza A(H1N1) outbreak, an active Influenza Epistemic Community participated. It institutionalized its bureaucratic power, and it was capable of contributing to the decision-making process at the local, national, and international levels, and to influence international cooperation. Table 26 summarizes these characteristics.

	Indicator	Influenza
1. Knowledge	Agreement on a common definition of the problem and possible solutions	The community had a consensual agreement before the outbreak.
	Clear identification of a common policy goal	They had a common goal to control and contain the spread of the influenza virus in a short period.
2.Socialization of ideas	Structure	The epistemic community is a loose structure with different nodes and where the WHO is an important participant. The size of the network extends to all the world. It has a broad global international representation at all levels and includes professionals from different areas.
	Dissemination mechanisms	They disseminate their knowledge through scientific publications, conferences, and other meetings.
	Participation in the international response	Many members of the Epistemic Community participated in the international response as members of international organizations (such as GOARN) and governments.
3. Institutionalization of bureaucratic power	Participation in the policy process.	Members of the epistemic community participated in groups of experts and committees, directly influencing the policymaking process.
	Experts and other professionals from the epistemic community in decision-making positions	The epistemic community had many members in crucial positions. They were also members of the Emergency Committee, the main body at the WHO providing advise for the international response.

Table 26. Characteristics influenza epistemic community.

The following section will examine how this epistemic community interacted and participated in the international response to the influenza outbreak.

5.5 The international response and the influenza epistemic community

A global system of influenza governance was in place by the time of the 2009 influenza outbreak, and the integration of an influenza epistemic community into this system facilitated the transmission of information, analysis of the situation, and timely notification of the emergency response. Figure 17 summarises the participation of the influenza epistemic community in the process of the international response.

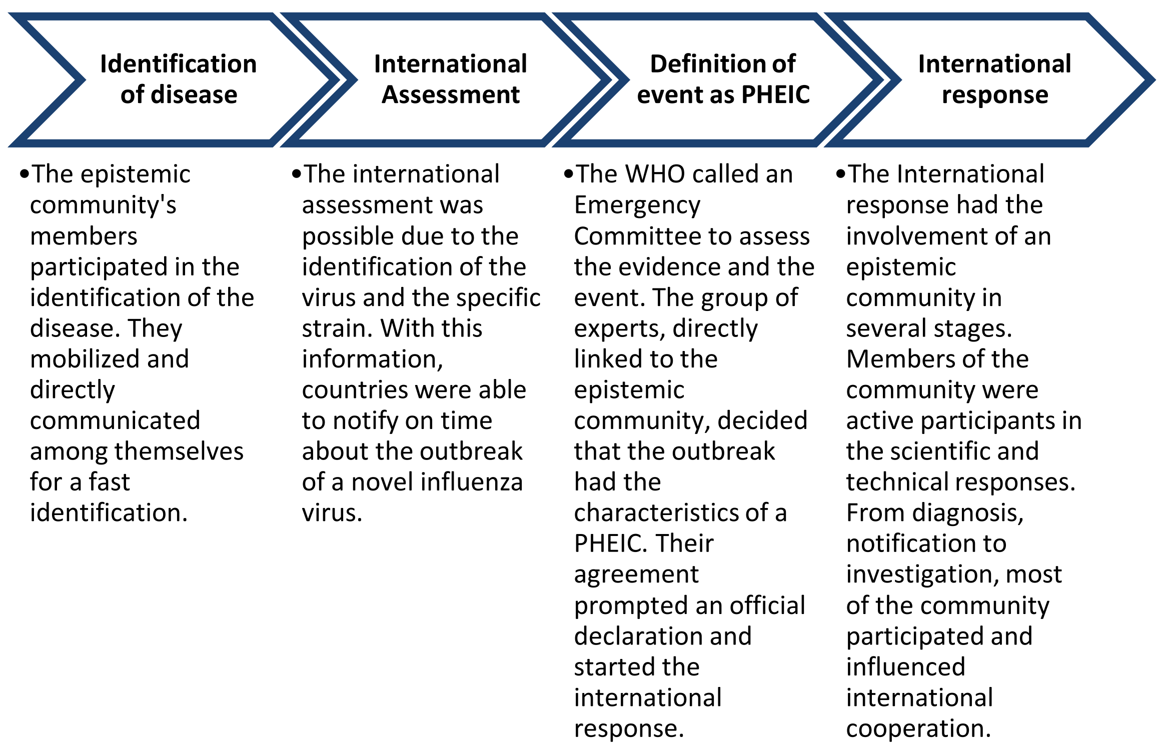

Figure 17. Participation of the influenza epistemic community in the international response.

Mexico and the United States were the first countries to notify cases of a new strain of influenza (346). Mexican national capacities for identification of the virus, however, were inadequate and insufficient (355). Due to these circumstances, the Head of the National Laboratory in Mexico sent electronic communications to the Head of the Winnipeg National Microbiology Laboratory in Canada, notifying him about the evidence of an unknown influenza virus circulating in Mexico[xliii]. These officers had previously developed a professional and personal relationship. The heads of the laboratories participated in the GISRS as NICs and in groups such as the North America Plan for Avian and Pandemic Influenza (NAPAPI), the Global Health Security Initiative (GHSI), and other expert groups and governing bodies at the WHO (Interviews 1 and 3). They were part of a broader epistemic community devoted to working on issues related to an influenza pandemic. Appendix H presents the full list of people identified as part of the epistemic community, including the people that started the process of identification and notification of the virus.

The communication between the two heads of the Canadian and Mexican Laboratories underlines the close relationship and a level of confidence between two professionals and experts on the topic. These government representatives built trust and mutual understanding before the outbreak, due to their continuing interactions through the epistemic community (Interviews 1, 2, 6, 7). Therefore, the Mexican officer could directly talk to his Canadian colleague about the situation in Mexico[xliv] and asked him to analyze samples of the virus in his laboratory. The Canadian health officer offered full cooperation and the assistance of the microbiology laboratory in identifying any samples sent to Canada from Mexico (316). Afterward, Mexico also received support from the head of the Influenza Program in the US CDC in Atlanta, the designated collaborative centre in the WHO laboratory network for influenza for the Americas (316). Flu samples from Mexico arrived

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[xliii] There was an exchange of e-mails between personnel from the Microbiology Lab in Winnipeg and the Secretariat of Health in Mexico in this critical stage of the epidemic.
[xliv] Celia Alpuche, e-mail message to Frank Plummer, April 17, 2009.

in Winnipeg on April 22, 2009. In six hours, the Canadian laboratory confirmed that the specimens contained a novel strain of influenza virus A (H1N1) with a swine virus component. On April 23, in a tri-national call conference among the heads of the three laboratories, the CDC confirmed that samples collected in California showed the same virus (316). Communication among the agencies and the experts was essential to determine the following steps and notify at the global level. During his speech to the 62nd World Health Assembly of 2009, the Mexico Minister of Health acknowledged the work and collaboration of the network of professionals from Mexico, Canada, and the USA in identifying the virus and informing the international community. He also recognized that due to these experts, Mexico could notify the outbreak on time, complying with the IHR 2005 (356).

The identification of the virus allowed the Government of Mexico to determine the gravity of the situation and which actions to implement. On April 23, the government made an official announcement and established the measures to limit and contain the outbreak (355,317). The international community recognized the government of Mexico for acting with transparency (357). The WHO also contributed to a fast collection, sharing, and analysis of data through the Event Management System (EMS). During the first days of the emergency, the system registered 305 users from around the world (336).

After the USA and Mexico notified WHO of the outbreak, the WHO Director-General organized for the first time an Emergency Committee[xlv] on April 25, 2009, with the participation of experts selected by the international organization and representatives of the

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[xlv] The rules to establish an Emergency Committee are stated in the IHRs 2005, Article 48.

most affected countries at that moment (USA, Canada, and Mexico). On the same day, the EC members agreed that, following the IHRs Article 12, the situation constituted a "Public Health Emergency of International Concern (PHEIC)." With the official declaration, the WHO requested all the NICs to be alert and to inform of any other outbreak. The following days more countries started notifying the presence of severe influenza illness, and later more countries confirmed the presence of the H1N1 virus in their territories.

With the PHEIC declaration, the international response officially started. The Americas mobilized the response through PAHO/WHO and GOARN. This network also coordinated response planning with the World Organization for Animal Health (OIE), the United Nations Food and Agriculture Organization (FAO), the Regional Office for the Western Pacific WPRO/WHO, and the Regional Office for the Eastern Mediterranean EMRO/WHO. By May 2009, the WHO published the Influenza A(H1N1) Global Pandemic Response Plan, with specific guidelines for the management of the outbreak (336).

The WHO and the UN System Influenza Coordination made an initial assessment of needs in countries requiring assistance. The assistance targeted two main areas: access to essential medicines and strengthening health systems. The WHO provided 4.7 million treatments of Oseltamivir to 128 countries (358) and established a mechanism to provide vaccines. The WHO delivered more than 70 million doses to 79 countries (358), along with other medical supplies and technical assistance. The second target included training of health workers, support for the development of operational plans for vaccine campaigns, and equipment supply. Mexico immediately received technical assistance from the WHO/PAHO and other countries around the world (317,336).

On April 29, 2009, the Antiviral Task Force was established to oversee the deployment of the Rapid Response Global Stockpile (336) located in Switzerland and the USA. On May 7th, 2009, the first shipment of antivirals arrived in African countries, and the last one was delivered on May 25th, 2009. The continued provision of supplies occurred between May and October 2009 (336). The assistance included 1,000 treatment courses to 46 African countries and 10,000 more that were made available to the Inter-country support teams in the region (336). The WHO assisted 62 least developed countries in procuring critical supplies, and equipment to build laboratory capacities (336)

Along with the material resources, financial assistance also spurred after the declaration. Donors provided around 1.2 billion in 2009 (359). The WHO and regional offices also received funds to respond, reaching a total of $137,126,601 during the pandemic (359), even though there was a shortage of funs to cover the total needs in all areas (359).

On May 4th, 2009, Dr. Margaret Chan, the WHO DG, briefed the UN Secretary-General and General Assembly on the H1N1 influenza situation. She emphasized the importance of scientific and technical knowledge to back up decision-making during the pandemic (360). In June of the same year, she recognized that the situation created "a demand for advice and reassurance in the midst of limited data and considerable scientific uncertainty (361)." Experts, therefore, became central in the response and provided information in four main areas: epidemiological, clinical, vaccine-drugs, and modeling (175).

The epistemic community contributed to determining the severity of the disease, the type of immunity in certain groups of the population, and to predict the speed at which the virus spread, leading to a rapid response by the international community. The epistemic community also helped answer some difficult questions such as the type of population that had to be vaccinated or if the vaccine that did not go through all the formal testing procedures had to be available immediately (Interview 12). Thus, the international response was guided for the experts' consensus, and the need to implement quick actions to avoid the worst-case scenario increased the demand for experts at different levels. In Mexico, where the outbreak started, the National Committee for Epidemiological Surveillance agreed the situation was of concern because of the characteristics of the disease (175). With the information provided by the National Committee, the President of Mexico ruled that the Minister of Health was in charge of dictating and implementing all the measures to confront the epidemic in the country. This instruction gave the specialized agency the power to guide the national response, coordinating actions with other domestic agencies, governments, and international organizations (362). The President also requested a special advisor to collaborate directly with the Ministry of Health and to work as a liaison for the presidential office (Interview 1). The advisor, a former public officer with previous experience working in influenza, was also a member of the epistemic community through the WHO and other sub-networks.

In the USA, the case was similar. The CDC identified the virus in the US territory and notified the WHO. In late June 2009, President Obama requested that his Council of Advisors on Science and Technology (PCAST) prepare an assessment of the 2009-H1N1 influenza A pandemic and the nation's response (346).

At the global level, the United Nations Secretary-General emphasized the World Health Organization's role as the agency leading the international response and requested the UN Member States to continue following the advice of this organization (363). The worldwide expectation that a new influenza pandemic could potentially cause millions of deaths in a matter of days made the WHO request expert consultations and international meetings to determine the course of action (274). Governments and the WHO knew about the threat that an emerging virus posed for the world, and they decided to implement measures based on the already available knowledge about influenza viruses (175,317).

The epistemic community worked through the WHO as its primary advisor. Early in the international response, it established the importance of decision making based on scientific evidence (363). The network of experts assisted in determining the steps to follow and the way the international organization would perform and use its resources. The main representatives of the epistemic community were in the Emergency Committee. Decisions made by this committee and experts in the world guided the response led by the WHO and the recommendations provided to the international community. The WHO ensured that scientific principles and available scientific evidence were behind all its actions (175). Table 27 presents the summary of statements made by the DG-WHO, where she refers to decisions under the advice of the experts from the EC and other expert advisors.

After the Emergency Committee's 4^{th} meeting (June 11, 2009), the WHO declared the outbreak to be a global pandemic. This decision was a consequence of a consensual agreement that the virus had reached a pandemic status since it had spread across geographical regions (175,364,276).

Meeting / Speech	Statement (Abstract)
Statement after the first meeting of the Emergency Committee was held on Saturday, 25 April 2009.	"After reviewing available data on the current situation, Committee members identified a number of gaps in knowledge about the clinical features, epidemiology, and virology of reported cases and the appropriate responses. The Committee advised that answers to several specific questions were needed to facilitate its work. The Committee nevertheless agreed that the current situation constitutes a public health emergency of international concern. Based on this advice, the Director-General has determined that the current events constitute a public health emergency of international concern under the Regulations".
Statement after the Second meeting of the Emergency Committee held on 27 April 2009.	"On the advice of the Committee, the WHO Director-General decided on the following. The Director-General has raised the level of influenza pandemic alert from the current phase 3 to phase 4. The change to a higher phase of pandemic alert indicates that the likelihood of a pandemic has increased, but not that a pandemic is inevitable. This decision was based primarily on epidemiological data demonstrating human-to-human transmission and the ability of the virus to cause community-level outbreaks".
Influenza A(H1N1) Statement by WHO Director-General, Dr. Margaret Chan 29 April 2009	"Based on an assessment of all available information, and following several expert consultations, I have decided to raise the current level of influenza pandemic alert from phase 4 to phase 5".
The world now at the start of 2009 influenza pandemic Statement to the press by WHO Director-General Dr. Margaret Chan 11 June 2009	"I have conferred with leading influenza experts, virologists, and public health officials. In line with procedures set out in the International Health Regulations, I have sought guidance and advice from an Emergency Committee established for this purpose. On the basis of the available evidence, and these expert assessments of the evidence, the scientific criteria for an influenza pandemic have been met. I have therefore decided to raise the level of influenza pandemic alert from phase 5 to phase 6".

Table 27. Statements WHO Director-General during A(H1N1) pandemic. Based on different sources (365)

The Emergency Committee agreed on other recommendations that were issued by the WHO. Table 28 presents a summary of the temporary recommendations issued by the Influenza Emergency Committee during the pandemic.

Date	Recommendation
25 April 2009	"Concerning public health measures, in line with the Regulations, the Director-General is recommending, on the advice of the Committee, that all countries intensify surveillance for unusual outbreaks of influenza-like illness and severe pneumonia."
27 April 2009	"The Director-General recommended not to close borders and not to restrict international travel. It was considered prudent for people who are ill to delay international travel and for people developing symptoms following international travel to seek medical attention." "The Director-General stressed that all measures should conform with the purpose and scope of the International Health Regulations."
24 September 2009	"Having considered the views of the Emergency Committee, and the ongoing pandemic situation, the Director-General determined it was appropriate to continue these temporary recommendations, namely: • Countries should not close borders or restrict international traffic and trade; • Intensify surveillance of unusual flu-like illness and severe pneumonia; • If ill, it is prudent to delay international travel; • If ill after travel seek care."
26 November 2009	"Having considered the views of the Emergency Committee, and the ongoing pandemic situation, the Director-General determined it was appropriate to continue all three temporary recommendations, namely: • Countries should not close borders or restrict international traffic and trade; • Intensify surveillance of unusual flu-like illness and severe pneumonia; With an updated third recommendation, namely: • If ill, it is prudent to delay travel."
24 February 2010	"Having considered the views of the Emergency Committee, and the ongoing pandemic situation, the Director-General determined it was appropriate to continue the three temporary recommendations, as modified, namely: • Countries should not close borders or restrict international traffic and trade; • maintain surveillance of unusual flu-like illness and severe pneumonia; • If ill, it is prudent to delay travel."

Table 28. Recommendations Influenza Emergency Committee.
Source: Report of the Review Committee on the Functioning of the International Health Regulations (2005) about Pandemic (H1N1) 2009, 5 May 2011, Document A64/10, WHO, p. 77 (175)

The adoption of the knowledge developed by the epistemic community was also possible for the quick dissemination of information and research — the WHO consistently reminded governments that scientific evidence had to guide the implementation of measures (290). Most governments and international organizations kept track of publications relevant to the outbreak in real-time, to have the most up-to-date information available for quick decision-making. To establish the importance of publishing and dissemination of data for the decision-making process during the outbreak, table 29 provides a sample of organizations that have in their websites reports directly referencing to the available research during the pandemic outbreak.

Organization	Level	Reference
World Health Organization	Global	Pandemic (H1N1) Guidance Documents (366)
European Centre for Disease Control and Prevention	Regional	2009 (H1N1) Influenza Pandemic (367)
US Centers for Disease Control and Prevention	National	Epidemiological Publications Related to the H1N1 Pandemic by CDC Influenza Division, Epidemiology and Prevention Branch Authors (368)
Ontario Agency of Health Protection and Promotion'	Local	H1N1 "The Literature" – this week at a glance June 5, 2009 (369)

Table 29. Sample of organizations publishing scientific references during the 2009 A(H1N1) outbreak.

Given the extent of the influenza epistemic community, it is impossible to track every single publication related to the influenza outbreak made by its members. Table 30 presents a sample of members from the epistemic community and the number of publications during the pandemic outbreak.

Expert[xlvi]	Affiliation	No. of publications[xlvii]
Nancy J. Cox **EC Member**	US Centers for Disease Control and Prevention WHO Reference Laboratory	60 (2009-2010)
Rogelio Pérez Padilla **EC Member**	National Institute for Respiratory Diseases, Mexico	27 (2009-2010)
Maria Zambon **EC Member**	Public Health England	53 (2009-2010)
Fernando Otazia **EC Member**	National Infection Control Program, Chile	11 (2009-2010)
Francis A. Plummer	Microbiology Laboratory, Canada WHO NIC	2 (2009-2010)
Celia Alpuche Aranda	Institute for Diagnosis and Epidemiological Reference WHO NIC	20 (2009-2010)

Table 30. Number of publications during the influenza outbreak selected experts. Source: Google Scholar

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[xlvi] Dr. Plummer and Dr. Alpuche facilitated cooperation between Canada and Mexico for the identification of the virus early in the outbreak

[xlvii] It refers to publications in peer reviewed journals, books or collaborations in scientific magazines.

The Global Influenza Programme (GIP-WHO) organized a global consultation to develop a public health research agenda for influenza with more than 150 participants (public health decision-makers, researchers, and representatives from 76 institutions in 37 countries) (336). Besides, the WHO published a list of 59 guidance documents during the response, all of them providing scientific evidence and technical data from professionals in the area of influenza pandemics and response to emergencies (370). Many of them made a direct reference to scientific literature produced by members of the epistemic community. As an example, on April 28 the WHO published the "CDC protocol of real-time RT-PCR for influenza A(H1N1)", the CDC is one of the WHO Collaborating Centres for Influenza and Dr. Nancy Cox, Head of the Centre and Influenza Program at the CDC, was one of the Emergency Committee members. The WHO published other documents, with direct policy implications, based on research coming from the epistemic community, such as the document "Characteristics of the emergent influenza A (H1N1) viruses and recommendations for vaccine development" (May 29, 2009). The report included as primary reference the study: "Pandemic Potential of a Strain of Influenza A (H1N1): Early Findings (331)" whose authors included people from Mexico who sent the virus samples to Canada and the USA, personnel working at the Global Influenza Programme from WHO and the Imperial College London.

Dissemination of information was also possible to the connections and structure of the network. The epistemic community at the three levels (national, regional, and global) simplified the exchange of information from the beginning of the outbreak and allowed a faster identification of the strain as well as its notification. Cooperation among Mexico, the United States, and Canada was possible because the officers of these countries had been working together in different influenza networks, as part of the pandemic influenza epistemic community (Interviews 1, 2, 11, 12). They have had constant interactions as a result of their participation in networks such as GISN, NAPAPI, GHSI, APEC, PAHO, and the WHO (68) (317).

The epistemic community was also directly involved in the international response at the operational level through two central bodies: GOARN and GISRS. The GOARN coordinated the international response at the technical level and facilitated the travel of experts to countries for investigating and controlling the outbreak (274). Over 44 partner institutions worldwide supported GOARN, which deployed 208 missions to 27 countries (341,336). Appendix F presents the list of partners, which include members of the National Influenza Centres, governments, universities, international organizations, and research institutions. The first responder was GOARN, who called experts from all around the world to help countries. WHO/PAHO provided technical assistance on infection control, field epidemiology, and risk assessment (336). GOARN worked with 44 partner institutions worldwide (336), deploying around 208 missions to 27 countries with 3288 person-days (336,341).

The GISRS provided the “scientific foundation for many response measures” (336). The network with participants in 99 countries (including the National Influenza Centres, WHO Collaborating Centres for Reference and Research on Influenza, Essential Regulatory Laboratories, and WHO H5 Reference Laboratories) provided updated information about laboratory assays and reagents, analyzing the epidemiological situation and vaccine recommendations (336).

Mexico (the least developed of the three most affected countries) received technical cooperation to identify the virus immediately after notifying the situation[xlviii]. This step was crucial in determining the measures to be followed during the international response — the WHO deployed the GOARN, providing technical and material assistance to manage the outbreak. There was an essential exchange of information worldwide, and flows of financial assistance increased to those countries that needed to invest in national capabilities for managing infectious diseases[xlix]. In response to the outbreak, the international community was able to put in place and test the effectiveness of the new IHRs, created after the SARS and H5N1 outbreaks.

Surveillance was a core issue during the outbreak, given the existing regulatory framework and the infrastructure already in place to manage seasonal influenza. According to Castillo-Salgado, "the WHO, with the assistance of international collaborative centres and recognized academic and scientific leaders, prepared specific guidelines for the surveillance of human infection with influenza A(H1N1) virus. The use of networks and the internet has facilitated in a few hours the rapid dissemination of these guidelines around the globe (371)."

The epistemic community also institutionalized its bureaucratic power due to its participation directly in the NICs, committees, and expert groups. During the outbreak, this

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[xlviii] The WHO sent a group of experts from GOARN to support different areas. Experts from Canada and the CDC went to Mexico to set up real-time PCR technology[xlviii] to directly test for H1N1. In addition, they also trained Mexican molecular biologists in different states to work with the PCR machines[xlviii]. The Canadian-United States expert team included two people from the Winnipeg National Laboratory of Microbiology, three epidemiologists, two laboratory technicians, and one logistic advisor from CDC Atlanta[xlviii]. The United States provided the funding and technical assistance for the construction of a new National Laboratory BSL-3 (Biosecurity Level 3), which will improve Mexico's future capabilities in disease research.

[xlix] This cooperation included US$0.68 millions under the concept of development assistance in 2010 to build laboratory capacities (DAC 2013). Other countries provided financial assistance as well. Australia provided a significant amount of money to support actions in South Asia.

power was strengthened through the epistemic community's participation in international fora to discuss and analyze the events as well as to define future measures. The WHO and national governments organized these meetings, which were vital for international coordination and collaboration. For instance, in May 2009, under the celebration of the 62nd WHA, the WHO organized the High-Level Consultation on New Influenza A (H1N1). The meeting had as main speakers the Minister of Health of Canada, the Secretary of Health of Mexico, and the Secretary of Health and Human Services of the USA. All WHO member states were able to send at least one representative to the session[1]. There, members of the epistemic communities (in their different roles- representing governments, international institutions, or the WHO experts) had direct access to the governance process at the global level and were able to participate in discussions directly. In this meeting, the WHO underscored the importance of ″having good data for decision-making″, and it advised on the importance if policy ″to be based on scientific evidence″ (290).

Derived from that meeting, the governments of Mexico, Canada, and the US organized another High-Level Consultation in Cancun in June 2009, creating another venue for an exchange of information between experts and policymakers. Their consultation included a high-level meeting and a technical conference. There were 40 Ministers of Health and representatives from other countries and international organizations. Appendix G shows the number of participants in this meeting by country or organization. The technical/scientific agenda included workshops and round tables by leading experts on the topics. There were

[1] The meeting was part of the 62th WHA Agenda. Thus, it is not possible to have a specific list of participants since all of them were part of the official delegations.

side meetings, including a GHSI Senior Officials encounter and a high-level NAPAPI meeting[li]. The Director-General of the WHO, Margaret Chan, attended this meeting along with other WHO officials. PAHO sent a delegation of 20 people, including its Director. In her address, the DG-WHO again emphasized the importance of policies guided by scientific advice, mentioning to the participants that:

> *"We have the advantages of science, and of rational and rigorous investigation, on our side, supported today by tools for data collection, analysis, and communication that are unprecedented in their power"* (372)

These high-level meetings facilitated direct interaction with key actors, and among the members of the epistemic community, and it helped with the dissemination of the epistemic community's research and knowledge.

Even though the epistemic community had a role in the response, its influence had some limits. The H1N1 influenza outbreak showed the realities of not having enough global capacity to supply vaccines during a pandemic. Due to limited availability, only those countries with resources and adequate production facilities (private or public) had access to vaccines in a prompt manner (373). The WHO, working with the scientific community, tried to address this issue years before the 2009 outbreak.

They established some guidelines to increase production and to make more efficient the distribution of vaccines to vulnerable populations (374). The vaccine was developed in the late spring-early summer of 2009. By then, pharmaceutical companies manufacturing it had already committed all their production to countries in Europe, the USA, and Canada. The

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[li] Information was obtained by the Mexican Government through the Access of Information Law.

WHO established the WHO Pandemic Influenza A(H1N1) Vaccine Deployment Initiative to mobilize donations and to buy and supply the vaccine for developing countries (336). Thus, manufacturing companies and countries sourced some vaccines to the organization. The world demand was estimated in 4.9 million doses, but by December 2009, only 500 million had been produced (336). Given the demand and the limited production capacity in the world, many countries had to wait longer to access the vaccine (175,375). The countries assisted by the WHO got the donations by December 2009, when developed countries had already started vaccinating their populations. The developed countries that got the vaccine first failed in donating it to the WHO (346).

The problem was not only to produce a vaccine in a short time but that vaccine production concentrated in a group of developed countries and that some countries secured contracts with companies to ensure access to the vaccine in case of a pandemic outbreak (374). Due to this problem, the epistemic community maintained the importance of distributing vaccines to vulnerable people to control the outbreak. Politics, driven by commercial and national interest, ignored the scientific advice and manufacturing companies sold their first stocks to developed countries that had a previous contract with them, regardless of their level of vulnerability. Instead of following a medical and scientific rationale, it was the international market (supply and demand) as well as the fear of the domestic consequences that guided the distribution of these products. Whereas developing countries were trying to access the vaccine, in countries where the vaccine was available, people refused to get it due to the fear of getting ill and the possible side effects (376). An adverse reaction to the vaccine occurred in almost all developed countries, even when experts argued that those vaccines were safe and a critical element to contain the outbreak.

There were other areas when governments did not follow the epistemic community's advice. Some countries imposed trade barriers to pork products against experts' advice. An early analysis of the virus showed that it had initially circulated among pigs. Therefore the H1N1 virus was initially named "swine flu" (377,175). Experts researching the influenza animal-human interface from different countries and international organizations, such as FAO and OIE, declared that eating pork meat was safe. There was no scientific evidence to support that limiting exports from affected countries would reduce the risk of contagion (Interview 4). The fear of transmission through infected pigs with the "swine flu," however, caused countries to ban pork meat from Mexico, Canada, and the United States (378,31,377). Russia, China, Indonesia, Thailand, the Philippines, Egypt were among the countries imposing embargos (378). The WHO reported that some countries admitted restricting the entry of animals and goods from most affected countries (175) (Interview 4). Governments established other measures against the WHO`s recommendations without a scientific rationale (175), including cancelation of flights going to affected countries. For instance, China quarantined a flight arriving from Mexico and forced all passengers to stay in a hotel for some days; the government also requested all passengers arriving at the country to report influenza-like symptoms (378). Even though quarantine was not an effective measure to stop transmission, China decided to implement it (Interview 1). The economy of many countries was affected due to these measures (379).

In general, the international response to the H1N1 outbreak had a high level of international cooperation. Based on the analytical model and indicators presented in chapter

4, Table 31 breaks out the analysis of the international response to the influenza outbreak and provides a quantification of the level of cooperation; it also summarizes how the epistemic community contributed to that level of cooperation.

ACTIVITY	MEASURE	Epistemic Community	International Response to Influenza 2009	*Level of Cooperation*
I. International Participation				
PROBLEM	1. Timely meetings at WHO and other settings.	The epistemic community provided its *consensual knowledge and disseminated* it for assessing the situation at the global level, recommending fast action.	The Emergency Committee was immediately convened after notification of the outbreak.	***6***
	2.If there were actions implemented as a result of those meetings	Members of the epistemic community were part of the Emergency Committee and provided their advice based on *consensual knowledge*.	After the First Meeting of the Emergency Committee, the influenza outbreak was declared a PHEIC, on April 25th, 2009 (336).	***6***
RESPONSE	Time frame after notification	Members of the epistemic community participated in GOARN's activities through the partnerships established by this network and *socialized its knowledge.*	The response occurred immediately after notification. The WHO deployed GOARN, and the regional offices also provided direct assistance (336). The GOARN's assistance to Mexico began on April 24, 2009 (336).	6
NO. OF COUNTRIES	Level of participation	The epistemic community supplied information on time, provided information recommending coordinated international action.	Worldwide participation. The WHO Regional Offices collaborated directly with states. All governments implemented response actions and cooperated with the organizations.	6
II. International assistance				
TECHNICAL A.	Type of participation in international missions.	Some members of the epistemic community participated in these missions as part of the partner organizations, *socializing its ideas*.	The number of missions and experts involved made this the second largest deployment in the history of GOARN (341).	6
FINANCIAL ASSISTANCE	The amount of money provided as financial assistance to address the emergency	It is not clear how an epistemic community could have influenced this. However, these experts have important actors during past pledging conferences for H5N1.	All activities related to Avian and Pandemic Influenza have received continuous funding since 2006. The H1N1 outbreak increased donor assistance to finance the response.	6
TREATMENTS	Type of population getting treatments	In this case, there were clear guidelines provided by the epistemic community for the distribution of vaccines to vulnerable communities, but they were largely ignored.	Countries in need received fast assistant for treatments and medicines (by May 7th, Africa received antivirals and other supplies), but with the vaccine, these countries were the last in getting them, given that the vaccine production concentrates in developed countries and its limited. There were also problems with access to Tamiflu; the antiviral considered the most effective for influenza (Interview 2).	3

Table 31. Levels of cooperation Influenza outbreak

ACTIVITY	MEASURE	Epistemic Community	International Response to Influenza 2009	Level of Cooperation
II. International assistance				
PROVISION	1. How fast was the deployment of assistance	The epistemic community contributed to a fast deployment by offering their collaboration and willingness to assist affected countries.	In general, the provision of essential health services to countries in need was fast. The WHO mobilized resources through its regional offices.	6
	2.Type of assistance	The epistemic community participated and promoted technical assistance for developing countries. Their *socialization of ideas and bureaucratic power* helped to promote assistance.	The WHO and the UN System Influenza Coordination provided medicines and technical assistance to strengthen national health systems.	6
III. Scientific response				
SAMPLES	If countries have shared virus samples	The GISRS and NICs were the principal drivers of this cooperation. These networks have helped to *institutionalize the epistemic community* bureaucratic power.	Mexico shared the virus and donated it to the WHO (317). Other countries shared with the WHO 19284 specimens for confirmatory diagnosis and characterization between April 19 and November 28, 2009 (336,380).	6
R&D	1.If data is disseminated on time	The scientific and academic community mobilized and organized several workshops, presentations, and conferences worldwide (346). These venues helped to socialize the epistemic community ideas and transmitted to policymakers.	Information was shared on real-time, including epidemiological and clinical data, and there was constant dissemination of information (110,317,336).	6
	2.Phases of the research during the outbreak	There has been much information published related to the H1N1 virus; many studies about treatments and medicines were available during the outbreak.	The Global Influenza Programme started a research agenda on influenza H1N1, and international meetings were held to review different topics: clinical management, management of the pandemic, among others (336).	6
IV. Policy adoption				
SURVEILLANCE	If countries implemented systems to allowed constant notification of possible cases	The *institutionalization of the epistemic community's bureaucratic power* and its network structure was crucial for the continuous monitoring of influenza viruses and its evolution, mainly through the Global Influenza Surveillance Network (GISN) and the NICs (336).	Most countries implemented Real-time surveillance systems in the influenza pandemic (381,110). Countries used different early warning and surveillance systems already in place. The NICs informed and sent data to FluNet, which by November 2009, had received data from 82 countries (336).	6

Table 31. Analysis level of cooperation Influenza 2009(H1N1) outbreak (Cont.)

ACTIVITY	MEASURE	Epistemic Community	International Response to Influenza 2009	Level of Cooperation
IV. Policy adoption				
NOTIFICATION	How long did countries wait to notify the WHO after identifying the cases?	Epistemic *community socialization of ideas through a network and the level of institutionalization* of its bureaucratic power made quick notification possible. The collaboration of a network of experts from Mexico, Canada, and the USA, who worked together to identify the virus, permitted to inform the WHO promptly.	The countries that detected the virus first were Mexico and the USA. Both countries followed international norms, the IHRs 2009, and notified promptly to the WHO (98,382), within the 24hrs after identification. After the first cases, other countries continued notifying cases to the WHO.	6
POLICY CONVERGENCE	1. How broad were the recommendations adopted and implemented?	There were limits to the epistemic community's socialization of ideas. Some countries did not follow advice and recommendations from the Emergency Committee and decided to implement actions without scientific support (357).	Countries imposed unilateral travel and trade restrictions (357), including the USA (276). There were also cases of quarantines and cancelation of flights. Many states also disregarded expert reports and banned pork imports from several countries (98,378,31,357,377).	2
	2.The degree of adoption of international norms.	The *institutionalization of power through the years* has helped to improve the system of influenza governance and the implementation of the IHRs in some countries.	The most critical issue was the adoption and implementation of the guidelines set by the IHRs 2005 for notification, surveillance, and response. The most affected countries (The USA, Canada, and Mexico) followed the procedures. However, some countries failed to comply and underreported or failed to report cases (357).	4

Table 31. Analysis level of cooperation Influenza 2009(H1N1) outbreak (cont).

Although there were some problems in the international response, it was on time and effectively managed the outbreak. Considering all these events, it is possible to categorize the level of cooperation in the international response as high, and there is evidence of an epistemic community participating and increasing the level of cooperation.

5.6 Conclusions

The analysis of international response to the influenza pandemic outbreak of 2009 based on the analytical model presented in chapter 3 provides evidence that the level of cooperation was high, and the participation of an epistemic community contributed to this level.

The analysis of the events concludes that the influenza epistemic community developed consensual knowledge and a policy goal. During the outbreak, it provided advice and knowledge about the situation and the process, and it had direct involvement in the policy-making process. The findings indicate that the epistemic community was a prominent actor during the influenza H1N1 outbreak. Its members acted in their role of experts in different positions and as decision-makers. They collected information, analyzed it, and generated evidence for the definition of the best interventions to manage and control the outbreak. Policymakers adopted and followed most of the recommendations suggested by this group. They framed the response and eased communication and collaboration among countries and with international organizations.

As members of an extensive network, with worldwide membership and branches that reached different levels (local, regional, global), they were able to connect and disseminate evidence-based policy advice. The provision of evidence-based policies and their implementation improved collaboration among countries. Their participation in the response as advisors and the field allowed the WHO to deliver appropriate guidance to the international community. The long history of the epistemic community and constant interactions of its members eased communication and enabled connections based on trust and shared understanding. The epistemic community`s members were able to connect fast and react to the situation, collaborating among them but also enabling cooperation among countries. The history of interactions, the size of the network and the work that it has done, helped to build a system of preparedness and response globally, where “even the poorest countries in the world have some systems to respond to influenza” (Interview 12).

Since epistemic communities are embedded in an international system formed by international organizations and nation-states, in this case, the WHO has facilitated the participation and influence of the epistemic community by creating a global system of influenza collaboration. The establishment of different networks long before the 2009 outbreak has allowed building strong relations, confidence, and trust among individuals and institutions (Interview 1, 2, 6). Members of the epistemic community have also created personal relationships that permit closer communication and cooperation. Through the WHO, these experts have direct access to the global system of influenza governance, and they have the power to persuade national governments about the importance of implementing global policies based on scientific evidence and guided by experts’ knowledge.

The analysis of the characteristics of the influenza epistemic community also recognizes its direct connection with the process of the international response to a disease outbreak, which made it possible for the epistemic community to influence international cooperation. Therefore, we can conclude that the presence of an epistemic community, that provided consensual knowledge and a policy goal consonant with the policy process, with the channels to disseminate and reach policymakers and that was able to consolidate bureaucratic power in the system of influenza governance, likely improved international cooperation during the H1N1 influenza outbreak.

Chapter 6: Middle East Respiratory Syndrome MERS-CoV

6.1 Introduction

The Middle East Respiratory Syndrome (MERS-CoV) was the second outbreak assessed under the IHRs 2005. MERS-CoV is a novel coronavirus that can cause a mild cold or more severe illness like SARS (383,384,385). SARS and MERS-CoV have some similarities, such as being of zoonotic origin from the same family (386). In both cases, air travel facilitated global transmission (386,387,388). Recent research shows, however, that MERS-CoV has been causing multiple transmission events from animals to humans, while SARS has been detected only twice since the virus was discovered (389). Furthermore, during the initial stages of the outbreak, MERS-CoV showed a higher mortality rate than SARS (55% for MERS-CoV and 40% for SARS) (386). Box 2 summarizes the disease characteristics.

Box 2. Coronaviruses

Origin of coronaviruses

Scientists first identified coronaviruses in animals in the late 1930s, including highly pathogenic viruses in livestock, laboratory animals, and pets (390). Coronaviruses, however, were, for a long time considered as not harmful to humans. Scientific and medical experts recognized the danger posed by these viruses with the SARS outbreak in 2002/2003 (391,390). After the SARS outbreak, other human coronaviruses have been detected: the HCoV NL63 and HCoV HKU1 in 2004 and 2005; and, more recently, the Middle East Respiratory Syndrome (MERS-CoV) (390,252).

The Coronavirus Study Group of the International Committee on Taxonomy of Viruses classifies coronaviruses in four species of *Coronaviridae: Alphacoronavirus, Betacoronavirus, Gammacoronavirus, and Deltacoronavirus* (389,391,390). The Alphacoronavirus contains two human coronaviruses associated with the common cold: HCoV-229E and HCoV NL63. Beta coronavirus has four subtypes A, B, C, and D, containing four coronaviruses associated with human infections: HCoV-OC43 and HKU1 (lineage A); SARS-CoV (lineage B); and MERS-CoV (lineage C) (391,392,393,390).

Box 2. Coronaviruses (cont.)

Nature of the disease

Evidence strongly supports that coronaviruses are from zoonotic sources, mostly found in wildlife (252,391,390). After the SARS outbreak, viruses related to this strain were found in small mammalian species such as Himalayan palm civets, raccoon dogs, bats, and others (390,252). The MERS-CoV is the first betacoronavirus in the C lineage associated with human infection, and it has been associated with other beta coronaviruses as well. Some evidence links the virus to animals like camels, goats, sheep, and farm animals. Scientists believed that the virus likely emerged in a natural reservoir. Evidence shows that it might be closely related to other betacoronaviruses in the C lineage found in bamboo bats and Japanese Pipistrelle bats, species captured in Hong Kong (391). Other novel coronaviruses have also been identified in bats (252).

Most research concentrates on bats since these animals are likely the host of these viruses (391,392,394,395,390). Recent research also presents some evidence that these viruses switch from their host to other species, likely from bats to humans (391,390). Nonetheless, in the case of MERS CoV, a study by Haagmans et al. (2014) suggested that the virus was transmitted directly from dromedary camels to a person (392). Later, other scholars confirmed these findings (389,396,397).

Global Threat

The novelty of coronaviruses makes it more difficult to find adequate medical interventions in this type of outbreak. During the SARS-CoV outbreak, the nucleotide (DNA) sequence was found a few weeks after the outbreak, and there was a lack of information and data on the structure of the virus (252). Most recent studies show some advances in the developing of drugs to fight coronaviruses like SARS (252). Scientists have made some advances to understand the genomic structure of SARS-CoV, which is imperative to understand the function of this type of viruses (252). Recently, the WHO included MERS-CoV in the list of priority diseases for the WHO R&D Blueprint and Global Program. In one of the working group's meetings, experts discussed principles to design trials for specific treatments and a vaccine (398,399).

Notification of cases has been constant since 2012. The last significant outbreak of MERS-CoV occurred in the Republic of Korea in 2015 with 185 cases. There has been a small response to the outbreak, although a global mobilization has not happened yet. The level of international cooperation, therefore, has been low to medium. The basis of the argument rests on the evidence that coronaviruses -like SARS- cause pandemics, and international cooperation is necessary to contain them and manage them. Although MERS-CoV represents a threat to global health, the WHO and other organizations have limited their response to technical assistance to Middle East countries and the region to control and manage cases. What are the factors limiting the level of cooperation and an official declaration by the WHO of MERS as a PHEIC?

The reaction to the MERS outbreak could be due to a concentration of cases in Saudi Arabia. Experts blamed the authorities of this country for withholding information and for lack of transparency (400). Limited data has restricted research related to the virus, knowledge about the disease's transmission mechanics, and the development of better treatments.

In contrast, international travel and concerns for the spread of the virus through mass gatherings brought some attention to the MERS-CoV outbreak due to the influx of visitors to the Middle East every year during the Hajj pilgrimage and the potential for a massive epidemic during such an event (134,386,388). Some of the measures that have been established to contain the outbreak have been the result of limiting cases during the pilgrimage and reducing the number of exported cases to more regions (401).

These contextual factors have impacted the level of cooperation seen during the international response to MERS-CoV. However, to what extent has an epistemic community influenced this cooperation? There is evidence of an epistemic community in coronavirus by the time of this outbreak started. The participation of the epistemic community, however, has also been affected by factors such as limited access to information and the level of secrecy kept by the government of Saudi Arabia (400). Although MERS-CoV is a new virus, it comes from a family of diseases already known and, to some degree, studied. This epistemic community, however, did not have a strong influence on the international response, and it has been unable to position itself as a key actor in the policymaking process at all levels. Figure 18 illustrates the MERS epistemic community connection with the low level of international cooperation.

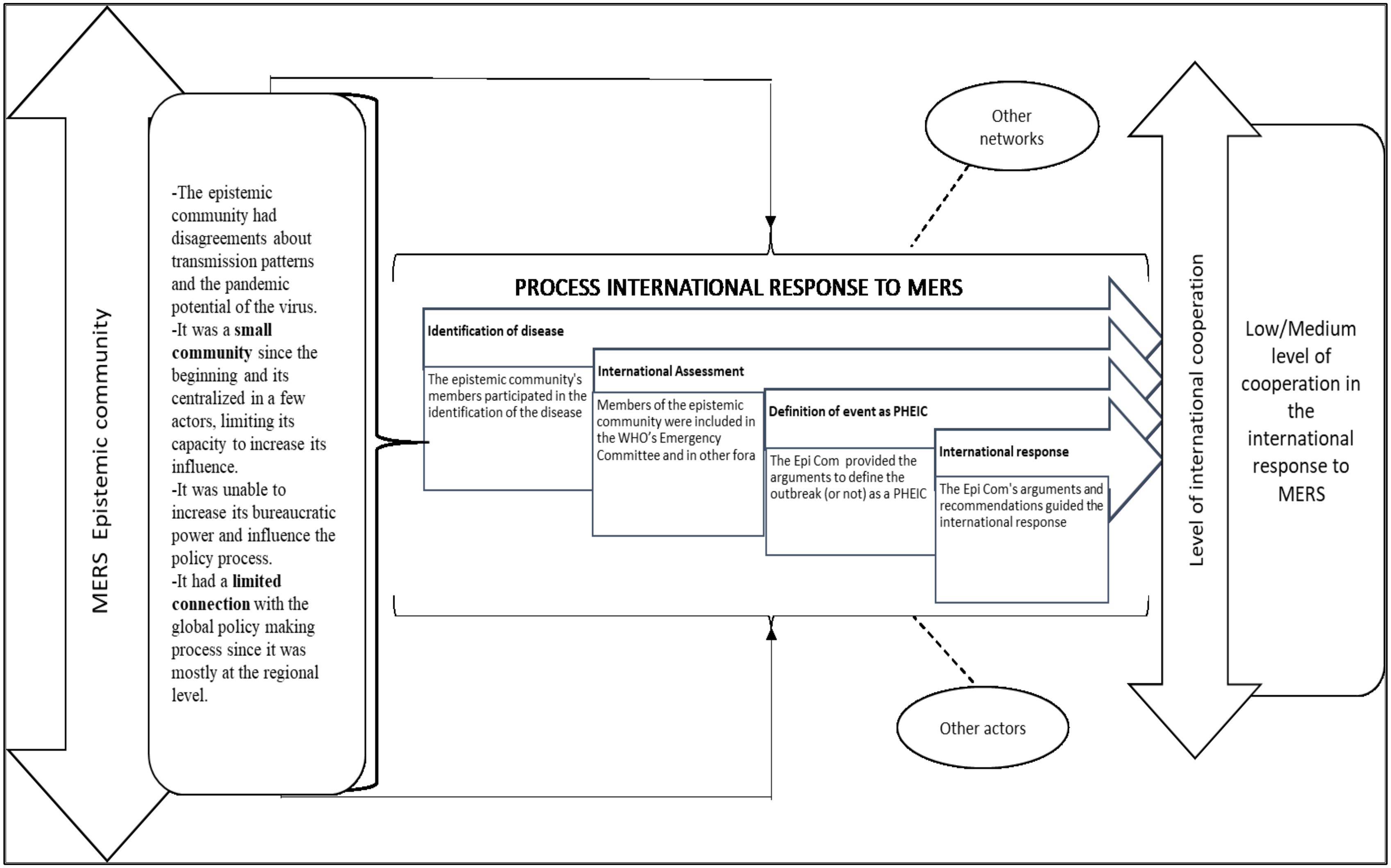

Figure 18. MERS epistemic community and its connection to the international response.

Therefore, the research characterizes the MERS-CoV's epistemic community with a lower capacity to influence higher levels of international cooperation and a formal international response to the disease outbreak.

6.2 The MERS-CoV outbreak

In June 2012, health professionals identified the index case of MERS-CoV as a patient who died of acute pneumonia in Saudi Arabia (383,395,402,403,394). The UK officially notified the first case to the WHO in September 2012, a patient originally from Qatar that had traveled to Saudi Arabia before getting ill (404). By the end of 2012, the UK, Jordan, and Saudi Arabia all reported cases and deaths due to the virus (405). Subsequent cases have mostly been detected in the Arab peninsula (383,406,407,408).

The virus was initially detected in Saudi Arabia by the virologist Ali Mohamed Zaki. Dr. Zaki took samples from a patient at *Dr. Soliman Fakeeh Hospital* in Jeddah, who presented severe pneumonia and tested negative for all usual tests (409). The virologist sent the samples to the head of the Virology Lab at the Erasmus Medical Centre in Rotterdam (410,409). Both Dr. Zaki and the Dutch Lab would later confirm that the virus was a novel type of coronavirus later named Middle East Respiratory Syndrome (MERS-CoV) (409). Given that a virus of this type caused the SARS outbreak in 2003, Dr. Zaki decided to publish a note on ProMED[lii] to alert the research community and public health agencies.

The government of Saudi Arabia did not welcome Dr. Zaki's actions and the hospital where he was working decided to end his contract (409). Later the Ministry of Health, represented by its Deputy Health Ministry Dr. Zaid Al-Memish, claimed that the government

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[lii] ProMED is the Program for Monitoring Emerging Diseases. An Internet-based reporting system, the program allows the global dissemination of information on outbreaks of infectious diseases on real time (716).

did not consent to the sharing of the virus between the Saudi doctor and the Dutch laboratory. At the centre of this dispute was the fight for patent rights of the virus (410).

Saudi Arabia did not inform the WHO of this coronavirus case, and between June and September of 2012, more cases emerged in the country, but health officials remained silent. The circumstances changed when cases of MERS were detected outside the Arabia Peninsula, and the United Kingdom officially notified the first case to the WHO on September 22, 2012 (411). The *St. Thomas's Hospital* in London informed the former Health Protection Agency (now Public Health England) about a man who had arrived from Qatar with symptoms of a severe respiratory infection. Similar to the first case in Saudi Arabia, the patient tested negative for known diseases. Scientists in Public Health England found Dr. Zaki's note in ProMed and matched the symptoms in both patients.

Notification of the first case of MERS was only possible after a group of scientists isolated the virus in the Netherlands and published the results in November 2012 (412). The Public Health Protection Agency proceeded to identify the genetic sequence of the virus, and the results were almost identical to the virus already sequenced by the Erasmus Medical Centre (409). With this information, the government notified the WHO. By July 7th, 2013, the WHO confirmed 80 cases, including 44 deaths, in Jordan, Qatar, Saudi Arabia, the United Arab Emirates (UAE), France, Germany, Italy, Tunisia, and the United Kingdom (385). With more cases worldwide, the WHO alerted the international community (413).

One of the factors that impeded prompt action was the scarce information shared by Saudi Arabia. The WHO later requested all countries to share samples with the WHO immediately if unusual cases were detected (410). Saudi Arabia later agreed to share the samples with the U.S. Centres for Disease Control, in part due to the WHO's intervention (409).

Another major outbreak occurred in the Republic of Korea in 2015, with 185 cases. It was the first significant outbreak outside the Middle East. The outbreak in Korea highlighted how travel facilitated the transmission of the disease since all cases outside the Arab peninsula originated in people returning from this region (402,394,387,384,414,408,415). People transmitted the virus to family and health workers in clusters, similar to the situation during the SARS outbreak (416,402,394,417,418,419,420,421). The disease predominantly affected health care workers. This group was highly vulnerable due to the lack of information about the disease, and that medical workers were most of the time unable to recognize the symptoms (422,407,417).

There is evidence to support human to human transmission; however, there is no conclusive evidence on how efficient this is (383,394,384,423,403,393). As of March 2019, 27 countries reported 2374 laboratory-confirmed cases, including 823 associated deaths (424) (See Appendix I). Table 32 summarizes the characteristics of MERS.

	MERS CoV 2012
Virus	Coronavirus
Case Fatality Rate	35%[liii]
Type of transmission	Animal to Human Human to human
No. of cases	2374 (March 2019)
No. of countries	22
Treatment	Unknown
Vaccines	None available yet

Table 32. Characteristics of the MERS-CoV outbreak.

[liii] This rate has varied during the outbreak, with peak periods of 50% (715).

The lack of knowledge about the MERS-CoV may increase the risk of transmission in the future due to the inadequate management of cases (415). Surveillance and notification of isolated cases, mostly from Saudi Arabia, continue. Countries will likely report more cases in the future (407). Nonetheless, the response concentrated on establishing a research agenda under the WHO R&D Blueprint Initiative (397). In 2012, the WHO concluded the outbreak was not a PHEIC, and the organization did not call for a new Emergency Committee meeting to reassess the most up-to-date evidence nor the 2015 outbreak in Korea.

6.3 The MERS epistemic community

The MERS-CoV outbreak is the only case analysed in this research that was assessed by an Emergency Committee that decided not to characterize the event as a PHEIC. Therefore, the EC did not call for a formal international response under the IHRs 2005. There was a response, however, mostly at the regional level, organized by the most affected countries and closely coordinated by the WHO, the Food and Agriculture Organization (FAO), and the World Organization for Animal Health (OIE) given the zoonotic origins of the disease and the interest in the confirmed animal-human transmission. The following analysis will provide better evidence about the context, the MERS epistemic community, and its possible impact on the events.

6.3.1 Origins of the MERS epistemic community: the Coronavirus epistemic community.

After the SARS outbreak, the WHO established the Coronavirus Lab Network (CLN), a group of 11 laboratories in the world, the first of its kind. The network researches these pathogens and works in the development of a test for the rapid identification of the virus (425). Currently, the CLN has 13 members (426). This network has helped to advance our understanding of coronaviruses, thereby establishing the foundation of an epistemic community. As in other cases, the WHO is a central actor in this epistemic community and acts as coordinator of the group. Members of the coronavirus epistemic community are part of the WHO's body of expert advisors and had provided the organization with information to face other outbreaks. The coronavirus epistemic community, however, has not been able to strengthen its influence into the WHO and other institutions, in part because the interest in researching SARS and similar viruses lost traction due to lack of funding (252).

When MERS-CoV emerged, people from this network of institutions were called to participate in the expert groups that this research identifies as the core of the MERS-CoV epistemic community. These groups are:

- The Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses which unified the scientific community and research by agreeing on the new pathogen's name (393);
- The WHO MERS-CoV Research Group (402);
- The MERS Emergency Committee established in July 2013;
- Group of experts participating in WHO technical consultations on MERS-CoV, WHO Blueprint Programme (399).

The CLN participates with 7 of its 13 institutions in these expert groups. Each of these seven institutions participated in one or more of these core groups with at least one expert. Table 33 presents the CLN institutions with participating members in the MERS CoV epistemic community's core groups and the number of experts representing each CLN institution.

Country	Institution	CLN	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	IC MERS CoV EMRO
Canada	Public Health Agency of Canada	1	1					
UK	Public Health England	1	1	2	2	1	1	1
USA	Centres for Disease Control and Prevention	1	1	2		1	2	4
China	China CDC	2				1		
Netherlands	Erasmus MC	1		4	2	2		
France	Institut Pasteur	1		3		1		1
Hong Kong	University of Hong Kong	2		2	2		1	

CLN: Coronavirus Lab Network; EC-MERS: Emergency Committee; MERS CoV RG: MERS CoV Research Group; CSG ICTV: Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses; WHO MERS R&D: WHO Consultation on MERS CoV R&D; WHO BP VT: WHO consultation on MERS-CoV vaccine and therapeutics

Table 33. Institutions with experts participating in the core groups of the epistemic community.

The coronavirus epistemic community led to the creation of the MERS-CoV epistemic community, given their expertise and knowledge obtained since 2003. To understand how much was able to influence the level of international cooperation in the international response to MERS, this section will analyse the epistemic community's characteristics.

6.3.2 Characterizing the MERS epistemic community

There is evidence that the previously organized coronaviruses epistemic community merged into the epistemic community for MERS-CoV. These experts, with experience in coronaviruses like SARS, joined efforts with experts from the most affected countries, mostly from the Arab Peninsula. This group has been growing over the years, and it has been continuously collaborating with the WHO. The group, however, has faced barriers to access information and internal disagreements.

6.3.2.1 Knowledge

When the WHO announced the first cases of MERS, scientists, experts in infectious diseases, and public health professionals faced more questions than they had answers (391). Besides some similarities with SARS (391), MERS-CoV was a mystery for the scientific community. There was no idea about where the virus originated from (host) and its transmission mechanism. By the time MERS-CoV appeared, research in coronaviruses had not sufficiently advanced to understand these pathogens or the outbreak, and there was insufficient data to develop quick treatments. Experts insisted on the need for more studies about the novel virus, the human-animal interface, risk factors, transmission, treatments, and vaccines (252,427). MERS-CoV showed a case fatality rate up to 50 percent during some periods, for a disease that practitioners did not know how to treat (416,391,428). The situation brought some concern, but some characteristics of the outbreak made some experts disagree with an immediate international response: the virus was showing only a limited human to human transmission (416,403,391), and cases were mostly in the Middle East.

The existence of conflicting and insufficient evidence regarding the level of severity of MERS-CoV impeded the possibilities to reach a consensus within the epistemic community. Some scholars considered there was not enough evidence about the possibility of airborne transmission (429,417,415). Other experts agreed that the evidence of sustained human-to-human transmission was scarce, dismissing MERS as having pandemic potential (418) whereas others did not discard this possibility, given that in South Korea the outbreak reached 184 cases in two months (430). This disagreement was strengthened by variation in the estimations of the pandemic potential of the disease. The first studies projected different reproductive numbers (R_0), between a range of 0.3 and 1.5 (422). A R_0 of less than 1 indicates that there is no pandemic potential (383). Breban et al. presented two scenarios in the early stages of the outbreak, the optimistic one, with a R_0 of 0.60 and a pessimistic with a R_0 of

0.69 (423). Later, Chowell et al. presented another model distinguishing between transmission by index cases and by secondary cases (422). The study found central estimates of R_0 between 0.8 and 1.3 (402). In their model, they estimated a R_0 of 0.88 for index cases while they concluded that secondary cases were less effective with a R_0 of 0.36 (422). In another analysis, Cauchemez et al. (2014) calculated a R_0 of 0.63. These studies acknowledged the scarce data and the problem of underreporting (402,418). Other studies warned of the risk of patients already infected but asymptomatic, that travel and increase the potential of a global pandemic (431). Some experts considered that MERS-CoV could evolve and increase its efficiency in human to human transmission as well as create a pandemic (402,394,431,432). The WHO recognized the variability of the reproductive ratio (407).

Currently, the most important scientific consensus is the zoonotic origin of the virus. Dromedary camels are the main reservoir and source of zoonotic transmission to human populations (433,397,392,432,434,435,436,437). It is still not clear, however, how the transmission occurs (389,397,435). MERS cannot be clinically distinguished from other types of respiratory illnesses in its early stages (397). It can only be detected by laboratory tests that take several days to process, increasing the risk of transmission (397,391). This is a common challenge with many emerging infectious diseases: front line doctors and health workers are not familiar with the symptoms, creating a delay in diagnosis and treatment (Interview 11).

More research is needed to understand the clinical evolution of the disease and to improve diagnostic methods, which are currently available only with molecular diagnosis methods (PCR, sequencing, and molecular data) (438,396). Scientists agree that developing commercial tests is also necessary to make diagnostic tests more accessible (397,402). There are no specific treatments for MERS-CoV, and some doctors use experimental ones developed for SARS (397), as well as treatments developed for other infectious diseases. There are new efforts to produce a vaccine, with a dozen in preclinical development (397,429).

Since the international community was dealing with a new pathogen, it seemed logical that the most crucial step for delineating policies at any level was gathering information. Therefore, the epistemic community's policy goal focused on improving the global health response through investing in research; strengthening collaboration and coordination for improving information sharing (397,439).

6.3.2.2 Socialization of ideas

To analyse how the epistemic community socialized its knowledge and use of diffusion mechanisms to influence the policy-making process, it is necessary first to understand its structure. The members of the MERS epistemic community included policymakers from affected governments and international organizations, scientists, epidemiologists, technicians, virologists, and health experts working on understanding the virus and developing effective measures to control the outbreak and treat the disease (Interview 4). Since SARS and influenza, the international collaboration to address zoonotic diseases increased, allowing a more multidisciplinary approach known as "One Health" (252). The initiative prompted closer collaboration among three UN agencies: the WHO, the FAO, and the OIE. Members of the three agencies have been an essential part of the epistemic community. The groups identified in table 31 (CLN; EC MERS CoV; MERS CoV REG; CSG ICTV; WHO MERS R&D; WHO BP VT; IC MERS CoV EMRO) had members in 35 countries concentrated in Europe, North America, and the Middle East. Figure 19 shows the geographical distribution.

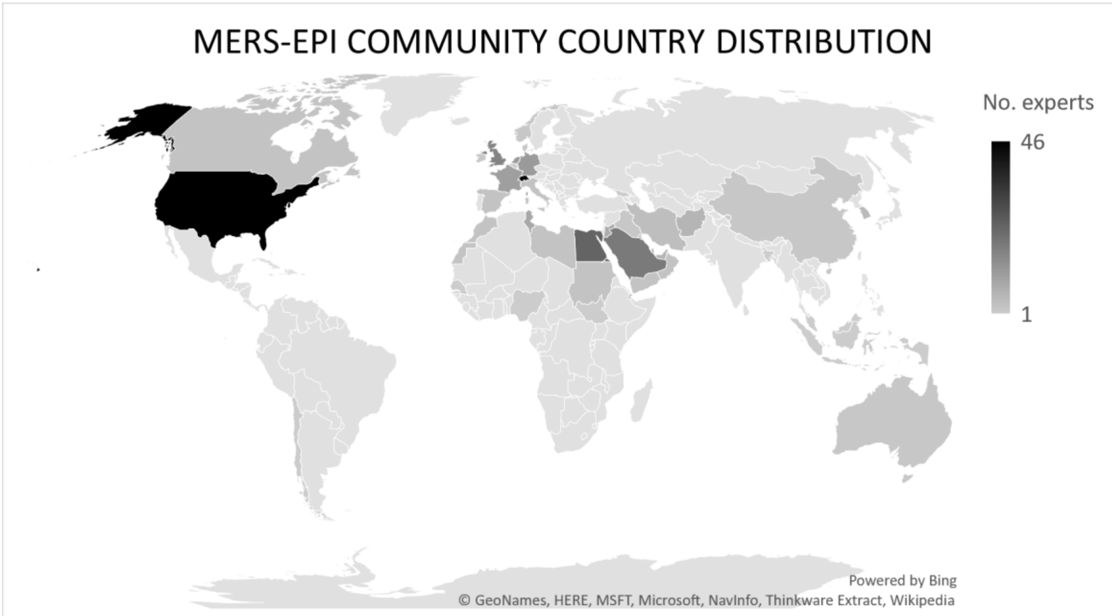

Figure 19. Geographical distribution of MERS CoV epistemic community main members.

Members of the epistemic community participated in multiple groups. Therefore, their overlapping participation created interconnections within the epistemic community. From all the members identified in the core groups, table 34 presents those members that participated in more than one. Appendix J includes the full list of members.

Even though the map shows an expanded network, through several regions, only a small group of institutions and countries continuously participate. The network includes health and animal experts from of Saudi Arabia, Qatar, United Arab Emirates, Kuwait, Oman, Egypt, Jordan, the US Centres for Disease Control and Prevention, Institute Pasteur of France, the Chinese University of Hong Kong, Erasmus Medical Centre-Erasmus University in Netherlands, University of Bonn in Germany and the WHO, FAO and OEI (See Appendix J).

Name	Country	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT
Ziad Memish	Saudi Arabia	Ministry of Health					
Maria Zambon	UK	Public Health England					
Christian Drosten	Germany	University of Bonn Medical Centre					
Bart L. Haagmans	Netherlands	Erasmus MC					
Ron A. M. Fouchier	Netherlands	Erasmus MC					
Maria Van Kerkhove	Switzerland	World Health Organization HQ					
Mohammed Mohammed Al-Hajri	Qatar	Supreme Council of Health					
Marion Koopmans	Netherlands	Erasmus Medical Centre					
Abdullah Mufareh Assiri	Saudi Arabia	Ministry of Health					
Cathy Roth	Switzerland	World Health Organization HQ					
Peter Ben Embarek	Switzerland	World Health Organization HQ					
Richard Pebody	UK	Public Health England					
Farida Ismail Al Hosani	United Arab Emirates	Ministry of Health					
Luis Enjuanes	Spain	Campus de la Universidad Autonoma de Madrid					
Myoung-don Oh	South Korea	National University College of Medicine					
Frederick G. Hayden	USA	University of Virginia School of Medicine					

EC-MERS: Emergency Committee; MERS CoV RG: MERS CoV Research Group; CSG ICTV: Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses; WHO MERS R&D: WHO Consultation on MERS CoV R&D; WHO BP VT: WHO consultation on MERS-CoV vaccine and therapeutics

Table 34. Members interconnecting the core epistemic community's groups.

The MERS epistemic community started as a small group, but it increased its size over time. Members of the network, however, are mostly concentrated in the Middle East Region, the WHO, and some other countries with research and laboratory capacities. Staff and experts from the WHO Geneva and the Regional Office EMRO were constant members of the community, and they concentrated the core of the community. The CDC in the USA is the second most influential institution in the epistemic community.

The structure of the epistemic community affected their connexion with the policy process and the way it disseminated its knowledge. The epistemic community was highly centralized and concentrated in the WHO, with more than 60 experts participating through Geneva and the Regional Office, which means that all information and connections depended on it. The MERS CoV epistemic community was less flexible and less open than others, limiting its possibilities of expanding its membership and influence. These characteristics did not favor the dissemination of information when research and development of data were necessary to produce information and scientific evidence for guiding policy interventions (440,427).

The 2012 MERS outbreak increased the scientific and academic interest in coronaviruses but still far from the levels seen with SARS. Perl and Savor Price identified only 475 scientific papers (peer-reviewed) after 33 months of the outbreak (427). They compared this response with SARS, for which, in the same period (33 months), scholars published 2854 papers (427). Another study focuses on the articles related to the outbreaks in Saudi Arabia; the authors found that 68 articles were published in total and that the WHO Epidemiological Bulletin only included six articles related to these outbreaks. The last figure is relevant since the Bulletin is the most important source of scientific information, and it directly targets policymakers (406).

These articles were published in 40 journals, including Emerging Infectious Diseases, *the International Journal of Infectious Diseases, Clinical Infectious Diseases, the American Journal of Roentgenology, Eurosurveillance, mBio, Epidemics, The Lancet, New England Journal of Medicine and PLoS Current Outbreaks* (406). Many of these publications appeared after the initial outbreak ended (406). Some members of the epistemic community were publishing and sharing information through different publications.

Dissemination was also affected by some scientists working with MERS that did not provide information on time or withhold data to be the first people publishing about the virus [(98) Interview 5]. This problem hindered access to faster research. National governments contested free scientific exchange of MERS samples, given the problems with patent rights and access to benefits (410).

The direct participation of members of the epistemic community in the international response also influences the dissemination process. The WHO's response required collaboration for the detection and identification of the virus. Some members of the epistemic community participated in a small network of global partners for scientific and technical collaboration, presented in Table 35.

Members network global partners MERS-CoV
World Health Organization, Geneva, Headquarters
WHO Regional Office Eastern Mediterranean Regional Office (EMRO)
Centers for Disease Control and Prevention, USA
Public Health England, England
Institute of Virology, University of Bonn Medical Centre, Germany
University of Hong Kong, Hong Kong
Robert Koch Institute, Germany
Ministry of Health, Jordan
Erasmus University, Netherlands
Ministry of Health, Kingdom of Saudi Arabia
Ministry of Health, Tunisia

Table 35. Global partners in the WHO's response to MERS-CoV between September 2012 and May 2014.
Source: Williams et al. 2015:313 (441).

Members of the epistemic community associated with those institutions participated in the identified core groups. Table 36 presents the number of people participating per institution in the core groups.

Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT
Centres for Disease Control and Prevention		1			2
Erasmus University		4	2	2	
Ministry of Health Saudi Arabia	1	2	2	4	1
Ministry of Health Jordan		3			
Public Health England		1	1	1	
University of Bonn Medical Centre		1	1	1	
University of Hong Kong		2	2		1
Robert Koch Institute		3			
World Health Organization HQ		19		9	5
WHO Regional Office Eastern Mediterranean Regional Office		3			

Table 36. Global partners in the MERS-CoV response and their connections to the epistemic community's core groups.
EC-MERS: Emergency Committee; MERS CoV RG: MERS CoV Research Group; CSG ICTV: Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses; WHO MERS R&D: WHO Consultation on MERS CoV R&D; WHO BP VT: WHO consultation on MERS-CoV vaccine and therapeutics

The analysis of the outbreak under "One Health" opened the epistemic community to include experts from other areas (animal health, environment, food security), which improved technical advice to affected governments. Members from this interdisciplinary epistemic community participated in the following international missions:

- WHO and the Ministry of Health and Welfare mission took place in the Republic of Korea 8-13 June 2015.
- WHO mission on Middle East respiratory syndrome coronavirus (MERS-CoV) in Saudi Arabia, 13 September 2015.
- WHO concludes a MERS-CoV risk assessment mission in the United Arab Emirates A team from the WHO and technical partners from the Global Outbreak Alert and Response Network (GOARN) has concluded a 5-day mission in the United Arab Emirates (UAE). The team consisted of 6 experts in coordination, epidemiology, infection prevention and control, food safety and the human-animal interface, and risk communication June 1-6, 2014.
- WHO experts probe Middle-Eastern respiratory syndrome coronavirus (MERS-CoV) in Jeddah, Saudi Arabia, 2 May 2014 - A team of experts from WHO started a two-day mission yesterday in Jeddah to assist national health authorities to investigate the recent increase in the number of people infected by MERS-CoV. From mid-March 2014, 111 people have tested positive in the Jeddah area, the most significant single surge in the MERS-CoV outbreak since the new virus was detected in April 2012. Thirty-one persons have died.
- WHO's high-level mission to Saudi Arabia on Middle East respiratory syndrome coronavirus (MERS-CoV) 11–14, January 2016.
- WHO EMRO technical mission of the Ministry of Health officials from Saudi Arabia to Egypt in May 2017 to share surveillance and laboratory experiences.
- WHO EMRO review mission to Qatar to review preparedness and response processes from 9 to 15 May 2017.

Members from the epistemic community also participated in training programs, such as the WHO Regional Office for Eastern Mediterranean (EMRO) workshop in Riyadh for surveillance of Severe Acute Respiratory Illness, held in Saudi Arabia from January 15 to 19, 2017. Besides, some international conferences brought together the scientific community and public health experts, such as the WHO and the University of Hong Kong informal meetings about the airborne transmission of MERS-CoV, held on 13-14 March 2017. All these meetings were essential venues to diffuse the epistemic community knowledge.

6.3.2.3 Institutionalization of bureaucratic power

The MERS epistemic community reached a certain level of bureaucratic power by participation in groups that had a direct influence on the policy process. Its participation included the Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses, which unified the scientific community and research by agreeing on the new pathogen's name (393); the WHO MERS-CoV Research Group (402); and the MERS Emergency Committee, established in July 2013.

The MERS-CoV epistemic community contributed to expert groups organized by the WHO. These were oriented to research and development, as well as to developing a vaccine in the short term. Most of these meetings were regional consultations, with participants from the affected countries and their neighbors. Some institutions from Europe and the USA also sent experts, given their expertise in the area. Table 37 summarizes the most important groups and meetings.

Group	Meetings
Country meeting	Intercountry meeting on the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak in the Eastern Mediterranean Region Cairo, Egypt 20–22 June 2013 (442)
The MERS-CoV Vaccine Working Group -WHO	First meeting on November 14-15, 2015 in Saudi Arabia (443)
WHO R&D Blueprint Initiative	WHO Consultation on MERS CoV R&D: Development of a Global MERS CoV R&D Roadmap –10-11 December 2015
Technical Consultation on MERS-CoV	First meetings held in Saudi Arabia in January 2013 and December 2013 (443).
	Consultative meeting to determine the public research agenda, Cairo, Egypt 15–16 December 2013 (444).
	Second meeting held in Saudi Arabia, in March 2014
	Third meeting held in Cairo in May 2015, Egypt from 5-6 May 2015 (hosted by WHO/EMRO (443))
	Fourth meeting, held in Doha, Qatar, on 27-29 April 2015 (hosted by FAO and the Supreme Council of Health of Qatar) and in Cairo) (445)
	Regional Technical Consultative Meeting on MERS-CoV Muscat, Oman, 20-21 May 2014 (439)

Table 37. Meetings MERS CoV.

Conferences and technical groups provided a space for members of the epistemic community to get more involved in the process and to have more access to the domestic and global policy process. There was continuous interaction between policymakers, experts, bureaucrats, and other participants. Appendix J includes the full table of institutions participating in the different groups and meetings related to MERS CoV.

The importance of the outbreak in the Arab peninsula and the continued risk that this virus represents for these countries have allowed the participation of many experts from decision making positions in expert and technical groups. These professionals are part of the epistemic community.

Their participation through the MERS CoV Emergency Committee also included them in the global decision-making process. After their 10^{th} meeting, the Emergency Committee participation concluded that the outbreak did not have the characteristics of a PHEIC. Since then, the WHO has not organized another meeting, although the organization continues monitoring the situation and providing updates.

There were also some members of the community directly involved in both the epistemic community and the decision-making process. One of them, Dr. Ziad Al-Memish, acted first as Undersecretary to the Minister of Health in Saudi Arabia. Then, he was appointed in 2012 as the head of the WHO Collaborative Global Centre for Mass Gathering Medicine, the first in the world. The Centre has devoted many resources to MERS and has concentrated its work on analysing the risk that this disease represented for the celebration of the Ramadan. The Centre provided information to WHO, and Dr. Memish's expertise has influenced decision making in Saudi Arabia and the field of Mass Gathering Medicine (446,447). As such, he has extensively published about MERS-CoV and mass gatherings, in collaboration with other members of the epistemic community [see references (448,401,386,446,432,449,450)].

The MERS-CoV epistemic community includes members from national governments and international organizations (See Appendix J). Nevertheless, the participation has been mostly regional and with a less extended international membership. There are not enough professionals around the world with expertise in coronaviruses. Therefore, members of the epistemic community came mostly from the Middle East.

This geographical concentration of experts reduced the epistemic community capacity to influence a global response, and potentially respond to future outbreaks in other geographic regions. High-level officials and experts in the Eastern Mediterranean Region meeting in October 2018 expressed their concerns about the limited number of MERS experts in the world and the probability of a future outbreak. There would be limited expert capacity to address such a global outbreak (451).

These characteristics, summarized in table 38, depict an epistemic community that had problems with establishing consensual knowledge, with limited resources to socialize its ideas and that did not gain much power.

	Indicator	MERS
1. Knowledge	Agreement on a common definition of the problem and possible solutions	The community had some disagreements about the pandemic potential.
	Clear identification of a common policy goal	They established a common goal during the outbreak (to improve the global health response through investing in research; strengthening collaboration and coordination for researching and improving information sharing)
2.Socialization of ideas	Structure	The epistemic community was small and centralized. Its members were mostly from the affected region and a few experts from countries that have research capabilities like the USA, Canada, and Australia.
	Dissemination mechanisms	Before the outbreak, research in coronaviruses was scarce, and even during the most critical days of the event, the availability of information and studies were limited. There were also problems with access to data and withholding of information by members of the epistemic community.
	Participation in the international response	The participation of the community has been through the WHO in activities related to research and development, and in the field gathering information about the virus and the outbreaks.
3. Institutionalization of bureaucratic power	Participation in the policy process.	MERS CoV was less important at the global level than other outbreaks. There has been a small number of committees, expert groups, and conferences related to MERS. Experts from the epistemic community participated, but it had a few opportunities to institutionalize its influence.
	Experts and other professionals from the epistemic community in decision-making positions	The participation was mainly through the Emergency Committee.

Table 38. Characteristics MERS CoV epistemic community.

6.4 The international response

The emergence of a new coronavirus in 2012 brought some initial uncertainty in part because of late notification, limited sharing of information, and ineffective collaboration by some countries (440,452). During the 66th World Health Assembly, Dr. Margaret Chan expressed her concern for the novel virus, given the lack of information about it (416,394). The WHO focused its response on working with Saudi Arabia, Qatar, and the UK (453).

Samples from these countries were tested by one of the WHO Collaborating Centres for Emerging and Re-emerging Infectious Diseases (NAMRU – 3) (411).

The WHO Director-General organized an Emergency Committee (EC) to assess the outbreak in the Arab Peninsula. Following the IHRs 2005, the WHO put together a group of experts to compose the EC. The MERS CoV EC held its first meeting on Tuesday, 9 July 2013. Here the epistemic community faced a fundamental problem: experts could not agree on the severity of the outbreak (454).

A critical aspect stopping the declaration of MERS as a PHEIC was a lack of consensus within the epistemic community and other experts about the potential danger represented by the virus (454). The first meeting of the Emergency Committee organized by the WHO concluded that “the Committee considered that additional information was needed in a number of areas. The Committee also considered it needed time for further discussion and consideration (455).” Therefore, members of the committee decided not to declare the event a PHEIC, claiming that the available information was not enough to support such a decision (456). Given the scarce knowledge about the MERS-CoV, the epistemic community first tried to understand how it behaved and the risk it represented. Experts agreed on the urgency to develop better interventions for treating the disease, including the development of a vaccine (403,397,396,441,457,395,458,459).

Due to the lack of a PHEIC declaration, an explicit international response never was required. Nonetheless, the WHO mobilized some resources to support the most affected countries and provide technical assistance. The WHO organized working groups and expert consultations with professionals from the epistemic community with the primary goal of increasing research and improving knowledge about the disease, as well as its management and treatment. The response was, therefore, mostly scientific and technical. The WHO provided recommendations to affected countries to prevent the spread and continued to provide technical assistance. Some countries outside the region collaborated to contain the disease, and the WHO recognized the importance of increasing global awareness (407).

Regardless of not having recommended a formal PHEIC, the Emergency Committee issued some measures to the WHO and its member states. Many of these were epidemiological, targeting transmission by improving case management in health facilities as well as increasing the protection of health workers. Although the last years the number of cases did not increase drastically, the WHO continued updating technical documents to provide guidelines for countries based on the most recent publications in relevant journals, country studies, clinical trials, among others (460). These documents include four categories:

1. Surveillance and investigation
2. Laboratory
3. Case management, infection prevention, and control
4. Travel and mass gatherings

The most recent documents are from 2018, and all of them include scientific evidence from ongoing research and development of the situation (424). The WHO regularly updated its reports and kept gathering data that could be necessary in case of another outbreak with information produced by members of the epistemic community.

The MERS-CoV Emergency Committee recommended measures to be followed by the international community for the control and management of future cases. In its last meeting, the EC noticed that many countries did not comply with the suggested measures: countries were not always reporting cases, sharing of information was limited, and research was slowly developed (461). They concluded their work with the next statement:

> *The Committee felt it important to alert all relevant authorities, especially national public health, animal and agricultural agencies, to the continued and significant public health risks posed by MERS. These sectors must collaborate, among themselves and internationally, and follow the advice that has been issued by WHO* (461).

The MERS-CoV EC had ten meetings between July 2013 and September 2015. In their last meeting, the group of experts acknowledged the need for more international collaboration in the development of vaccines and treatments as well as for more cooperation from national governments to share on-time information (461). During this period, there were different opinions about whether the outbreak should have been called a PHEIC or not, and renowned experts and WHO's officers, such as Keji Fukuda and David Heymann[liv], defended the EC's decisions (454).

The response was mostly at the regional level, focused on assisting those countries with cases. The WHO also prompted scientific and technical collaboration to understand better the disease and to define effective medical and non-medical responses. The involvement of the MERS epistemic community increased due to the establishment of a global research agenda. Many of the activities were possible due to the use of the Program for Monitoring Emerging Diseases (ProMED), which is updated by the WHO, the US CDC[lv], and the European CDC (383,441). With this program, the WHO aimed to increase the scientific knowledge of the virus and to develop treatments and interventions for managing future outbreaks.

[liv] Keji Fukuda was the WHO's Assistant Director General for Health Security and participated in most of the international meetings related to disease outbreaks. David Haymann was an Executive Director for Communicable Disease at the WHO, currently working as the Head of the Centre on Global Health Security at Chatham House. He was member of the Zika's Emergency Committee.

[lv] The MERS-CoV Working Group

In September 2012, the WHO, CDC, and other global partners started assisting with detection and surveillance activities. That same month, the Institute of Virology, University of Bonn Medical Centre made available the first assay reagents. In November 2012, a group of international scientists published the complete genome sequence of the virus (441).

The zoonotic origin of the virus identified by experts (436,446,402) and gaps in knowledge also facilitate the inclusion of the topic into the “One Health” approach. This perspective guided part of the response, focusing on the animal-human interface, “the interaction among animal and human health within an environmental context (441).”

The influence of the epistemic community in research and development is also observed its participation in technical meetings. Table 39 summarizes some meetings were the epistemic community had a direct influence on the outcome.

Group	Meetings	Outcome
Country meeting	Intercountry meeting on the Middle East Respiratory Syndrome Coronavirus (MERS-CoV) outbreak in the Eastern Mediterranean Region Cairo, Egypt 20–22 June 2013 (442)	Participants agreed on a series of recommendations including: Increase detection through increased surveillance and testing. Free and open data-sharing using a standard questionnaire developed by WHO Develop and participate in the further development of diagnostic assays. Ensure international cooperation and collaboration (442)
The MERS-CoV Vaccine Working Group -WHO	First meeting on November 14-15, 2015, in Saudi Arabia (443)	They establish a collaborative model with key partnerships, promoting transparency and sharing of data (457).
WHO R&D Blueprint Initiative	WHO Consultation on MERS CoV R&D: Development of a Global MERS CoV R&D Roadmap –10-11 December 2015	MERS-CoV is one of the eight pathogens included in the WHO's blueprint list. They reviewed the current status of the research, including therapeutics, vaccine, diagnostics, epidemiology, and establish priorities (397).
Technical Consultation on MERS-CoV	First meetings held in Saudi Arabia in January 2013 and December 2013 (443).	This was the first of a series of meetings in the region to analyze the outbreak and the health response.
	Consultative meeting to determine the public research agenda, Cairo, Egypt 15–16 December 2013 (444).	Affected countries would participate in an international multi-country Case-control study. Agreement on a "probable" case definition for MERS-CoV for reporting purposes
	Second meeting held in Saudi Arabia, in March 2014	There is no specific information about outcomes
	Third meeting held in Cairo in May 2015, Egypt from 5-6 May 2015 (hosted by WHO/EMRO (443))	The final protocol for the case-control study on MERS-CoV was finalized and.
	Fourth meeting, held in Doha, Qatar, on 27-29 April 2015 (hosted by FAO and the Supreme Council of Health of Qatar) and in Cairo) (445)	During the Doha and Cairo meetings, participants shared published and unpublished research findings "These meetings, including this fourth one, have contributed immensely to improving our understanding of the virus, its evolution and risk factors for transmission, as well as identifying critical information and knowledge gaps that can better guide an effective global public health response," said WHO's Regional Director Dr. Ala Alwan (WHO EMRO 2015).
	Regional Technical Consultative Meeting on MERS-CoV Muscat, Oman, 20-21 May 2014 (439)	It followed-up recommendations from past meetings

Table 39. MERS-CoV meetings and expert groups. Source: WHO/EMRO and various publications.

The relevance of research and gathering data required the active participation of the epistemic community. Figure 20 presents the participation of the epistemic community in the process of the international response to MERS-CoV.

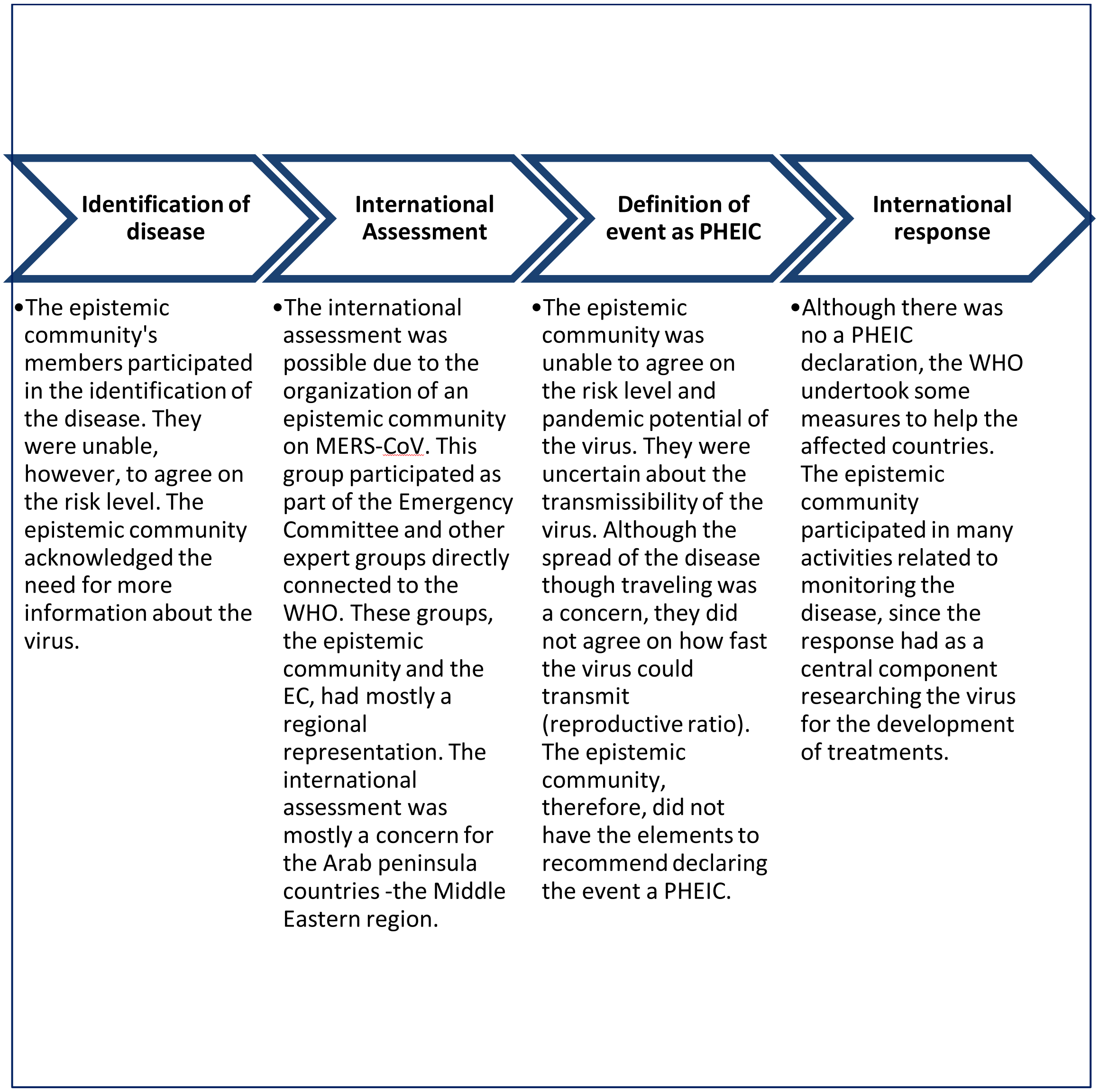

Figure 20. Process for the international response to MERS-CoV.

A few governments explicitly endorsed recommendations by the epistemic community. Saudi Arabia started following recommendations based on scientific evidence once the WHO established the Saudi Global Centre for Mass Gathering Medicine (462,449). Some studies found that in Qatar, the response and communication strategy was based on documents developed and supported by scientific evidence, following the International Health Regulations 2005 guidelines (463).

Countries that have experienced exported cases, like the USA, have also relied on their national experts to develop guidelines (441,464). The CDC has been one of the main advisors to the WHO, and it also organized a national MERS-CoV Working Group to study the outbreak (441). Other countries, like Canada, have established expert working groups to guide the detection and management of possible MERS-CoV cases (465). Experts from these agencies were part of the global epistemic community.

Table 40 summarizes international cooperation during the MERS-CoV outbreak based on the framework presented in chapter 4. It also identifies how the epistemic community influenced this response.

ACTIVITY	MEASURE	Epistemic community	International Response MERS	Level of Cooperation
I. International participation				
PROBLEM	1.Timely meetings at WHO and other settings.	Even though an epistemic community participated in this activity, *the lack of consensual knowledge* affected the result of these meetings.	The WHO called for an Emergency Committee, and it organized its first meeting on July 9, 2013. There have been ten more meetings to assess the situation (455). These meetings, however, started more than six months after the cases were notified.	3
	2.If there were actions implemented as a result of those meetings	The epistemic community, with its representatives in the EC, endorsed those actions. The limited response was related to the *disagreements about the pandemic potential of MERS.*	MERS is the only disease assessed by an Emergency Committee that has not been declared a PHEIC (127). As a result, there was no call for an international response. There have been some actions. However, these originated from recommendations issued after these meetings.	3
RESPONSE	Time frame after notification	Experts helped to notify the outbreak, but the *epistemic community did not have strong connections, and it did not have enough power to influence policymakers*.	The first Emergency Committee was convened in July 2013, more than six months after the notification of the first cases (466). The international response was partially affected by the late notification. Saudi Arabia provided notification to the WHO of the first case a few months after it was identified (383).	2
NO. OF COUNTRIES	Level of participation	The epistemic community had a small network. *Therefore, the socialization of its ideas was concentrated on people* from a few countries.	The level of international participation was low, given that the outbreak was not declared a PHEIC. Countries with research and development capacities participated in the response, providing technical assistance and expertise to the affected countries.	1
II. International assistance				
TECHNICAL A.	Type of participation in international missions.	Some experts from the epistemic community participated in these activities. This *helped to socialize its ideas, but the impact was less visible due to its disagreements.*	The WHO provided technical assistance through its networks of experts. It supported the conducting of risk assessments and joint investigations with national authorities; convening scientific meetings, and developing guidance and training for health authorities and technical health agencies on interim surveillance recommendations (467).	2

Table 40. Analysis levels of cooperation in the MERS-CoV response

ACTIVITY	MEASURE	Epistemic Community	MERS	Level of Cooperation
II. International assistance				
FINANCIAL ASSISTANCE	Money provided as financial assistance to the emergency	No evident participation of the epistemic community.	There are no records of financial assistance to the affected countries nor information of specific funds settled down to assist the R&D efforts.	0
TREATMENTS	Type of population getting treatments	Research is in process, and the virus now is considered a priority for the WHO Blue Print initiative, where many experts from the epistemic community participate (457,397).	When the virus emerged, there were no specific treatments for MERS, and the vaccine was not available (468).	2
PROVISION	1. How fast was the deployment of assistance	No evident participation of the epistemic community.	Assistance has been provided mostly by WHO since 2012 to some of the affected countries (468).	2
	2.Type of assistance	Some members of the epistemic community participated in the response, identifying the virus. The *socialization of ideas within the network helped* for sequencing and diagnosis.	Technical assistance has been provided for laboratory testing of cases, infection prevention and control, and clinical management (467).	2
III. Scientific response				
SAMPLES	If countries have shared virus samples	The sharing of the virus happened through *experts participating in the epistemic community network*. Although it was problematic.	The sharing of the virus was controversial due to problems with patent rights. This situation caused late access to virus samples (410).	1
R&D	1.If data is disseminated on time	Some members of the epistemic community have been part of this controversy.	There have been problems with transparency in the information (98,410), and it has transmitted late, which has affected the development of research studies (456).	2
	2.Phases of the research during the outbreak	There have been many experts from the epistemic community working on research and development, using its network to socialize its ideas and potentially increased its power in the process. The research process, however, has been slow (393).	Research started during the outbreak, and it is still ongoing.	3

Table 40. Analysis levels of cooperation in the MERS-CoV outbreak (cont.)

ACTIVITY	MEASURE	Epistemic Community	MERS	Level of cooperation
IV. Policy adoption				
SURVEILLANCE	If countries implemented systems to allowed constant notification of possible cases	The EC recommended increased surveillance. This suggestion derived from one of the *epistemic community's agreements.*	There has been continuous surveillance since 2012, mostly by affected countries. Notification of timely information, however, has not been consistent (456).	3
NOTIFICATION	How long did countries wait to notify the WHO after identifying the cases?	*The epistemic community network* influenced the notification.	The WHO received notification of the first cases in 2012. Some countries have been doing this better than others at notification (456). Some considered that the data about the epidemic was shared late (127).	4
POLICY CONVERGENCE	How broad were the recommendations adopted and implemented?	Even though the epistemic community provided some advice, its small and closed network, as well as its weak bureaucratic power, limited its influence, especially at the national level.	In its 10th meeting, the MERS-CoV EC noted that its advice had not been entirely followed by countries (although the EC did not mention explicitly which countries). In some cases, reporting of cases was inaccurate, or it was not being done as required (461).	4
	The degree of adoption of international norms.	The epistemic community limited institutionalized power made it more difficult to modify some country's interests in implementing the norms, even with those countries that have financial resources.	Although affected countries have been working with the WHO since the beginning, they still must improve their surveillance and diagnostic (467).	4

Table 40. Analysis levels of cooperation in the MERS-CoV outbreak (cont.)

The analysis of the international response provides evidence that the level of international cooperation, in this case, was low to medium. Even though the outbreak impacted several countries, there was evidence of cases outside the region of origin, due to travel and lack of treatments. The international community, however, did not implement more coordinated actions to address the situation. An epistemic community participated during the outbreak and the response.

It had active participation in the international decision-making process, and it influenced some of the activities in the response. The lack of an agreement within the community of the level of severity, the management of the outbreak by some of the countries, and the need for more information, made this a technical and scientific response with a highly regional component.

6.5 Influence of the epistemic community in the level of cooperation.

The MERS-CoV epistemic community did not play a substantial role in the international response. This statement, however, does not dismiss its participation in the process or its contribution to it. Evidence demonstrates that the MERS epistemic community faced some constraints with establishing itself as a more influential actor. It did not reach a scientific consensus about the risk posed by the MERS-CoV. Some researchers considered the MERS outbreak was not like the SARS outbreak; therefore, they concluded the likelihood of a pandemic was low (383), whereas other experts affirmed this virus had similar characteristics to the SARS coronavirus (421,252). The partial consensus and lack of information affected the creation of consensual knowledge for decision making. Even though they were the primary providers of information, they could not offer specific guidance on how to address the situation.

There were problems within the epistemic community that also affected the production of knowledge, such as the sharing of samples among experts to identify the virus. The Saudi virologist acted upon the public interest and tried to share information globally as soon as it was available. On-time notification, however, was hindered in part by competition and claims over property rights made by the Erasmus Medical Centre (ECM), which limited the access to samples (410). ECM was part of the epistemic community and acted as a barrier to collaboration among experts. In addition to this, political interference in the sample sharing process also delayed notification.

The structure of the epistemic community was small and regional rather than global. The WHO and its partners acted as the central nodes and providers of information, while the most affected countries in the Middle East were the direct recipients of assistance. The epistemic community members had many interactions, but most of them were in a closed group, which made it difficult to exchange information with others outside the epistemic community. The scarce research slowed down the diffusion process, creating barriers to improve guidelines and norms. There were problems in the diffusion of information and access to data. The centralization of the actions at the regional level restricted awareness at the global level. The fact that Dr. Al Memish was central in the epistemic community and, at the same time, protecting the interest of national governments, affected the interactions of the community with decisionmakers.

MERS-CoV continues circulating in the environment, without being considered a pandemic yet. Although person to person transmission is confirmed (383,384), there is no consensus on the efficacy of its transmission (423,392,393,252). Much information about the virus remains unknown. Experts are concerned about what could happen in the future, as well as in the lack of global interest and resources invested in this area (252,384).

Coronaviruses seem to attract less attention from the scientific community due to the lack of incentives for research and funding (252). There is, however, a growing interest in developing a vaccine, and more resources have been invested for that (457,458). Other areas (such as the human-animal interface) remain less popular among researchers (461).

In conclusion, this research identifies an epistemic community on MERS early in the outbreak. This network of professionals, however, had a lower capacity to influence more cooperation during the international response to the outbreak, given its inability to establish a consensus in the community and to position the topic in the global health agenda. The incapacity to position itself also as a reliable source of information, problems within the epistemic community due to divergent interests and problems to access to data, made it more difficult to institutionalize bureaucratic power at the global level. Fewer of the epistemic community's members were involved in the policy-making process, directly or indirectly, also limiting the network's influence. In some cases, political interest seemed to be a stronger driver during the process than scientific and technical considerations.

Chapter 7: Ebola Outbreak 2013-2016

7.1 Introduction

Ebola has puzzled experts worldwide, given the type of pathogen and its characteristics. Today Ebola is known as one of the world's most lethal diseases, a threat for national security (469,470,37,471,32), and is classified as a bioterrorist agent by the US CDC (See Box 3). The first-ever recorded outbreak of Ebola Hemorrhagic Fever occurred in 1976 (472). Since then, there have been 26 major outbreaks and other isolated individual cases (473).

Box 3. Ebola virus disease (EVD) (Ebola Hemorrhagic Fever)

Origins of the disease

The first cases of the Ebola virus emerged in 1976 in Zaire (now the Democratic Republic of Congo-DRC) and South Sudan. Before 2014, African countries had registered 25 outbreaks: DRC, Sudan, Republic of Congo, Ivory Coast, Sierra Leone, Guinea, Mali, and Liberia (474,475,476,477,473).

The virus received the name of Ebola due to the Ebola River in Zaire (DRC), the place where the first case was detected (478,479). Ebola is part of the Filoviridae family, which can cause severe hemorrhagic fevers in humans and primates. Scientists have identified three types: Cuevavirus, Marburgvirus, and Ebolavirus (480,479,481,474). Ebolavirus is the most virulent of the family (475,474). There are five Ebolavirus species known: Zaire, Bundibugyo, Sudan, Reston, and Tai Forest -all named after the location where they emerged (475,481,479,482). Four of them have been found in Africa and one in Asia (474).

Nature of the disease

The virus is zoonotic, which means that the first case in an outbreak -or index case-, the virus will likely transmit from an animal to human (477,475,483,479). Although it is still unclear which animal species is the main reservoir (484,477,475,476), recent studies show that primates in Africa (gorillas, chimpanzees) have died from these viruses for a long time (474). There is evidence that these animals may be contracting the disease from fruit bats, species that also seem to be responsible for the human transmission (474,475,485). Once the animal to human transmission occurs, sustainable human to human transmission can occur (475,474).

People infected with the virus can have a fever, abdominal pain, headache, myalgia, sore throat, vomiting, diarrhea, maculopapular rash, limited renal and hepatic involvement, bleeding (hemorrhages), among others symptoms (480,486,478,487,475). Given the number and variate of symptoms, doctors usually can confuse with Lassa and symptoms in early stages mimic malaria (endemic in the region). They can also confuse it with yellow fever, salmonella, typhoid fever, and meningitis (478,488,479).

Box 3. Ebola virus disease (EVD) (Ebola Hemorrhagic Fever) (cont.)

Person to person transmission occurs through direct contact with human fluids (through blood, saliva, sweat, semen, vaginal fluids, urine), organs, or contaminated surfaces and materials (bedding, syringes, needles) (487,476,489,479,480,490). The most affected people are usually doctors, nurses, health workers, and people directly assisting ill people (491). These characteristics gave it the name of the “caregivers’ disease” (492). Global health specialists are concerned about Ebolavirus, given that its fatality rates tend to vary between 25% to 90% (479,493,474). It is usually a fatal disease when adequate treatment is not provided on time (479,483).

Global Threat

Since 1976 this disease has been studied, the virus isolated, and there is an extensive understanding of its transmission patterns, severity, surveillance, and management during and after an outbreak (483,475). Thus, experts used to believe that Ebola outbreaks were localized and that they followed a specific trajectory: it suddenly appears, and, after some weeks, several cases continue appearing; later, the transmission chain stops, with a sudden decline in cases, starting a burnout phase (494,475). Before the last outbreak, the possibility of a major international outbreak was remote since previous outbreaks were in isolated areas (475). The disease was relatively easy to contain with adequate protective equipment and isolated procedures. However, the outbreak of 2013 in West Africa followed a different trajectory, spreading across multiples villages and crossing international borders (479,490).

On March 23th, 2014, the WHO announced the Ebola outbreak in Guinea (473). In the following months, the virus spread out to Sierra Leone and Liberia, and by October 2014, the three countries combined had more than 6500 cases (495). The humanitarian organization Médecins Sans Frontières (MSF), already assisting the government of Guinea to control an outbreak of Malaria, was involved early in the Ebola outbreak (241). The GOARN-WHO arrived at the country later, after the government notified the outbreak. The WHO, however, did not immediately call for an Emergency Committee to assess the epidemic (496). The outbreak spun out of control after a few months, showcasing the problems within the international system’s capacity to respond to pandemics (497,498,37).

The response to the 2014 Ebola outbreak is now broadly recognized as a failure (499,110,473), with enough evidence to characterize it as having a low level of international cooperation, which contributed to the rapid spread of the virus and fatal consequences for the communities. The failure in the response to the outbreak and the subsequent problems can be attributed to multiple factors, from the location of the outbreak to political and social problems, as well as how the WHO addressed the situation.

Some attribute the failure to respond in part to the experience with past Ebola epidemics. Ebola outbreaks are frequent in Africa, in remote villages where they are usually easily contained (241,473). The WHO initially considered the 2013-2014 outbreak in Africa small and isolated like previous ones (241). Therefore, the organization deemed it unnecessary to start an immediate international response. However, the rapid spread of the virus to neighboring countries and the number of cases exposed the consequences of globalization in its transmission, when a virus erupts in an area with the regular movement of people across borders (500).

Problems with the response were also attributed to the lack of interest in Africa, which translated into ignorance about the continent and its problems, as well as xenophobia and ethnocentrism towards the "African" (501). This lack of interest exacerbated feelings in the world population of anxiety and fear of the virus and the situation (502,241,503). The fear was reinforced by continuous and regular air travel to the most affected countries and the probability of exporting the infection (504). As a consequence, some people did not want their countries involved in the region, and, instead, they supported more restrictive policies such as quarantines (503,501,505), affecting the international responses to the outbreak

The affected countries also had domestic issues that slowed down the response. Sierra Leone and Liberia are post-conflict states, suffering the consequences of devastating civil wars that weakened their institutions (506,507). Guinea did not have a civil war but has suffered from the instability of the region (507). This context has affected the countries' health systems, making them weak and more dependent on international assistance. Their governments are still unstable; people do not trust them (501,507,506). During the outbreak, the combination of these factors affected domestic and international responses. The governments of Guinea and Sierra Leone recognized late the severity of the situation, delaying global notification due to the fear of causing panic, and the implications for international tourism and trade (241). In contrast, Liberia's government reported the cases in its territory immediately after they were detected. Nonetheless, Liberian people accused their government of exaggerating the situation to get more foreign aid, and they were reluctant to receive help due to the fear of intervention (241,507).

In addition to that, the WHO also showed several organizational and structural problems due to budgetary cuts, not enough personnel for operations, and political interference (508). After the financial crisis of 2008, the WHO's budget has suffered significant cuts with the epidemic funding reduce by half in 2012 (508,509). The reduced funding to assist countries during pandemics originated a reduction of WHO's staff in field operations (510). Besides, the politics and relationship with its member states played an important role in delaying actions (241). The WHO depends on its member states for funding, and they are the ones who decide how to allocate the money. Most of the budget is earmarked, eliminating the possibility of more flexibility in case of an emergency. As well, the organization requires its members to approve changes in its structure, making any necessary change to the operations a political process. Finally, the relationship between the headquarters and the regional offices also affected the WHO's participation (508,509). The Director of the Regional Office for Africa was a political appointee, and he decided to make decisions based on politics instead of evidence. Presumably, he did not provide all the information to the WHO Geneva about the situation. However, others also blamed the WHO for denying evidence and the seriousness of the situation following the countries' requests (509,241), postponing a response.

Finally, even when Ebola disease has been considered a priority for global health security, the outbreak did not prompt action under a global security agenda, and countries prioritized their national interests over international security (511,469).

Given all these factors, how does the participation of the epistemic community fit in here? Figure 21 illustrates the relationship between the Ebola epistemic community and the level of cooperation in the international response. This chapter will analyze the epistemic community and will provide explanations to understand how an epistemic community contributed to this level of cooperation, given all other factors affecting the low levels of international cooperation.

For simplifying the analysis of the international response and the influence of an epistemic community, this research considers the outbreak had two pivotal moments. During the first one, the international community failed to respond quickly to unfolding events in West Africa. In the second phase, once the outbreak reached countries outside Africa, international alarm increased, leading to a coordinated international response.

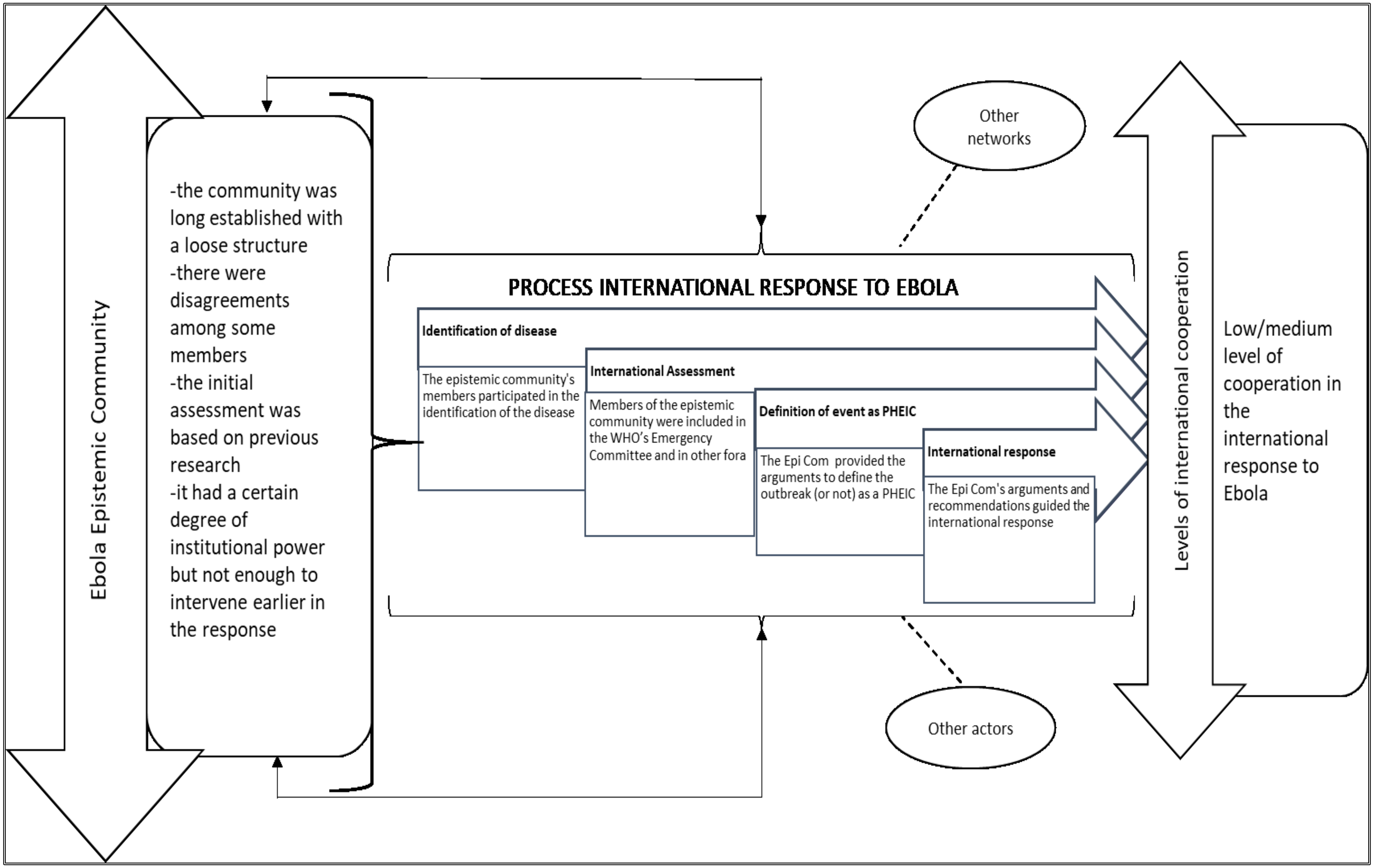

Figure 21. Ebola epistemic community and its participation in the international response

7.2 Ebola outbreak in West Africa 2013-2016

The 2013 Ebola outbreak was the first one in West Africa from a Zaire Ebolavirus, one of the most deadly strains of Ebola (241). Ebola's case fatality rates have varied from period to location, fluctuating between 40 percent to 80 percent, with health workers usually being the most affected population (512,513). Ebola outbreaks have shown a high mortality rate in the past (493,479,479), and reproductive ratio R_0 between 1.35 to 3.65 (518,519,497). This was the same pattern documented in the West Africa outbreak; however, Ebola high case fatality rates estimations in this outbreak fluctuated between 50-90%, due to underreporting (512,487,493,474,516).

The WHO Ebola Response Team estimated a R_0 of 1.71 in Guinea, a R_0 of 2.02 in Sierra Leone, and a R_0 of 1.837 in Liberia (513). The team analysed data reported by individual countries between December 30, 2013, and September 2014 (513). According to this analysis, these numbers were similar to the case fatality rates found in other recent outbreaks in Africa. The team of experts also confirmed that the epidemic had the same characteristics previously seen (513). Table 41 shows the characteristics of the 2013-2016 outbreak.

	Ebolavirus (EVD)
VIRUS	Zaire Ebolavirus
CASE FATALITY RATE	40-90%[lvi]
TYPE OF TRANSMISSION	Animal to human (index case) Human to human (subsequent)
NO. OF CASES	28,616 (June 10, 2016)[lvii]
NO. OF DEATHS	11,310
NO. OF COUNTRIES	10[lviii]
TREATMENT	
VACCINES	Non-existent during the outbreak[lix]

Table 41. Characteristics Ebola outbreak West Africa 2013-2016.

[lvi] The case fatality rate initially was calculated 50%.
[lvii] As reported in the latest Situation report published by the WHO on June 10, 2016
[lviii] Guinea, Liberia, Sierra Leone, Italy, Mali, Nigeria, Senegal, Spain, The United Kingdom and the United States
[lix] In December 2016 The Lancet published the results of a randomized trial of a vaccine that seems to provide high protection against the pathogen. The vaccines are called rVSV-ZEBOV, and the trial involved 11 841 people in Guinea during 2015. (718) .

Epidemiological evidence traced back the outbreak to December 2013, in Meliandou, Guinea. The WHO Ebola Response team found information that on December 26, 2013, a two-year-old boy was reported severely ill, presenting symptomatology of a mysterious disease and dying after two days (110,382,111,483,517,518). Subsequent epidemiological investigations showed that the boy died of Zaire ebolavirus likely from contact with a bat (483). This patient is now considered the index case. According to information reported by the WHO, doctors in the village of Meliandou issued an official medical alert on January 24th, 2014, when they informed district authorities of various patients with severe and fatal diarrhea (518,519). This report included the cases of people that were in contact with the boy and included his immediate family, midwives, and traditional healers. Health workers from the hospital in the Gueckedou District, where these patients received medical care, were also among the infected people (519). At that time, local health officials suspected cholera, although their investigation was inconclusive (519). The disease, however, spread out outside the village due to the traditional funerals that were attended by members of the boy's extended family, and who started transmission chains that soon reached the capital of Guinea, Conakry, which had its first cases in February 2014 (518,519).

On March 13th, 2013, the Ministry of Health informed the WHO Regional Office about the situation. The same day the WHO opened an investigation suspecting first an outbreak of Lassa fever, a viral hemorrhagic fever endemic in the region (518,241). The government of Guinea requested assistance from MSF to investigate the situation. The first MSF staff arrived in the village with suspected cases on March 18th (241,473). MSF deployed more teams in Guinea and Sierra Leona when its senior epidemiologist, Dr. Michel Van Herp, suspected they were dealing with Ebola. Due to Dr. Van Herp's suggestion, on

March 21st, the organization sent virus samples to the Institut Pasteur in Lyon, France (a WHO Collaborating Centre) where scientists identified the virus on March 22, 2014 (382,111). The same day the Ministry of Health of Guinea officially declared the outbreak as Ebola (241). The event was internationally reported on March 23th, 2014 by the WHO's Africa Regional Office (496). The WHO announced to the world that Ghinea notified and confirmed 49 cases and 29 deaths (518,111).

Ebola symptoms are similar to malaria and Lassa fever in their early stages; diseases endemic in the region (520,517,476). Thus, after the first case in Guinea, the disease quietly spread for months before being detected. Liberia confirmed two cases in the Foya District, close to the border with Guinea and Sierra Leone on March 30th, 2014 (473). Sierra Leone confirmed the outbreak on May 24th, 2014, and the first case in Kenema, a city closer to the border of both Liberia and Guinea (473). Between June and September of 2014, the number of cases detected increased exponentially.

After a few months of the outbreak, more countries notified cases (521). On September 30th, the first case of Ebola outside Africa was detected in Spain when a nurse working in West Africa with Ebola patients became sick after returning to her country (518). The second case outside Africa occurred in the United States after a person flew from Liberia to Dallas and was hospitalized on September 25th for what was later confirmed as Ebola (518). This patient died and transmitted the disease to two nurses. The imported cases to the USA increased the international alarm and fear of a massive worldwide spread of the disease (273). Figure 22 presents the chronology of the outbreak.

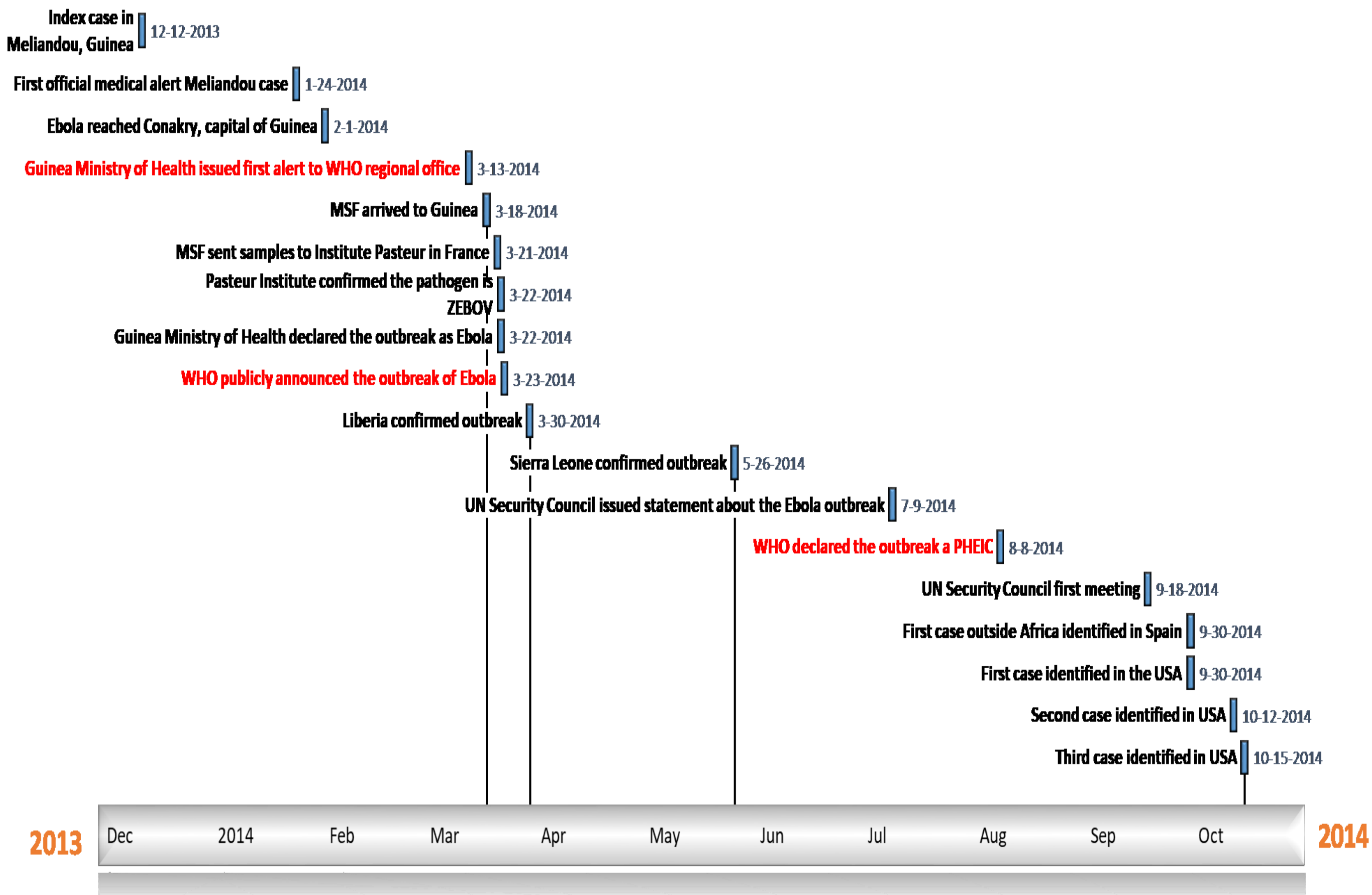

Figure 22. Chronology Ebola outbreak in West Africa 2013-2014

At the beginning of the outbreak, scientists identified the animal to human transmission in some parts. However, most infections occurred due to human to human transmission (483,518). The lack of information and knowledge about Ebola delayed notification and control measures, which increased the risk of transmission among health workers and caregivers (492).

Late notification, movement of infected people across borders, failure to undertake contact tracing, and traditional burial practices facilitated the spread of the disease, increasing the international concern for the pandemic potential of the outbreak. Figure 23 shows the geographical distribution of Ebola cases in October 2014.

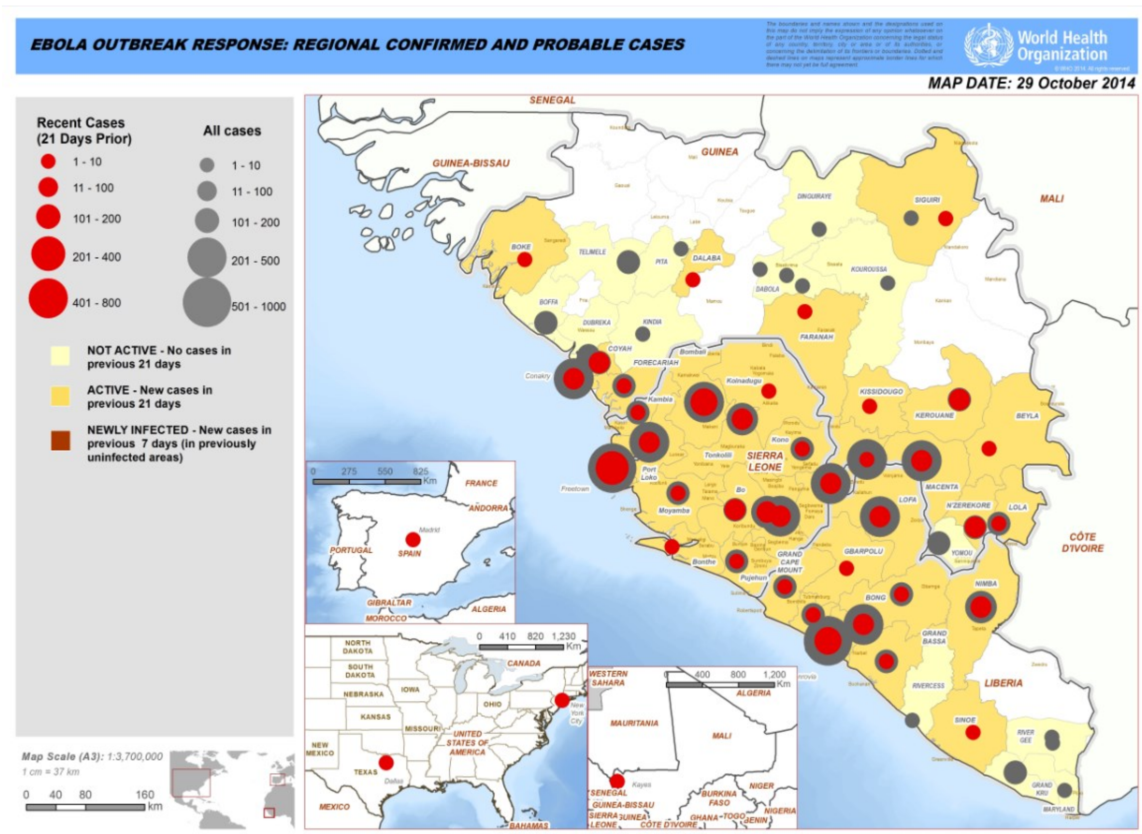

Figure 23. Geographical distribution of Ebola cases, October 2014.
Source: WHO Ebola Maps (http://www.who.int/csr/disease/ebola/maps-2014/en/)

The events in West Africa and the Ebola outbreak brought to light problems with the global system of governance and the international response to pandemics. The impact of the epidemic changed from country to country, as a result of the number of people infected and the timing of the interventions, Sierra Leone being the most affected country (516).

7.3 The Ebola epistemic community

Analysing the epistemic community's characteristics will help to determine its influence on the level of cooperation seen during the West Africa outbreak.

7.3.1 Origins of the Ebola epistemic community

The epistemic community originally comprised experts that worked together when the first Ebola outbreak was detected in 1976 in Zaire (now DRC) and Sudan (now South Sudan). This outbreak had 318 confirmed cases and 280 deaths (478), with a case fatality rate of 88% (477). It started in patients at the Yambuku Mission Hospital, showing the vulnerability of health workers, where 11 of 17 staff members died of the disease (478,476). The outbreak was initially concentrated in the Bumba zone of the Equator region. However, in Sudan, health authorities detected patients with Ebola near the border with Zambia; people traveling between communities probably transmitted the disease (478). The government of Zaire requested international assistance to control the outbreak in October 1976 (476), and the WHO organized the International Commission for the Investigation and Control of Ebola Hemorrhagic Fever (478,476). The WHO called experts from recognized health institutions from Belgium, Canada, France, the Republic of Zaire, South Africa, the United States of America, and the World Health Organization to participate in the Commission (See Appendix K for the full list of experts). The Commission visited Yambuku for the first time on October 19 (478). By then, the area was in quarantine, and air services had stopped, limiting the access to medical equipment and other essential goods.

Countries faced a lack of materials for medical protections (mainly gloves and lab coats), as well as problems with inadequate cleansing of medical equipment (syringes, needles, surgical instruments) and inadequate treatment of possible cases (478). The Commission brought medical experts to inform and educate medical personnel about how to contain the disease and use protection when treating patients. They also established a team for researching possible cases and collecting samples, which later the US CDC in Atlanta used to isolate the virus (478).

Given the situation in the area, and the high mortality rate, the Commission returned a second time and "mobilized all available resources, national and international, to cope with a possible major threat to public health in Zaire and elsewhere" (478). The group of international experts established a total of ten surveillance teams by November 9, 1976. They visited 550 villages, interviewed around 34,000 families, and identified 231 probable cases (478). The International Commission advised lifting quarantine on December 16, six weeks after the last death from Ebola was reported (478). Experts that participated in the response to this first outbreak considered that quick recognition of the disease was crucial for controlling it (476).

Since 1976, there have been several Ebola outbreaks in Zaire/DRC and Uganda, showing a high mortality rate. The transmission, however, was concentrated in communities (community-based transmission), with index cases that usually had the first contact with animal reservoirs (animal-human transmission) (522). Before 2013, outbreaks were concentrated in central and eastern Africa (473). Table 42 summarizes the outbreaks and their main characteristics.

Year	Country	Ebolavirus species	Cases	Deaths	Case fatality
2012 Nov-2013 Jan	Uganda	Sudan virus	6	3	50%
2012	Democratic Republic of Congo	Bundibugyo	57	29	51%
2012	Uganda	Sudan	7	4	57%
2012	Uganda	Sudan	24	17	71%
2011	Uganda	Sudan	1	1	100%
2008	Democratic Republic of Congo	Zaire	32	14	44%
2007	Uganda	Bundibugyo	149	37	25%
2007	Democratic Republic of Congo	Zaire	264	187	71%
2005	Congo	Zaire	12	10	83%
2004	Sudan	Sudan	17	7	41%
2003 (Nov-Dec)	Congo	Zaire	35	29	83%
2003 (Jan-Apr)	Congo	Zaire	142	128	90%
2001-2002	Congo	Zaire	59	44	75%
2001-2002	Gabon	Zaire	65	53	82%
2000	Uganda	Sudan	425	224	53%
1996	South Africa (ex-Gabon)	Zaire	1	1	100%
1996 (Jul-Dec)	Gabon	Zaire	60	45	75%
1996 (Jan-Apr)	Gabon	Zaire	31	21	68%
1995	Democratic Republic of Congo	Zaire	315	254	81%
1994	Cote d'Ivoire	Taï Forest	1	0	0%
1994	Gabon	Zaire	52	31	60%
1979	Sudan	Sudan	34	22	65%
1977	Zaire	Zaire	1	1	100%
1976	Sudan	Sudan	284	151	53%
1976	Zaire	Zaire	318	280	88%

Table 42. Ebola outbreaks over time.
Source: WHO Ebola Chronology; Outbreaks Chronology Ebola Virus Diseases CDC USA (523).

In December 1977, during the International Colloquium on Ebola Virus Infection and Other Haemorrhagic Fevers held in Antwerp, Belgium, experts recognized that new diseases occurring in remote areas far from research institutions were less likely to be investigated (524). Despite this recognition, only a few institutions initiated research programs related to hemorrhagic diseases. These institutions are found mostly in the USA and Canada, and research is guided by security precepts, due to the fear that Ebola can be used as a biological weapon (525,110).

The group that included experts in the International Commission, and whose later participated in the International Colloquium, can be identified as the origins of the epistemic community in Ebola. Since the 1970s, the epistemic community has been working together, expanding its research to other Filoviruses. It has had continues interactions and disseminating their knowledge. Table 43 presents a list of international conferences and symposiums.

Conference	Date and location
International Colloquium on Ebola Virus Research	September 4-7, 1996, Antwerp, Belgium
Russian-German Colloquium on Filoviruses	January 28-February 2, 1997, Koltsovo, Russia
Symposium on Marburg and Ebola Viruses	October 1-4, 2000, Hesse, Germany
VRC Symposium on Viral Hemorrhagic Fevers	October 14-17, 2003, Bethesda, USA
Outbreaks of Ebola Haemorrhagic Fevers in Central Africa (2001-2003)	September 7-8, 2004, Paris, France
Workshop on Controlling the Impact of Ebola on African Apes	March 10-11, 2005, Washington D.C., USA
Filoviruses: Recent Advances and Future Challenges	September 17-19, 2006, Winnipeg, Canada

Table 43. Conferences related to Ebola and other Filoviruses (526).

The Ebola epistemic community has advanced our knowledge about the virus since the 1970s, and its research has been used to respond to different outbreaks. Since 1995, collaboration among experts has increased, and more scientists have shown interest in the virus (527). In the 2000s, the creation of the WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF institutionalized the Ebola epistemic community, increasing its participation at the WHO as technical advisors, who are involved in drafting policy documents (528,527). Thus, in 2014, an epistemic community existed. The network shared among its members' common interests, normative beliefs, causal beliefs, epistemological beliefs. Table 44 summarizes these characteristics.

Common interest	They want to increase research on Ebola and improve its diagnosis and treatments.
Epistemological beliefs	They considered that science should guide policies. They agree that Ebola represents a risk and threat to humans. Therefore, vulnerable populations should be better prepared to deal with future outbreaks.
Normative-principled beliefs	They are working on reducing the number of deaths and human suffering due to Ebola.
Causal beliefs	Ebola is transmitted from animal hosts to humans, and human to human transmission can be fast.
Notions of validity	They have established general practices for research and development of medical and non-medical interventions.

Table 44. Characteristics Ebola epistemic community.

These elements have made possible the work of an Ebola epistemic community, which has produced consensual knowledge and a common policy goal.

7.3.2 Characterizing the Ebola epistemic community

The foundations of the Ebola epistemic community come from the first outbreak of Ebola registered in history and the formation of a group of professionals interested in advancing our knowledge about the disease. The characteristics of this community will be analysed to understand its participation during the response in the 2014 Ebola outbreak.

7.3.2.1 Knowledge

The epistemic community had developed its consensual knowledge before the outbreak in West Africa in 2014. Experts knew that the Ebola virus caused outbreaks with high mortality rates due to a hemorrhagic fever. Scientists also believed the disease was confined usually to remote areas, and it affected only certain countries in Africa. These characteristics made it easier to contain outbreaks, with the expectation of a low number of people infected (517,489,513). Ebola epidemics, however, frequently started in countries with weak and unprepared health systems, where the health personnel was scarce, with limited knowledge about how to respond to the disease, making this group highly vulnerable (489,529,491,530).

When news on the West Africa outbreak started, many members of the epistemic community agreed that using the same strategies used in past outbreaks would work again [contact tracing, establishing quarantine and isolation of cases, infection control, and safe burial (513)]. In the end, these measures were not enough to contain the outbreak (517,489). Others, however, believed the events required a different approach and demanded quick action and prompt intervention of the international community. This was the case of MSF's Ebola experts, who were an essential part of the international response. According to MSF reports, WHO experts initially disregarded MSF experts' suggestions about the emergency (241).

The disease spread quickly, and people moving across countries were transmitting the disease, causing micro-epidemics in clusters of cases. The quick transmission made it necessary to provide faster diagnostics. Because the virus incubates in 3 to 21 days, the focus shifted to improve the diagnosis, implement quarantine of infected people and containment, and educate people and health workers about essential sanitary measures (517,513).

Once the outbreak was under control, the epistemic community recognized that the incident brought new lessons about the management and response of future epidemics (531). Experts agreed that this outbreak was different from others because of the context and lack of preparation in the countries (513). This was the first outbreak in a highly interconnected area where traveling increased the rate of transmission [(489,513), Interview 12]. Even though there was information about the disease and how to handle it, the context changed, and these professionals were unprepared to act faster (Interview 12).

Experts also agreed that a rapid response could effectively interrupt transmission (516). This was the case in Nigeria, where the outbreak was contained easily, and only 15 people were infected (516). This last finding was not novel since experts had previously documented the importance of quick identification and notification (476,475).

The epistemic community developed consensual knowledge that was used to guide the initial response, but it failed to recognize changes in the context (513). Besides, the epistemic community's policy goal was evident after the outbreak started. The policy goal appeared in the 2014 Strategic Plan designed with the WHO, which recognized Ebola as a public health issue in sub-Saharan Africa. Countries in that region, according to the report, require better tools, resilient health systems, and equipped workers to fight future outbreaks (532). When the outbreak spun out of control, this policy goal extended to a global concern, acknowledging widespread inexperience on dealing with Ebola outbreaks (496), and the limited knowledge about specific aspects of the disease, symptoms and transmission patterns.

7.3.2.2 Socialization of ideas

Having developed consensual knowledge and policy goals are not sufficient conditions to influence international cooperation if these are not socialized among members of the epistemic community and made accessible to policymakers. The Ebola epistemic community disseminated its consensual knowledge during the Ebola outbreak through its network structure, its participation in international conferences, and the publication of information and evidence.

The structure of the Ebola epistemic community, however, is smaller than the influenza epistemic community and closed. The WHO has acted as a loose coordinator, although, during the outbreak, the WHO concentrated a lot of the information and distributed it directly within the network (533). Having the WHO's experts collecting and managing most information, limited the capacity of other epistemic community's members to connect with experts outside the network (Interview 11).

The epistemic community also is a closed, rigid structure that restricts the integration of other experts. The WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF, the Ebola Emergency Committee, the Members of the WHO Advisory Group on the Ebola Virus Disease Response, and the GOARN were the groups that formed the core Ebola epistemic community. The WHO's experts, however, acted as the focal point for the network, and many decisions were centralized within the WHO's bureaucracy.

The epistemic community had several interactions before and during the outbreak through meetings and other mechanisms. For instance, the group of experts that analysed the outbreak and prepared the first guidelines, had meetings in Burkina Faso (Ouagadougou), Gabon (Libreville), and Republic of the Congo (Brazzaville) between 2004 and 2009 (532). Some of these experts were also part of the WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF. As well, the WHO organized the Emergency Committee in August 2014, which held nine meetings between August 8th, 2014, and March 29th, 2016. The Members of the Advisory Group interacted with the Emergency Committee and the WHO for the response (534)**.** The Advisory Group had thirteen meetings between October 15th, 2014, and January 12th, 2016.

The size of the epistemic community was not very big. The network, however, increased after the outbreak, and more professionals joined (499,110). The epistemic community has also remained concentrated in the most affected countries and developed countries with research capacities. Figure 24 maps the epistemic community by country.

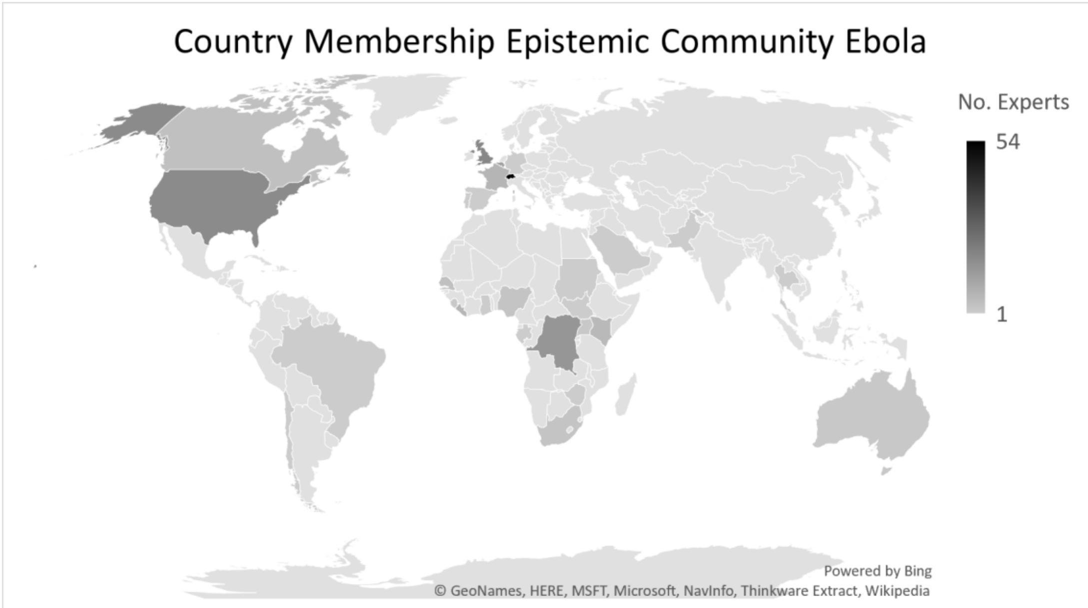

Figure 24. Geographical distribution epistemic community members Ebola.

The existence of an epistemic community, with consensual knowledge and a network connected to the main policy-making structure, are not enough elements to be able to influence international cooperation. The community must create knowledge, disseminate it, and make it useful for the policy process. One of the challenges of the community was to produce research to understand the events in West Africa. Although Ebola was identified in the late 70s, a recent study found that between the years 1976 and 2013, there were only 2485 publications with the word Ebola in the title, and 3081 in keywords and abstract. After 2013, more research was published about Ebola (485), mostly by experts in North America and Europe, and studies from scholars based in African countries were less common [mainly from Gabon, Republic of Congo, Central African Republic and Cameroon (485)]. Most research collaborations concentrated in Canada and the United States; two countries that have invested in research due to national security concerns and have most of the laboratories with a biosafety level 4 (BSL-4), facilities that are required to isolate dangerous pathogens (485).

The availability of evidence supported by scientific research, the dissemination of information, and knowledge-sharing are critical activities for a pandemic response (476). During the first phase of the outbreak, there was limited information available about treatments and drugs, and the possibility of testing and producing a vaccine in a short time was unlikely (110,241). The epistemic community was the primary source of information, and it needed to be able to disseminate it as soon as possible. Dissemination and sharing data, however, were problematic, and it took time to collect samples and develop research capacities (517,127). Part of the problem originated in the affected countries for not having adequate systems for transmitting data, and information was not shared in a timely and open manner (110,535,241). Some researchers also withheld some information, and other scientists were not credited for accessing it (110,127,126,536). During the second stage of the outbreak, researchers prioritized the testing of vaccines and researching new drugs (110,485).

The WHO was the central coordination and dissemination channel for the epistemic community, organizing meetings for data sharing and establishing norms that were included in a "blueprint" in which Ebola appears as one of the priority pathogens (110,537). In August 2014, members of the epistemic community collaborated with the WHO and published the document "Ebola and Marburg virus disease epidemics: preparedness, alert, control and evaluation." These experts were part of the WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF, who compiled the document based on the outbreaks recorded since 1995 (532). They, however, did not have relevant participation in the decision-making process at the beginning of the outbreak, and their role was limited to technical assistance. The WHO published around 80 technical documents to guide the response (270).

During the second stage of the outbreak, the WHO issued publications and policy documents, which included recommendations and information provided by the epistemic community. The Emergency Committee made the most important recommendations. Table 45 presents a summary of the most important of them.

Date	Recommendation
8 August 2014 First meeting EC	Recommended declaring the Ebola outbreak in West Africa a Public Health Emergency of International Concern (PHEIC). The Director-General endorsed the Committee's advice and issued them as Temporary Recommendations under IHR (2005) to reduce the international spread of Ebola, effective 8 August 2014. The EC also suggested an immediate coordinated international response to stop and reverse the international spread of Ebola.
22 September 2014 2nd meeting EC	The EC recommended "enhanced mobilization and coordination of resources to facilitate response efforts; to engage the global research community and address key research opportunities (e.g. virus mutation, modelling effects of entry/exit strategies, effectiveness of various public health measures directly relevant to Ebola control including health-care worker infection and protection, new/unregistered medical interventions).."
23 October 2014 3rd meeting EC	"The Committee reiterated its recommendation that there should be no general ban on international travel or trade. A general travel ban is likely to cause economic hardship and could consequently increase the uncontrolled migration of people from affected countries, raising the risk of international spread of Ebola. The Committee emphasized the importance of normalizing air travel and the movement of ships, including the handling of cargo and goods, to and from the affected areas, to reduce the isolation and economic hardship of the affected countries. Any necessary medical treatment should be available ashore for seafarers and passengers (…)."
21 January 2015 4th meeting	"The Committee reaffirmed the need to avoid unnecessary interference with international travel and trade, as specified in Article 2 of the IHR 2005(...)" "The Committee concluded that the primary emphasis must continue to be on 'getting to zero' Ebola cases, by stopping the transmission of Ebola within the three most affected countries. This action is the most important step in preventing international spread. Complacency is the biggest risk of not getting to zero cases. Continued vigilance is essential".
7 July 2015 6th meeting	The Committee addressed the need for interagency collaboration, especially at the community level, and that operational agency should have better communication with communities. Affected countries should make every effort to retain and retrain health workers and ensure the engagement of communities in all aspects of the response. The Committee emphasized the importance of providing social and psychosocial support to communities and support to persons placed in quarantine.

Table 45. Emergency Committee summary recommendations Ebola outbreak.

Date	Recommendation
5 October 2015, 7th meeting EC	The EC considered that Ebola contacts or cases should not travel unless the travel is part of an appropriate medical evacuation. Its recommendations to minimize the risk of international spread of virus included: "Confirmed cases should immediately be isolated and treated in an Ebola Treatment Centre with no national or international travel until 2 Ebola-specific diagnostic tests conducted at least 48 hours apart are negative; Contacts (which do not include adequately protected health workers and laboratory staff who have had no unprotected exposure) should be monitored daily, with restricted national travel and no international travel until 21 days after exposure; Probable and suspect cases should immediately be isolated, and their travel should be restricted in accordance with their classification as either a confirmed case or contact. States should conduct exit screening of all persons at international airports, seaports and major land crossings, for unexplained febrile illness consistent with potential Ebola infection." The EC also requested States implementing excessive or inappropriate travel and transport measures that go beyond these Temporary Recommendations terminate them by the end-October 2015.
29 March 2016, 9th meeting EC	The EC decided that the outbreak was no longer representing a high risk of international spread and that countries could respond rapidly to new outbreaks. "Accordingly, in the Committee's view, the Ebola situation in West Africa no longer constitutes a Public Health Emergency of International Concern and the Temporary Recommendations adopted in response should now be terminated. The Committee emphasized that there should be no restrictions on travel and trade with Guinea, Liberia, and Sierra Leone and that any such measures should be lifted immediately (538)".

Table 45. Emergency Committee summary recommendations Ebola outbreak (cont.).

During the outbreak, there were also different international conferences organized to share information and provide updates on scientific knowledge for the response. *The Informal Consultation on how science can inform our response to the Ebola virus disease outbreak* on 7 October 2014, was sponsored by different institutions, and it became an important forum to exchange information. Some of the participants included:

- Dr. Sylvain Baize, Institut Pasteur
- Dr. Philippe Calain, MSF Switzerland
- Professor Jean-Francois Delfraissy, INSERM
- Dr. Scott Dowell, The Bill and Melinda Gates Foundation
- Dr. John Edmunds, The London School of Hygiene and Tropical Medicine
- Dr. Robert Fowler, Sunnybrook Medical Centre
- Professor Stephan Günther, BNI, University of Hamburg
- Dr. Lisa Hensley, US National Institutes of Health
- Dr. Peter Jahrling, US National Institutes of Health
- Dr. Gary Kobinger, Public Health Agency of Canada
- Dr. Mandy Kader Konde, Institute of Research Guinea

- Dr. Stuart Nichol, US Centres for Disease Control and Prevention
- Professor Peter Piot, London School of Hygiene and Tropical Medicine
- Dr. Michel Van Herp, MSF Belgium

Many of these people were part of the epistemic community, and the conference allowed a high-level interaction with stakeholders, experts, and organizations involved in the topic and with decision making positions.

Some epistemic community members participated through the GOARN, which also faced some constraints due to budgetary cuts (110). The GOARN, as an operational and loose structure, gave access to members of the epistemic community to active participation in the field. After the PHEIC declaration, this participation also expanded due to the creation of the United Nations Mission for Ebola Emergency Response (UNMEER). There was an increasing number of partners and mobilization of extra resources from all over the world to support activities in the affected area. Other subnetworks of experts participating directly in the response were the Emerging and Dangerous Pathogens Laboratory Network (EDPLN), and the WHO Emergency Communication Network (270,539).

7.3.2.3 Institutionalization of bureaucratic power

The Ebola epistemic community advised the WHO during the outbreak through committees and expert groups, but it did not depict a strong power to influence an early response. Participation in decision making was limited in the first stage of the outbreak. The centralization of decision making within the WHO and domestic politics reduced the impact that the epistemic community's input had. Once the PHEIC was declared, the epistemic community had more involvement.

During the second stage, the Emergency Committee acted as the leading consultant as well as the Advisory Group, a group of experts appointed to guide the response and to advise the WHO Director-General, the UN Special Envoy on Africa and the GOARN (540). These groups worked together with experts from the WHO Collaborating Centres, and some also were part of the 2014 WHO response team. However, some members of the epistemic community, with broad experience, were left outside the primary global decision-making process. For instance, experts from the WHO Collaborating Centres were not included as members of the Emergency Committee (EC), and only one of the members of the EC was part of the group that drafted the Ebola Strategy of 2014. Table 46 presents the list of the EC members and their relationship with the other groups.

Country	Member	Institution	EC	WHO AG Ebola Virus Disease	Ebola Strategy 2014	WHO Collaborating Centres Ebola.
Australia	Chris Baggoley	Australian Government Department of Health				
Australia	Michael Selgelid	Monash University				
Canada	Anthony Evans	International Civil Aviation Organization				
Canada	Theresa Tam	Public Health Agency of Canada				
Chile	Fernando Otaiza	Ministry of Health				
DRC	Jean-Jacques Muyembe	National Institute of Biomedical Research				
France	Alain Epelboin	National Centre for Scientific Research and National Museum of Natural History				
Ghana	William Ampofo	University of Ghana				
Kenya	Vincent Anami	University of the Health and Sciences, Friends International Centre				
Nigeria	Oyewale Tomori	Redeemer's University				
Portugal	Maria João Martins	Ministry of Health				
Saudi Arabia	Abdullah Al-Assiri	Minister of Health for Preventive Health				
Sierra Leone	Amara Jambai	Ministry of Health and Sanitation				
South Africa	Lucille Blumberg	National Institute for Communicable Diseases, National Health Laboratory Service				
Spain	Dirk Glaesser	World Tourism Organization				
Switzerland	Robert Steffen	WHO Collaborating Centre for Travellers' Health University of Zurich				
Uganda	Sam Zaramba	Ministry of Health				
UK	Andrew Winbow	International Maritime Organization				
UK	Mark Salter	Public Health England				
USA	James LeDuc	University of Texas Medical Branch				
USA	Martin Cetron	Centres for Disease Control and Prevention				
USA	Vincent Covello	Centre for Risk Communication				

Table 46. Overlapping of members in the epistemic community's core groups with the Ebola Emergency Committee (EC).

At the institutional level (institutions with membership in the epistemic community), there was a better distribution and representation of the epistemic community. Table 47 presents institutions with multiple and overlapping representations.

Country	Institution	EC	WHO AGEVDR	ES 2014	WHO CCDEM	ST 1976	WHO ERT2014	IC 1976	GOARN
Switzerland	WHO/Headquarters			16			37	2	3
USA	Centres for Disease Control and Prevention	1	1	1				8	1
	WHO/AFRO, DPC/CSR			12					
UK	Imperial College London						8		1
Sudan	Ministry of Health					8			
Liberia	Ministry of Health						7		
UK	Microbiological Research Establishment					5			
Guinea	Ministry of Health						4		
	WHO/EMRO			4					
Canada	National Microbiology Laboratory/ Public Health Agency of Canada	1		1	1				1
Senegal	Institut Pasteur				1	1			1
UK	London School of Hygiene and Tropical Medicine					2			1
Belgium	Médecins Sans Frontières			2					1
Sierra Leone	Ministry of Health and Sanitation	1					2		
South Africa	National Institute for Communicable Diseases	1			1				1

EC: Emergency Committee; WHOAGEVDR WHO Advisory Group on the Ebola Virus Disease Response; WHOCCDEM: WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF. ES2014: Ebola Strategy 2014; ST 1976 Study Team 1976; WHO ERT2014 WHO Ebola Response team 2014; IC1976 International Commission 1976

Table 47. Overlapping institutions with multiple representations in the epistemic community's core groups.

Country	Institution	EC	WHO AGEVDR	ES 2014	WHO CCDEM	ST 1976	WHO ERT2014	IC 1976	GOARN
UK	Public Health England	1					1		1
Zaire	Service d'Hygiene							3	
Zaira	Universite Nationale du Zaire							3	
Germany	Bernhard-Nocht-Institut for Tropical Medicine (BNI)				1				1
USA	Centre on Global Health Security, Chatham House		1					1	
Belgium	Institut de Medecine Tropicale							2	
France	Institut Pasteur							1	1
Gabon	Institute for Development Research (IRD) International Centre for Medical Research			1	1				
Belgium	London School of Hygiene and Tropical Medicine		1					1	
Switzerland	Médecins Sans Frontières			1					1
France	Médecins Sans Frontières								2
Uganda	Ministry of Health	1	1						
Kenya	Ministry of Health					2			
Nigeria	Ministry of Health						2		
France	National Centre for Scientific Research and National Museum of Natural History	1		1					
Pakistan	National Emergency Operations Centre		1	1					
Congo	National Institute of Biomedical Research	1	1						
USA	University of Texas Medical Branch	1							1

EC: Emergency Committee; WHOAGEVDR WHO Advisory Group on the Ebola Virus Disease Response; WHOCCDEM: WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF. ES2014: Ebola Strategy 2014; ST 1976 Study Team 1976; WHO ERT2014 WHO Ebola Response team 2014; IC1976 International Commission 1976

Table 47. Overlapping institutions with multiple representations in the epistemic community's core groups (cont.).

Table 47 also presents the number of experts participating from each institution in the core groups and including those from the epistemic community formed in 1976.

Other subgroups also emerged during the second phase of the outbreak with resources for R&D. The WHO created the VSV Ebola Consortium (VEBCOM), which initiated studies phase 1 in the development of a vaccine that could progress rapidly into clinical trials. The VEBCOM used the candidate vaccine developed by the Canadian National Microbiology Laboratory rVsV-ZEBOV obtained from the Zaire Ebola virus (541). The Consortium included some members of the WHO Collaborating Centre for Arbovirus and Hemorrhagic Fever Reference and Research (541). Before the VEBCOM, the US National Institute of Allergy and Infectious Diseases launched a global collaboration in 2013, the Viral Hemorrhagic Fever Immunotherapeutic Consortium, which part of its work focused on finding therapies for viruses such as Ebola (542).

The Executive Board in January 2015 (during the outbreak) decided to create a panel of independent experts, requesting an interim assessment of the WHO response (Resolution EBSS3.R1). The WHO Ebola Interim Assessment Panel assessed the intervention of the organization and the mechanisms in place for an international response. This subgroup presented its findings before the end of the outbreak was declared making recommendations for changes in the system (499). The WHO Secretariat responded on 19 August 2015, and it made clear that most of those recommendations had to be approved by Member States (543).

The panel evaluated the situation and made recommendations to implement during the outbreak and to improve future responses. The Sixty-eighth World Health Assembly in May 2015 reviewed and discussed the Panel's first report, included in decision WHA68(10). Table 48 presents the people who participated in this panel.

Name	Position	Country
Dame Barbara Stocking	Chair of the Panel. Formerly Chief Executive of Oxfam GB, where she led major humanitarian responses. Currently President of Murray Edwards College, University of Cambridge	United Kingdom
Professor Jean-Jacques Muyembe-Tamfun	Director-General of the National Institute for Biomedical Research	The Democratic Republic of the Congo
Dr. Faisal Shuaib	Head of the National Ebola Emergency Operations Centre	Nigeria
Dr. Carmencita Alberto-Banatin	Independent consultant, and advisor on health emergencies and disasters	Philippines
Professor Julio Frenk	Dean of the Faculty, Harvard T. H. Chan School of Public Health	United States of America
Professor Ilona Kickbusch	Director of the Global Health Programme at the Graduate Institute of International and Development Studies	Switzerland

Table 48. Participants WHO Ebola Interim Assessment Panel (499).

Some members of the epistemic community worked directly with their national governments and international organizations to establish measures to follow. They participated in international fora as part of their national delegations and provided their advice and knowledge regarding the status of the pandemic.

During the second phase of Ebola, there were also some policy entrepreneurs from the epistemic community that had critical participation in the global decision-making process and were able to influence it. Some of them were:

i. David Nabarro: He was appointed UN System Senior Coordinator for Ebola Virus Disease; he was consulted together with the WHO D.G. to establish UNMEER (WHO). On September 23, 2014, he was appointed Special Envoy on Ebola and Anthony Banbury as his Special Representative and Head of UNMEER

ii. Bruce Aylward: The WHO D.G appointed him as the D.G. Special Representative for the Ebola Response, representing the WHO in the UNMEER meetings. He was responsible for analyzing the epidemiological data and used to drive the response across all the actors involved and help to provide technical direction (544). He also advocated for more resources for financing the response. He participated in the elaboration of the WHO Ebola Response Roadmap 2014.

iii. Peter Piot: Former UNAIDS Executive Director, he was a member of the WHO Commission sent to Zaire to investigate the first Ebola outbreak in 1977. He is considered one of the scientists who identified the pathogen. During the 2014 international response, he was part of the Advisory Group for Ebola.

iv. Dr. Anshu Banerjee: He was nominated by the WHO to be UNMEER's Director of Emergency Operations and Ebola Crisis Manager, who reports directly to the Special Representative of the Secretary-General.

The epistemic community developed a consensual knowledge that guided the initial response, but neither the WHO and its member states nor the epistemic community itself considered that the context of this outbreak could change the evolution of the outbreak. The epistemic community was able to disseminate its knowledge, but its structure limited the network's communication (small, concentrated in a few countries, coordinated by the WHO). The epistemic community was less efficient to institutionalize its bureaucratic power, although some of the epistemic community's prominent personalities had an active role during the outbreak, their influence was still limited. Table 49 summarized all these characteristics.

	Indicator	Ebola
1. Knowledge	Agreement on a common definition of the problem and possible solutions	There was some previous consensual knowledge about the characteristics of the outbreaks. During the outbreak, there were disagreements about its severity.
	Clear identification of a common policy goal	The policy goal was reached when the outbreak had not been declared a PHEIC.
2.Socialization of ideas	Structure	It is a small network with some international participation, mostly from developed countries.
	Dissemination mechanisms	Even though Ebola has been considered a priority given its categorization as a biological agent, research has been limited. Before the outbreak, a few studies were available. During the outbreak, research increased.
	Participation in the international response	Many members of the Epistemic Community participated in the international response mainly through GOARN.
3. Institutionalization of bureaucratic power	Participation in the policy process.	After the outbreak was declared a PHEIC, the WHO created different groups and organized meetings with experts and other actors to discuss and address specific issues related to the outbreak. Countries included experts as part of the national delegations participating in international conferences sponsored by governments or international organizations.
	Experts and other professionals from the epistemic community in decision-making positions	The epistemic community participated through the Emergency Committee and as an advisory group to the WHO. There were also important policy entrepreneurs in key policy positions.

Table 49. Characteristics Ebola epistemic community.

7.4 The international response

The failure of the response was due to several factors from misinformation, lack of resources, to political issues. NGOs and domestic agencies had to deal with the outbreak with limited resources, inadequately trained personnel, and equipment to managed cases (110,517). Governments delayed international notification due to the fear of economic sanctions (110). The outbreak also exhibited a limited commitment with the IHRs, since this international instrument failed in improving areas such as transparency, sharing of information as well as in incentivizing the building of capacities for reporting and surveillance (110,545,110,499). There was an evident lack of compliance with international norms by the affected countries since the IHRs 2005 required them to establish a system of disease surveillance[lx] (546,37,110,111). Limited surveillance capacities contributed to the spread of the virus. This area was critical for controlling previous outbreaks (524).

Many of these factors were more important than evidence-based decision making and expert knowledge. Therefore, the Ebola epistemic community faced several obstacles; it was unable to expand its ideas and disseminate them and had a reduced bureaucratic power. These factors limited its ability to influence the policy process and an earlier response. Figure 25 summarizes the participation of the epistemic community in the international response.

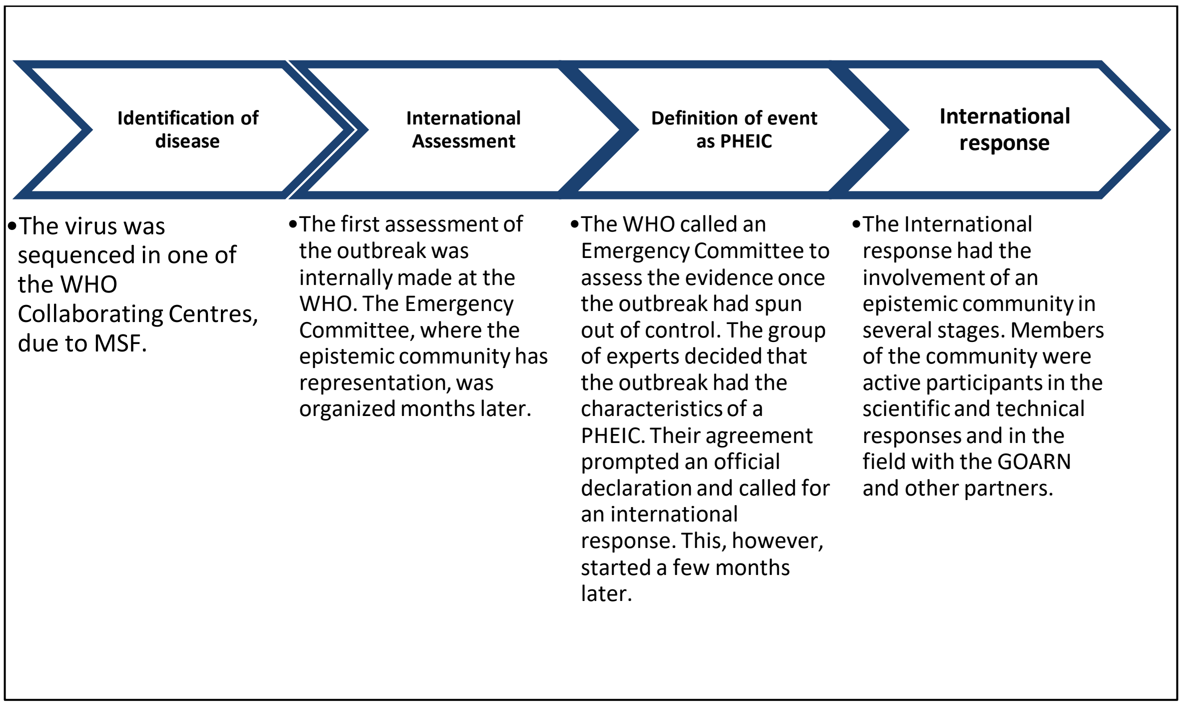

Figure 25. The process of the international response to the Ebola outbreak and the participation of an epistemic community.

[lx] The problem with compliance has been in part a problem with funding since building these capacities requires investments.

The first stage of the response occurred when the first cases emerged in December 2013, the notification by MSF and its response to the outbreak, the WHO initial confirmation of cases, and its initial participation providing technical assistance jointly with the CDC but without a global mobilization (382). The second stage started when the WHO convened an Emergency Committee to assess the situation and declared a PHEIC, followed by an official coordinated international response.

In the first stage, the response was limited. Context triggered a faster transmission than what was expected. The Guinean government issued the international alert on March 13, 2014, once the disease had reached the capital (519). The country's inability to detect it in time enabled the virus to spread across countries (547,110), in an area inside the Guinean forest, near the borders with Liberia and Sierra Leone (489). These countries shared borders with few migration controls that enabled the transit of people from one country to another, facilitating the transmission of Ebola (517,489). The context of poverty, lack of adequate health infrastructure, health personnel, mishandling of cases, and even denial of the situation aggravated the crisis (547,492). Nevertheless, these countries did not have big international airports with a high flow of visitors, although an international transmission and imported cases occurred unexpectedly when a person from Nigeria carrying the disease traveled to the airport in Lagos (489).

When the outbreak started, the Ebola Epistemic Community was unable to have direct access to information, and its members' participation was limited. Some of the experts got involved early only because of their connections in the communities (Interview 11).

The political situation in the region caused poor handling of the situation; therefore, politics rather than science guided the response at the beginning (489). The WHO Regional

Office in Africa, which got the early reports about the outbreak, did not provide accurate data. The WHO Regional Office was held responsible for failing on submitting reports to the WHO headquarters in Geneva, due to political decisions given that its representatives in West Africa "were politically appointed country directors, and they were downplaying the crisis (517)". This brought strong criticism to the WHO even by old collaborators such as Peter Piot, who later declared that the regional office was "really not competent" in the handling of the outbreak (548). Once the outbreak was out of control people involved in the response also blamed the WHO Regional Office for not allowing experts to assist local authorities, some reports affirmed that "they obstructed travel by experts, and they resisted offers of assistance from the Centers of Disease Control as well as from USAID (517)." The delay in responding to the outbreak was based mostly on political decisions rather than technical advice (517).

After the Institut Pasteur confirmed the presence of Zaire ebolavirus, MSF publicly declared on March 31, 2014, that the outbreak was "unprecedented" (241). The organization alerted the disease was spreading fast and into urban areas. Later, MSF claimed that on April 1st, 2014, the WHO Geneva's chief spokesperson challenged MSF's assessment. He based his comments on what experts already knew about Ebola outbreaks, and he objected that "the virus dynamics were not unlike those of past outbreaks, nor was the outbreak unprecedented (241)." In this declaration, there was an acknowledgment of the epistemic community's previously developed consensual knowledge.

The WHO's actions and initial response to the situation in West Africa were on the basis of that previously available knowledge. The WHO sent in May 2014 the organization's senior Ebola expert, Dr. Pierre Formenty, to Guinea. With the confirmation of Ebola as the virus causing Guinea's outbreak, he traced the first 14 cases in detail[lxi]. His investigation "yielded no strong or convincing hints, either from clinical features of the illness or the pattern of its transmission, or just what the causative agent might be, especially in a country with so much background noise from multiple other killer diseases (500)". Therefore, he did not think Ebola was the principal cause, recommending no further actions, and the WHO preferred to wait for the evolution of events (110,499). The WHO then stated that: *Alarm bells might have gone off had any doctor or health official in the country ever seen a case of Ebola. No one had. No alarm bells rang for the government or, for that matter, for the international public health community either* (500).

Some reports also indicated that the WHO did not act promptly due to concerns about possible opposition from political leaders in West Africa (110,499). Others, however, attribute this outcome to the criticisms of the WHO's management of the H1N1 2009 influenza outbreak (110).

Before the PHEIC declaration, the epistemic community participated mainly through the GOARN team based in the WHO and the CDC Atlanta (110). It was mostly humanitarian organizations that actively assisted the population in this phase (499). After notification in March 2014, the WHO mobilized its collaborating laboratory in Lyon, France, together with West African laboratories located in Doka, Guinea, Dakar, Senegal, and Kenema, Sierra Leone (270). The GOARN traveled to Guinea on 28 March. By 5 May, WHO had deployed 112 experts to West Africa to assist in the response, including 68 experts deployed through

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[lxi] The WHO published on its website a note titled "Ground zero in Guinea: the Ebola outbreak smoulders – undetected – for more than 3 months. A retrospective on the first cases of the outbreaks" with the subtitle "Ebola at 6 months". It is unclear when exactly this report was published by the WHO, although it clearly refers to the months after the case that was later identified as the first one (the 2-year-old boy).

its global surge mechanism, ten external experts, and 33 international experts from GOARN (270). The experts included epidemiologists, laboratory experts, infection prevention and control professionals, clinical case management specialists, and experts in logistics, medical anthropology, risk communication, and social mobilization (270,549). Appendix L presents the full list of partners participating with GOARN. Once the international response started, these groups had to interact often during the outbreak to provide advice and guidance to the WHO and its member states.

Some experts involved in the response agreed that the centrality of the decision-making exercised at the WHO constrained the involvement of the epistemic community (Interview 1, 5, 11). Even though the WHO monitored the outbreak since March 22nd, 2014, it decided to organize the International Health Regulations' Emergency Committee until August 8th, 2014. By then, the outbreak had reached four countries (Guinea, Liberia, Nigeria, and Sierra Leone) with 1 711 cases (1 070 confirmed, 436 probable, 205 suspected), and 932 deaths (more than 50% of the cases) (550).

As a result, the second phase started when the WHO finally decided to call an Emergency Committee for an assessment of the outbreak, an expert body that immediately recommended declaring it a Public Health Emergency of International Concern (PHEIC) (550). The declaration started an international response, although the mobilization of resources to the region officially began in September 2014. The WHO later recognized this Ebola outbreak was the "largest ever recorded" and "most complex" (551,499). This delayed PHEIC notification prevented the most affected countries from having faster access to international assistance (552,37,471,553). By the time the international response was declared necessary to control the outbreak, the WHO had reports of 4963 probable, confirmed and suspected cases of Ebola, and 2453 deaths.

Once the outbreak was considered a PHEIC, a global mobilization started. Between March 2014 and March 2015, GOARN deployed more than 2013 experts, including 600 epidemiologists, 76 field coordinators, 73 data managers, 242 laboratory technicians, 26 clinicians, 110 logisticians, 128 IPC specialists, 44 communications officers, 53 social mobilization and communication experts, and 15 anthropologists (270). GOARN deployed more than 1000 of these experts after August 2014 (127). Besides, 58 foreign medical teams from the African Union, China, Cuba, Denmark, France, Norway, Uganda, the United Kingdom, and the United States collaborated (110,270).

The UN Security Council approved resolution 2177 (2014) on the Ebola disease outbreak in Africa, declaring it a "threat to international peace and security (110)." The resolution included the creation of the UN Mission for Ebola Emergency Response (UNMEER) (240,554). The mechanism was formally organized in September of 2014, but its operations started later due to the lack of funding and inadequate coordination (517,110). The UNMEER had to mobilize resources and logistic capacities in a short period, establishing targets of 30, 60, and 90 days (554). For this aim, the Operational Conference for Scaling up UN-System Approach to the Ebola Response was held in Accra from 15-18 October 2014. The Ebola Interim Assesment Panel concluded that this mission had little success in coordinating the response for the affected countries (499).

By October 2015, donors had disbursed US$5.9 billion, 66 percent of the total amount pledged, US$8.9 billion (555). From these funds, 80 percent of them were allocated to the response. Sixty-one countries pledged funds and sixteen organizations (NGOs, Banks, among others.). The money mobilized was used to pay for essential drugs, equipment, and materials for health workers, vehicles (556). The WHO also constructed 5 Ebola treatment units (ETUs) and 72 community care centres. The estimated cost for controlling the outbreak increased due to the late response and the severity of the situation (382).

The outbreak was declared a humanitarian crisis due to the precariousness of the situation, the lack of resources, and the risk perceived by actors such as MSF (such as social unrest in some places) (557,558,127,558). NGOs assisting in the field and local agencies were overwhelmed with the situation while the fear of the people increased. The USA, UK, China, France, and Germany deployed more than 5,000 military personnel to support the actions in the field (382,557). It was at that moment when the international response effectively started.

The actions implemented made it possible to control the outbreak and stop the transmission (499). International cooperation, however, was not optimal because the situation was already out of control, and there was an intense fear of importing cases. Scientific evidence guided part of the response; however, many recommendations were not broadly accepted by governments. The IHR required state parties to notify the implementation of measures and its rationale within 48 hours of their implementation. During the outbreak, WHO reported that 40 countries adopted additional measures to those recommended by the Emergency Committee, but only a few of them informed the WHO (559,98,110). These measures included the closure of borders, temperature checks, questionnaires, screening methods, quarantines, and implementation of administrative controls, such as cancellation of flights. The WHO called for lifting such measures, but by December 2015, 34 countries were still enacting them (13). The WHO also had 570 reports or rumors of traveling and trade bans involving 69 countries as of April 2015 (127). Of those, 470 were assessed by the WHO, and it determined that they did not interfere with travel and transport (127). The implementation of protective measures for some countries aimed to limit the spread of the virus through different points of entry (air and seaports) (560). As a consequence, flights were halted to the affected area, limiting the access of health personnel and supplies (517,496). Travel bans also affected scientists and researchers (273,486), since some countries did not allow them to go to the region of West Africa.

In its fifth meeting, the Emergency Committee discussed the implementation by governments of inappropriate health measures not recommended by these experts. There was a concern that additional measures, such as quarantine of returning travelers, refusal of entry, cancellation of flights, and border closures could interfere significantly with international travel and transport and damage both the response and recovery efforts. There were also reports that some countries did not share information about international travelers, one of the main recommendations made by the Emergency Committee (98).

Countries and institutions decided to stop sending health workers under the argument that they could have been in danger (517). For them, there was an imminent risk that justified these measures (489). For instance, in the case of the United States, some states ordered quarantine without being supported by the scientific community. It was political leaders who decided to implement this course of action (517,475,486). This brought severe consequences for affected countries, which could not get access to qualified personnel, health workers, and medical supplies (499).

In addition to these challenges, professionals from epistemic communities had to convince a very traditional population to change some cultural patterns to reduce contagion.

The changes included eliminating burial and funeral practices such as body washing the corpse (561,562). Modifying people's behaviour, and their traditions, was not easy, even when there was evidence that these religious practices were increasing the number of cases. In general, the population did not trust professionals and experts, and it took some time for them to accept the experts' recommendations (563).

The international response at the end was effective in containing and controlling the outbreak. The WHO declared that the Ebola outbreak was no longer considered a PHEIC on March 29, 2016. The World Bank (WB) estimated the economic impact of the outbreak for the region around US$32.6 billion by the end of 2015 (517,475). The WB also estimated losses of at least US$2.2 billion in economic growth (556), Liberia and Sierra Leona being the most affected countries (564). For the UN, the cost of the response was more than US $4 billion. Some calculations considered that if the outbreak had been controlled by April 2004, the cost would have been only $200 million (382). Based on the indicators proposed in chapter 4, table 50 presents the summary and analysis of the level of cooperation in the response to Ebola.

ACTIVITY	MEASURE	EPISTEMIC COMMUNITY	EBOLA	LEVEL OF COOPERATION
I. International participation				
PROBLEM	1. Timely meetings celebrated at WHO and other settings.	The epistemic community participated in the investigation of cases and provided information to the international community. There were disagreements about the situation.	The first meeting of the Emergency Committee was convened on August 8, 2014. The WHO had conducted three assessments in March- five months earlier (127,112). The first case traced back to December 2013 (551).	0
	2.If there were actions implemented as a result of those meetings	The participation of the epistemic community was as part of the Emergency Committee, but decision-making was centralized at the WHO.	The PHEIC declaration was the result of the meeting (110) five months after the outbreak, and the response started later.	2
RESPONSE	Time frame after notification	The epistemic community participated late in the outbreak.	The WHO started working with the affected countries in March 2014 (112,110), but it later withdrew. The international response started on August 8th, 2014, when the Emergency Committee declared the outbreak a PHEIC, eight months after the first cases appeared in Guinea. The UNMEER started operations on September 19, 2014 (98,110). However, the response, in general, is characterized as slow, even after the PHEIC declaration, since funds and assistance were delivered late. It also did not consider cultural and local settings, and it was poorly coordinated (112,110,565).	1
NO. OF COUNTRIES	Level of participation	The level of participation was mainly motivated by the situation and the urgent need to control the outbreak.	After the PHEIC declaration, the Security Council called the outbreak "a threat to international peace and security." The participation in the response of international organizations and countries increased once the UN General Assembly approved Resolution A/Res/69/1 as recommended by the Security Council Resolution 2177 (S/Res/2177-2014), unanimously adopted by 134 Member States (112,127).	5
II. International assistance				
TECHNICAL A.	Type of participation in international missions.	The epistemic community participated in the response. This helped to mobilize its ideas and influence.	The severity of the situation required a more comprehensive, multi-sectoral, and multi-agency. Thus, the response also included humanitarian, military, private-commercial components (127).	4

Table 50. Analysis levels of cooperation in the international response to the Ebola outbreak in West Africa.

ACTIVITY	MEASURE	EPISTEMIC COMMUNITY	EBOLA	LEVEL OF COOPERATION
II. International assistance				
FINANCIAL ASSISTANCE	The amount of money provided as financial assistance to address the emergency	No indications that the epistemic community influenced growth in funding.	Once the international response started in October 2014, financial assistance was provided to help. The amount of money required was not provided (382).	5
TREATMENTS	Type of population getting the treatments	The epistemic community has been mobilizing its ideas to produce a vaccine and better treatments. However, most of its influence and participation have been after the outbreak.	There were no specific treatments for Ebola, and there were problems with access to medicines. Vaccines were not available during the outbreak, even though the virus has been known since the late 1970s. However, Europe, Canada, and the USA could accelerate the process for the testing of three possible vaccines (110). There are now different prospects of going through different phases.	0
PROVISION	1. How fast was the deployment of assistance once the outbreak started	Members of the epistemic community participated in the deployments. Its influence, however, was marginal to mobilize it faster.	The UNMEER started operations on September 19, 2014, and other substantial international assistance arrived in the affected countries by October 2014 (382,127).	1
	2.Type of assistance		Given the situation in the most affected countries, the response included medical personnel, provision of food security and nutrition, access to essential health services, the supply of materials and equipment, transport and fuel, medical care for responders (555).	2
III. Scientific response				
SAMPLES	If countries have shared virus samples		Doctors without Borders (MSF) shared the first samples to identify the virus. Governments made available samples of the virus by the end of 2014 when the international response was fully operative in the area (110).	3
R&D	1.If data is disseminated on time		Access to public health information and cases were not shared immediately, and data was restricted (110,127).	3
	2.Phases of the research during the outbreak		After the late response and the severity of the situation, the WHO established an accelerated development process to produce vaccines, which during the outbreak reach a Phase III clinical trial. Research and development of therapies and drugs also intensified as well as diagnostic methods (270,110).	4

Table 50. Levels of cooperation in the international response to the Ebola outbreak in West Africa.

ACTIVITY	MEASURE	EPISTEMIC COMMUNITY	EBOLA	LEVEL OF COOPERATION
IV. Policy adoption				
SURVEILLANCE	If countries implemented systems to allowed constant notification of possible cases		The late notification was the consequence of not having the right tools in place for surveillance in the affected countries (499). Although this has been an aspect included in the IHR, countries have not met the core capacities requirements yet under this international agreement (110).	2
NOTIFICATION	How long did countries wait to notify the WHO after identifying the cases?		The notification was late; there was an initial denial of cases and the extent of the outbreak (499). The first cases were notified in March 2014 in West Africa (in a rural village in Guinea) (98,565,110), but reports of cases of people dying from a rare condition were communicated to the government since January.	4
POLICY CONVERGENCE	1. How broad were the recommendations adopted and implemented?	The Ebola epistemic community has less bureaucratic power at the national and international levels.	After the Emergency Committee declared the outbreak a PHEIC on August 8th, 2014, the WHO recommended not to impose travel bands or restrictions on international trade to the affected countries (566), however, by April 2015, the WHO had 570 reports from 69 countries that were not following the advice (127).	2
	The degree of adoption of international norms.	The epistemic community has been less influential in changing norms and implementing international agreements.	One of the major problems during the Ebola outbreak was the limited technical capacities that the affected countries have. Even though by 2014, the IHRs should have had fully implemented, there are still financial gaps that have affected the improvement of core capacities to face pandemics. During the Ebola outbreak, the lack of resources in the affected health systems delayed the response and compliance with the international norm (127). Countries were also afraid of the possible consequences of notifying an outbreak (110).	4

Table 50. Levels of cooperation in the international response to the Ebola outbreak in West Africa (cont.)

The level of cooperation in the international response was initially low, reaching a medium level by the end of the outbreak. Nonetheless, the response is considered a failure since many deaths could have been prevented.

7.5 Influence of an epistemic community in the level of cooperation.

The analysis of the level of cooperation, in this case, confirms that at the beginning of the outbreak, cooperation was low. After the disease spread outside the region, the international community reacted and dramatically increased the level of cooperation.

A network of professionals had worked in issues related to Ebola since the 1970s; however, during the first stage of the outbreak, it had limited participation due to factors such as:

- Lack of political will. The WHO's ability to coordinate and share information with members of the epistemic communities was constrained by its political position and the fact that it always must consult and respect its State Members' requests.
- Fear of economic consequences: countries with cases were fearful of the possible economic consequences of notification (110,127,499), given that in the past countries had faced severe trade restriction and international backlash after notifying a disease outbreak with pandemic potential (Interview 5).
- WHO internal decision-making process: Even though the organization has six regional offices, most of them act under a central leadership in Geneva (the exception could be PAHO, partially due to its history as the first health multilateral agency in the world, created before the WHO). A delayed assessment by an Emergency Committee under the IHRs 2005, made it harder for experts to participate in this stage.
- The Ebola epistemic community had different perspectives about the outbreak,

causing internal divisions. This was the case with MSF's Ebola experts who early in the outbreak insisted on implementing stronger measures and requested more international participation. Even though at the end, MSF's experts closely collaborated with the epistemic community through GOARN and other institutions.

These characteristics indicate that in the first stage of the outbreak, the epistemic community was weak and had limited access to the policy process. The WHO decided to implement measures based on the available knowledge of the disease, and without requesting additional advice from experts outside the WHO. Other experts' participation was possible in the second stage. Political issues, however, limited the epistemic community's ability to prevent international measures that hindered access to assistance.

The outbreak of 2014 also uncovered problems within the epistemic community itself, the lack of R&D, and the still limited understanding of the disease. Ebola has been a known virus since the end of the 1970s, and since then, a small scientific community has been interested in it. In 2014, however, there were still questions about the transmission in the animal-human chain and the reservoirs of the virus. In part, the assumption that the disease was endemic only in Africa limited the research. The limited knowledge was mostly based on the virus's potential to become a biological weapon. This research was useful to speed up the testing of a vaccine during the outbreak, but the vaccines were still in trial phases (530,110). The lack of international interest, however, affected the development of treatments and drugs to fight the diseases, as well as the possible development of a vaccine since 1977. These problems affected the epistemic community's level of cohesion, thereby making it more difficult for it to influence policymaking during the outbreak.

Additionally, the epistemic community was highly connected to the WHO.

Sometimes communication among members depended on the WHO's mobilization mechanisms to interact. Besides, the network's centrality made it challenging to open it to other levels. It was concentrated at the global level, with scarce connections with national and local actors. The epistemic community understood that it was essential to expand the group beyond the global level since it could help prevent future outbreaks and respond to other epidemics (Interview 5; Interview 11). The WHO recognized the importance of more community involvement to reach the affected population, and to ensure better medical attention (112).

The epistemic community was essential to guide the response, providing evidence-based arguments and recommendations to manage and control the disease. This created a positive impact on international cooperation in the second phase, and the trust and reliance on this network of professionals allowed them to have more participation. Nonetheless, fear and distrust were common among the population, policymaker, and political actors, which affected the acceptance of the epistemic community's recommendations and the legitimacy of its advice.

Chapter 8: Zika Virus 2013-2016

8.1 Introduction

The 2015 Zika virus outbreak began while the international response to the Ebola outbreak in Africa was still in progress. The outbreak is the first PHEIC due to a disease transmitted by a vector, which has expanded its habitat likely due to climate change (214,567,568). It is also the first mosquito-borne virus capable of sexual transmission and severe congenital disabilities (569).

The mosquito *Aedes aegypti* transmits the Zika virus, as well as yellow fever and dengue. The vector is well-known in the region of the Americas, and it was almost eradicated in the 1960s through the widespread use of DDT (570). The mosquito proved resilient and returned to the region, acting as a vector for the return of dengue and yellow fever. In 2015, Aedes aegypti acted as the vector for the Zika virus.

The Zika virus was first identified in the 1940s. Before 2007, Zika presented as a mild disease, with only 16 cases notified worldwide (571,572,573). The first recognized large outbreak of the Zika virus occurred in 2007 in Micronesia, where estimates calculate that 5,000 people out of a population of 6,700 people were affected by a Zika virus of Asian origin (574,575). In the Pacific Islands and French Polynesia, health services received around 28,000 people with possible Zika infection and 383 laboratories confirmed cases (576,571,574,575,577,572).

The outbreak in the Pacific Islands was the first-time that health professionals associated Guillain-Barré Syndrome (GBS) and microcephaly with the virus (578,576,571). After this outbreak, other islands reported more (567). The 2007 outbreak sparked scientific interest in the disease (See Box 4. Zika Virus).

Box 4. Zika virus

Nature of the virus

The Zika virus is an arbovirus of the flavivirus type mosquito-born- (ZIKV) (579,580,581), transmitted by the mosquito *Aedes aegypti* (582,571,583). There are two main species of ZIKV, Asian and African (583). This mosquito is responsible for transmitting other diseases such as dengue, yellow fever, and chikungunya (570,577,583). Studies have also identified the *Aedes albopictus* species and other mosquitos as a carrier of the disease (584,585,567,583). The mosquito is common in tropical and subtropical regions. They feed during the day on human blood and breed in water-holding containers (577). Non-primates and primates are reservoirs, and transmission is human to vector to human (577). Recent research has shown that the virus can also be transmitted human to human via body fluids such as transplacental, perinatal, sexual, and blood-borne routes (579,586); and at least ten countries documented sexual transmission (587).

The Zika virus was, for the first time identified in 1947 when it was isolated from a Macaca monkey in the Zika forest of Uganda (578,588,589). The virus was later recovered from the mosquito Aedes Africanus (578,571). In 1952, the virus was isolated in humans from Uganda and Tanzania, in Africa, and India and Malaysia in Asia (567,575,571,567,590). Some isolated cases were later found in Central Africa and South Asia (589).

Characteristics of the disease

The symptoms associated with this virus are mild compared to other similar diseases, such as Dengue (580,591,588,575). People infected with Zika will have a fever, headache, and some people will present a maculopapular rash -skin eruption with flat and small lesions (592)-, conjunctivitis, or both (593). These symptoms will appear three to twelve days after the bite, and they will last for 2 to 7 days (593,594,587). Some people will not develop symptoms at all; around 80% of infected people can be asymptomatic (589,582). Since its symptoms are similar to dengue and other more severe diseases, health professionals have to discard these conditions first and perform a laboratory test by genetic sequence to confirm the Zika virus (582). As a result, the WHO believes Zika was under notified before 2007 (571). There are no known antiviral treatments for Zika virus; doctors will only treat symptoms, and infected people should be isolated (575,577). Currently, there are no vaccines available, but research started early in the outbreak (584,588). Laboratories tested two possible candidates (595), and the Brazilian government is collaborating with the US for developing a vaccine (588).

Global Threat

For years, Zika was considered an “innocuous pathogen (568).” However, the confirmed association with microcephaly in newborns [the brain size is smaller than average, causing severe developmental and cognitive disorders (577)] and other neurological disorders such as Guillain-Barré Syndrome (GBS) have changed this status (596). Researchers expect a decline in the number of cases in 2 years, although it is likely that the disease will become endemic in America (595).

Brazil reported the Zika virus in May 2015 and, after more than 20 countries in the Americas notified cases, the WHO organized an Emergency Committee and declared the outbreak a PHEIC on 1 February 2016 (597). After the declaration, the international response unfolded fast, being efficient enough to trigger worldwide participation for the outbreak's management.

Different factors could have influenced the level of cooperation in the international response. For instance, the epidemic started in Brazil, a powerful country in Latin America, strategic for the regional and global economy. In 2014, the country contributed to the global economy with 3% of the global GDP, ranking it as one of the tenth largest economies in the world (598). Brazil has a high level of development compared to other countries in the region, and it is highly active in the international arena. The strategic importance of Brazil contrasts with its level of poverty and social inequalities (599), and some considered that the response did not reach the most needed in the country (599), including poor people and women. Brazil also has the Amazonia, one of the most critical ecosystems in the world and a perfect setting for the reproduction of mosquitos, and the potential to affect thousands near the region.

Another explanation for the reasonably well-organized response was the potential for Zika to spread to the United States as well as Europe due to the Olympic Games. Brazil was set to host the Olympics in the summer of 2016 (600). Some experts argued that the Olympics heightened the level of international scrutiny and placed pressure on both Brazil and the international community to act quickly and decisively (601,602), even though some experts considered there was a low risk of international spread (603).

Some scholars also claimed that the experience with Ebola led to a faster response to the Zika pandemic (572,604). Due to the problems and delayed response to Ebola, governments, and advocates also increased their scrutiny of the WHO and the international system for managing pandemics. The WHO engaged in a reform process to become more transparent. In the case of Zika, the WHO facilitated open access to decisions related to the outbreak and the response, which enabled more open discussion among experts and improved access to information regarding the WHO's actions and recommendations (597).

While these factors facilitated a more effective response, the analysis shows that the role of the epistemic community was both critical and unique. As Zika had been a previously relatively obscure disease, no Zika-specific community existed. However, vector-borne diseases represented 17 % of the global burden of infectious diseases (605), and a robust epistemic community on vector-borne diseases existed, mainly related to diseases carried by mosquitos [such as Malaria, which has a well-established epistemic community (606,607)]. As outlined below, this community was in a unique position of influence and was able to mobilize and respond to the Zika outbreak quickly.

The global response to Zika enabled the recently formed epistemic community to play an active role, given the limited knowledge about the disease, and that research became a crucial component in the overall response. Figure 26 presents the connection between the epistemic community and the level of international cooperation in the response. As outlined below, the international response to the Zika outbreak exhibited a medium to a high level of cooperation.

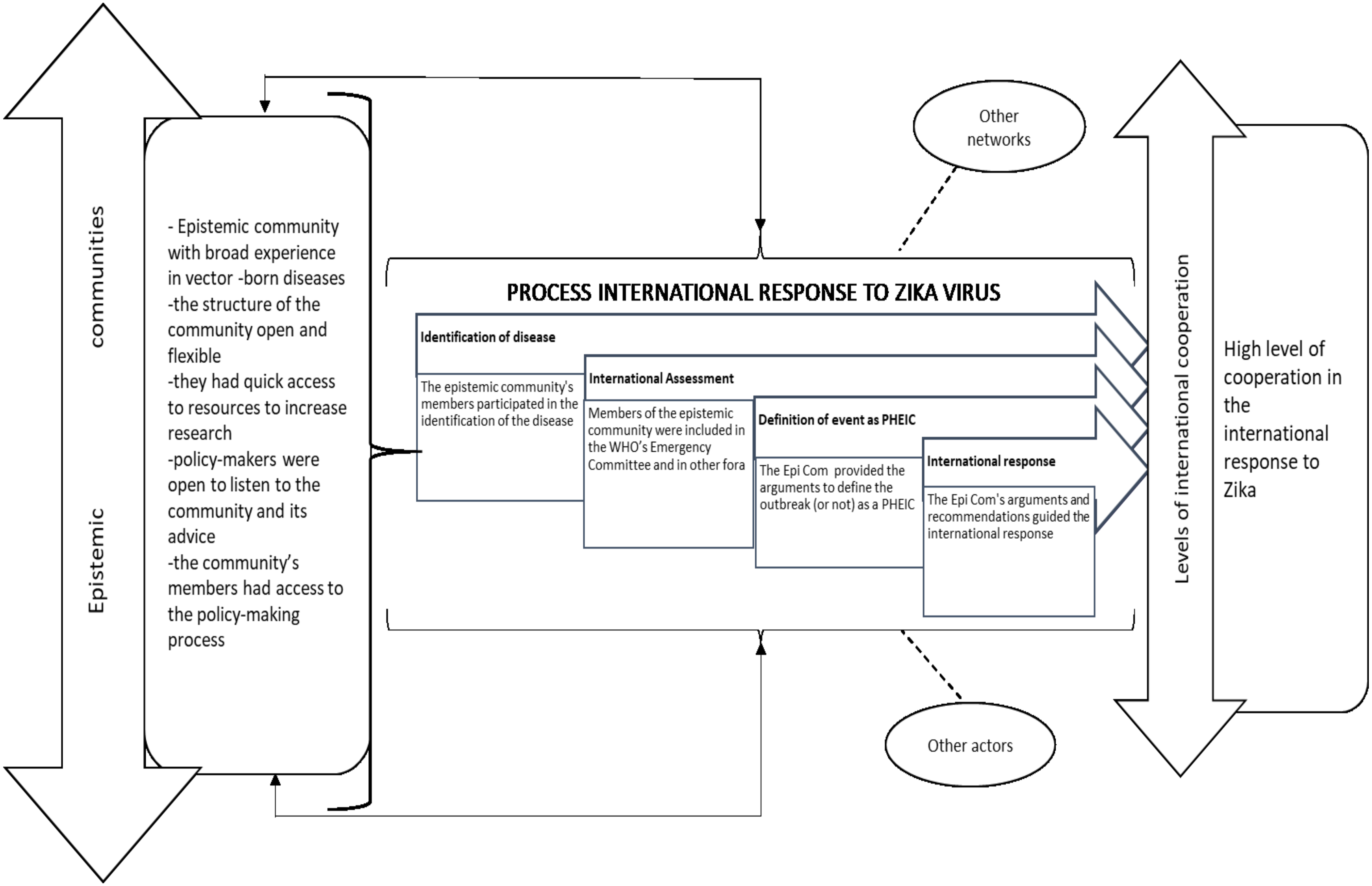

Figure 26. Zika epistemic community and its influence in the international response

8.2 Zika outbreak 2015 in the Americas

In 2014, scientists detected the Zika virus directly transmitted[lxii] by the mosquito *Aedes aegypti* in the Americas (582). Chile confirmed the first case found on Easter Island in February 2014 (582). Haiti, in 2014, also documented some cases (608).

In 2013, health officials in the northeast of Brazil started reporting to the Health System (Sistema Unico de Saude - SUS) cases of a disease caused by an unknown virus (608). In 2015, they found patients with dengue-like symptoms in the same area, and, in March of 2015, health workers sent samples of those patients at the Oswaldo Cruz Institute (609). Laboratory analysis identified the virus on April 30, 2015, and in May 2015, Brazil notified and confirmed indigenous transmission of Zika virus to PAHO (582,572).

More dramatic was the regional increase in cases of newborn microcephaly, born to women who experienced fever and rash during their pregnancy due to the Zika virus (610,568). By October 2015, the Brazilian government reported an increased incidence of infant microcephaly (583) and an unusual cluster of microcephaly in the northeastern region (611). Laboratory confirmations later supported these findings (612). Other countries, including Slovenia, Spain, and the United States, reported cases of microcephaly among infants born to mothers with a travel history to countries where the vector was found (594). Later studies provided scientific evidence to confirm the relationship between Zika and microcephaly.

The Zika virus was also associated with neurological disorders (613,594,614).

[lxii] This type of transmission is referred as indigenous or autochthonous and it is important to differentiate from those cases that are exported due to people traveling to the area where the vector lives.

Doctors in Brazil identified an increase in Guillain-Barré syndrome (GBS) in the Zika affected region. Research on the outbreak in French Polynesia showed that 42 patients in hospital with Zika infection had also GBS, confirming the association of neurological disorders, microcephaly, and GBS to Zika infection. The risk of GBS was estimated to be 2.4 per 10,000 people infected (594). Countries reporting Zika cases in the Americas also reported an increase in GBS cases.

Given the increasing number of cases of the Zika virus and their potential link to cases of microcephaly, the Ministry of Health of Brazil published an order declaring a Public Health Emergency of National Importance on November 12, 2015 (Emergência de Saúde Pública de importância Nacional – ESPIN) (583,608). In 2015, health officials reported Brazil had a Zika incidence of between 440,000 and 1,300,000 cases (583).

The strain of the Zika virus found in Brazil was closely related to the one found in French Polynesia. Therefore, experts believe that the mosquito probably originated in Asia and migrated to Brazil from French Polynesia (589,609). The spread of the disease in Brazil, and throughout the rest of South America, was in part because of the Amazonia, an ecosystem that offers the perfect environment for the reproduction of mosquitos and makes vector control more difficult (615,589). For instance, PAHO reported that Dengue cases in Brazil increased more than 200% in 2015 compared to 2014 (616,617). There were reports of two waves of Zika infection that coincided with the rainy season in the area (608). Health authorities estimate that there have been more than 1 million cases of Zika in 25 countries in America since May 2015 (98).

By August 2017, 48 countries in the Americas had reported autochthonous transmission of Zika (individual to individual), five through sexual transmission (618,568) (See Appendix M for the distribution of cases in the Americas as of January 2018). Due to the lack of immunity in the Americas and the high density of the population, the WHO estimated 3 to 4 million cases of Zika infection (including asymptomatic cases) would appear in the continent in one year (572).

8.3 The Zika Epistemic Community

The Zika virus was expanding geographically. Although the Zika virus is associated with low mortality rates (593), as outlined above, evidence of neurological disorders, GBS, microcephaly, and congenital malformations associated with the virus alarmed the world (571,572,619). This association also brought great scientific interest (613). There were no treatments or vaccines available to manage the outbreak (620). This degree of scientific uncertainty facilitated framing the situation as an urgent event, "demanding quick and effective solutions (613)".

The need for evidence increased the demand for experts, allowing the participation of an epistemic community in the response activities and influenced international cooperation. As outlined below, the epistemic community not only gathered information and provided scientific advice; they joined the decision-making process at the international and regional levels. Their participation and their research and scientific advice in the face of uncertainty became a core component of the response.

8.3.1 History: Vector-control and the Zika epistemic community.

Vector-borne diseases are common in tropical areas, affecting usually poor people living in precarious conditions and with insufficient access to sanitation. America (mostly

Latin American countries), Asia, and Africa are the regions that struggle most with vector control. Health systems face many challenges controlling and eradicating vectors, and some practices, such as the use of certain chemicals were effective but controversial (597,621). Climate change is also expanding the areas where insects can live, increasing their population worldwide, and creating more challenges for the control of vectors. There is a wide variety of diseases transmitted by vectors or insects like mosquitoes. Table 51 presents a list of these diseases.

Vectors and the diseases that they can transmit		
Vector	**Specie**	**Diseases**
Mosquitoes	Aedes aegypti	Dengue, Yellow fever, Chikungunya, Zika virus
	Aedes albopictus	Chikungunya, Dengue, West Nile virus
	Culex quinquefasciatus	Lymphatic Filariasis
	Anopheles (more than 60 known species transmit diseases)	Malaria, Lymphatic Filariasis (in Africa)
	Haemagogus	Yellow fever
Sandflies		Leishmaniasis
Triatomine bugs		Chagas disease
Ticks		Crimean-Congo Haemorrhagic Fever, Tick-borne, Encephalitis, Typhus, Lyme Disease
Fleas		Plague, Murine Typhus
Flies	Various species	Human African Trypanosomiasis, Onchocerciasis

Table 51. Vectors and the diseases they transmit.
Source: World Health Organization (621)

For decades, the international community has trusted science and experts to find approaches to control vectors. In 1949, the WHO created the Expert Committee on Insecticides, since, for many years, experts and governments considered pesticides as the primary intervention tool (621). In 1976, this committee became the WHO Expert Committee on Vector Biology and Control, a group of "academics gathering which served as a focal point for the epistemic community working on this issue (622)." This group included experts from other UN agencies (UNDP, FAO, ILO) and other organizations. In addition to this committee, the WHO created the Pesticide Evaluation Scheme (WHOPES) [previously known as the WHO Pesticide Evaluation Program (1960)]. WHOPES consisted of a network of laboratories, universities, and industry (622). The WHO also expanded its mandate on vector control creating expert committees on malaria, schistosomiasis, filariasis, onchocerciasis, trypanosomiasis, and leishmaniasis. In particular, the Global Malaria Program has acquired a central role in vector control given that malaria is endemic in more than 90 countries, mostly in tropical regions, and the burden of the disease is still very high in some African countries (623,624).

The complexity of vector control, however, required multiple strategies and a multisectoral approach. Therefore, in 2004, the Health and Environment Linkage Initiative sponsored by the WHO and the United Nations Environment Program (UNEP) created the Global Strategic Framework on Integrated Vector Management (IVM) (625,626). This strategy was evidence-based and called for an integrated approach to include collaboration with other sectors (environment, education, tourism, development) and to increase knowledge about the ecosystem in areas with a high risk of transmission. As well, it required engagement with local communities and called experts to provide access to accurate information and evidence (591,267,626). This program built the basis of a broader epistemic community working at all levels and with multiple sectors to create better collaborations and decision making based on science and evidence (626).

The Global Strategic Framework oriented the international community into a more integrated area, instead of focusing only on specific diseases, and some expert groups have included vector control as a specific goal. One of these initiatives, the RBM Partnership to End Malaria, founded in 1998 and with over 500 partner institutions worldwide, created the Vector Control Working Group in 2010. Participants in this partnership and working group closely collaborated with the Global Malaria Programme, the Programme for Research and Training in Tropical Diseases, and established the WHO Global Vector Control Response (606,627), which included Zika.

8.3.2 Characterizing the Zika epistemic community

The Epistemic Community on the Zika virus naturally evolved from these larger vector control initiatives, as it included scientists and other experts working on vector control and infectious diseases. It also collaborated with other vector control expert groups such as the Vector Control Advisory Group created in 2012. This Advisory Group recommended new approaches for vector control and provided information to guide policy development (607). This group worked closely with the Emergency Committee on Zika (ECZ) and issued specific recommendations after the ECZ's second meeting (593).

8.3.2.1 Knowledge

The medical and scientific community did not invest in researching the Zika virus for over 50 years since it considered the pathogen mild and innocuous (584). When the 2015 outbreak was declared a PHEIC, scientific uncertainty surrounded the link between the Zika virus and microcephaly. Data from a previous outbreak in French Polynesia showed the likely link, evidence strong enough to declare the outbreak a PHEIC (593,628)

Despite the lack of knowledge, the scientific community mobilized to gather evidence. On June 14, 2016, during the WHO Emergency Committee 3rd meeting, experts announced the international scientific consensus that the Zika virus can cause infection in the fetus, neurological complications such as microcephaly, other brain abnormalities, and GBS in newborns (569,629,579,628,573,581,630).

Although this consensus was critical for the continued prioritization of Zika, as well as for guiding policy responses, there were some crucial disagreements. For instance, *the Lancet* (one of the most influential peer-reviewed journals in health) started a debate regarding the danger of having the Summer Olympic Games in Brazil in the middle of the outbreak. The editorial board of *The Lancet Infectious Diseases* analysed this situation and concluded that the virus represented a minimal threat to the games' visitors (631). In response to that editorial, Dr. Attaran from the University of Ottawa in Canada wrote a reply arguing the opposite and accusing the journal of endorsing an event that was potentially a risk to global health (632). Not only did *the Lancet* reply to Dr. Attaran's letter defending its position, but a group of Brazilian scholars published a response to him agreeing with the journal's assessment and calling the WHO Director-General not to endorse postponing or reallocating the Olympic Games (602,633). This disagreement reflects the uncertainty in the epistemic community about the virus.

Experts recognized the need for more research to understand the virus and its full impact on people's health (568). There were gaps in knowledge, and the community agreed that more information was necessary to fill those gaps. For scientific experts, the lack of data itself represented a threat to public health (612). Thus, the one key policy goal was to increase understanding of the nature of the disease to guide the response (593).

8.3.2.2 Socialization of ideas

When the international response to the Zika virus outbreak of 2015 started, the epistemic community was relatively small. This group mostly derives from the Vector Control epistemic community and some members from the Malaria epistemic community. It is possible, however, to identify core subgroups of experts that compose the community. These are:

- The Emergency Committee for Zika
- The Vector Control Advisory Group (VCAG)
- The Expert Advisory Group on Design of Epidemiological Trials for Vector Control Products
- The WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases.

The ECZ's second meeting recommended that the WHO establish an ad-hoc Advisory Group on aircraft disinsection[lxiii] for controlling the international spread of vector-borne diseases, adding another component to the epistemic community. The group had to give specific recommendations about the effectiveness of aircraft disinsection and guidelines for its implementation (634). The VCAG also created the Expert Advisory Group on Design of Epidemiological Trials for Vector Control Products.

The WHO regional office PAHO also played an important role, and it became the regional hub for the Zika epistemic community by facilitating the formation of other groups. These included the Technical Advisory Group on Entomology of Public Health Vectors as well as the External Evaluator Group of New Technologies for the control of Aedes. Some of the people advising the Emergency Committee were already working with this regional

[lxiii] "Disinsection" refers to the elimination of insects by spraying inside an aircraft (634).

organization, given the history of the region with Dengue and Chikungunya (593).

As outlined in table 52, both individuals and institutions overlap in some of these networks. There were other expert groups organized by the WHO during the outbreak and other organizations to review and assess different aspects of the disease[lxiv] (See Appendix N for the individual lists of members).

Expert/Institution	EC-ZIKA	VCAG	SG DET VC Products	WHO Ad-hoc AGAD
Steven W. Lindsay				
Salim Abdulla				
Immo Kleinschmidt				
Kalpana Baruah				
Thomas Smith				
Thomas W. Scott				
Centres for Disease Control and Prevention				
London School of Hygiene and Tropical Medicine				
Durham University				
Ifakara Health Institute (IHI)				
International Civil Aviation Organization				
Imperial College London				
Institute for Health Metrics and Evaluation				
Liverpool School of Tropical Medicine				
Ministry of Health and Family Welfare				
Swiss Tropical Institute				

EC Zika: Emergency Committee Zika; VCAG: Vector Control Advisory Group; SG DET VC Products Expert Advisory Group on Design of Epidemiological Trials for Vector Control Products; WHO Ad-hoc AGAD: WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases
Table 52. Main institutions and participants in the Zika epistemic community.

Although the WHO staff members do not appear in this list, the Global Malaria Programme, the Department of Control of Neglected Tropical Diseases, and the Special

[lxiv] One of these technical groups was the WHO Zika Causality Working Group, or the GB Working Group

Programme for Research and Training in Tropical Diseases were involved in the process and with the epistemic community. These departments have also been directly connected to the Vector Control Advisory Group (607). Besides the expert groups, GOARN and the Partners for the Zika Response were also essential components in the Zika epistemic community, given that some of their member-institutions were interconnected to the core of the community. Appendix N presents the list of all the institutions in the Zika response and their membership in the different groups of the Zika epistemic community. Table 53 and 54 include those institutions that participated in more than one core group of the epistemic community, GOARN, and Partners for the Zika Response. From these institutions, four central nodes connect through the network:

- World Health Organization (Geneva)
- Centers for Disease Control and Prevention (CDC-USA)
- London School of Hygiene and Tropical Medicine (LSHTM-UK)
- Institute Pasteur (Network- France)

It is also noticeable that all the WHO regional offices participated as individual members in the GOARN and the Partners for the Zika Response, and not as part of the WHO headquarters.

ORGANIZATION	COUNTRY	P. ZIKA RESP.	GOARN	EC-ZIKA	VCAG	SG DET VC Products	WHO Ad-hoc AGAD
Department of Health	Australia		1				1
Durham University	UK				1	1	
European Centre for Disease Prevention and Control	Sweden	1	1				
European Virus Archive goes Global	France	1	1				
Ifakara Health Institute	Tanzania				1	1	
Imperial College London	UK					1	1
Institut Pasteur, Dakar	Senegal		1	1			
Institut Pasteur (Network)	France	1	1	1			
Institute for Health Metrics and Evaluation	USA				1	1	
Institute of Environmental Science and Research Limited	New Zealand	1	1				
Institute of Tropical Medicine	Belgium		1		1		
International Civil Aviation Organization	Canada			1			1
International Federation of Red Cross and Red Crescent Societies	Switzerland	1	1				
International Organization for Migration	Switzerland	1	1				
International Severe Acute Respiratory and Emerging Infection Consortium Coordinating Centre	UK	1	1				
Liverpool School of Tropical Medicine	UK				2		
Ministry of Health and Family Welfare	India			1			1
National Institute for Communicable Diseases	South Africa	1	1				
National Institute of Infectious Diseases	Japan	1	1				
Public Health Agency of Canada	Canada	1	1				
Swiss Tropical Institute	Switzerland				1	1	
UN High Commissioner for Refugees	Switzerland	1	1				
United Nations Food and Agriculture Organization	Italy	1	1				
University of Texas Medical Branch	USA	1	1				

Table 53. Central institutions participating in the response to the Zika outbreak and the epistemic community. The table presents all the meetings or groups where these institutions had participants and the number of people representing them.

ORGANIZATION	COUNTRY	P. ZIKA RESP.	GOARN	EC-ZIKA	VCAG	SG DET VC Products	WHO Ad-hoc AGAD
WHO Regional Office for Africa	Congo	1	1				
WHO Regional Office for Europe	Denmark	1	1				
WHO Regional Office for South-East Asia	India	1	1				
WHO Regional Office for the Americas	USA	1	1				
WHO Regional Office for the Eastern Mediterranean	Egypt	1	1				
WHO Regional Office for the Western Pacific	Philippines	1	1				
WHO Headquarter	Switzerland	1	1	1	1	1	1
UN International Children's Emergency Fund	USA	1	1	1			
London School of Hygiene and Tropical Medicine	UK		1	1	1	1	
Centres for Disease Control and Prevention	USA	1	1	1	3	2	2

P. Zika Response: Partners Zika Response; GOARN: Global Alert and Response Network; EC Zila: Emergency Committee Zika; VCAG: Vector Control Advisory Group; SG DET VC Products Expert Advisory Group on Design of Epidemiological Trials for Vector Control Products; WHO Ad-hoc AGAD: WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases.

Table 54. Central institutions participating in the response to the Zika outbreak and the epistemic community. The table presents all the meetings or groups where these institutions had participants and the number of people representing them.

During the Zika outbreak, the four core groups were regularly advising the WHO and regional offices, providing analysis of the evidence and recent research. They connected and represented prestigious institutions that influence the global, regional, national and local levels. The experts had several interactions during the outbreak through face to face and virtual meetings. In the case of the VCAG, members of the group had constant interactions since its members meet twice a year in Geneva (nine meetings between 2012 and 2018) (607). The Ad-hoc Advisory Group on aircraft disinsection met once in April 2016, and the Emergency Committee had five meetings in 2016.

These groups also connected to a vector control epistemic community through the WHO and the Vector Control Working Group from the RBM Partnership. Figure 27 represents the connections among these groups. This connection is relevant because it recognizes that a vector control epistemic community was able to adapt its resources and network to the Zika response. The VCWG has been an active participant in the global vector control policy, promoting the implementation of WHO guidelines and contributing to the formulation of global policy, such as the Global Vector Control Response (606).

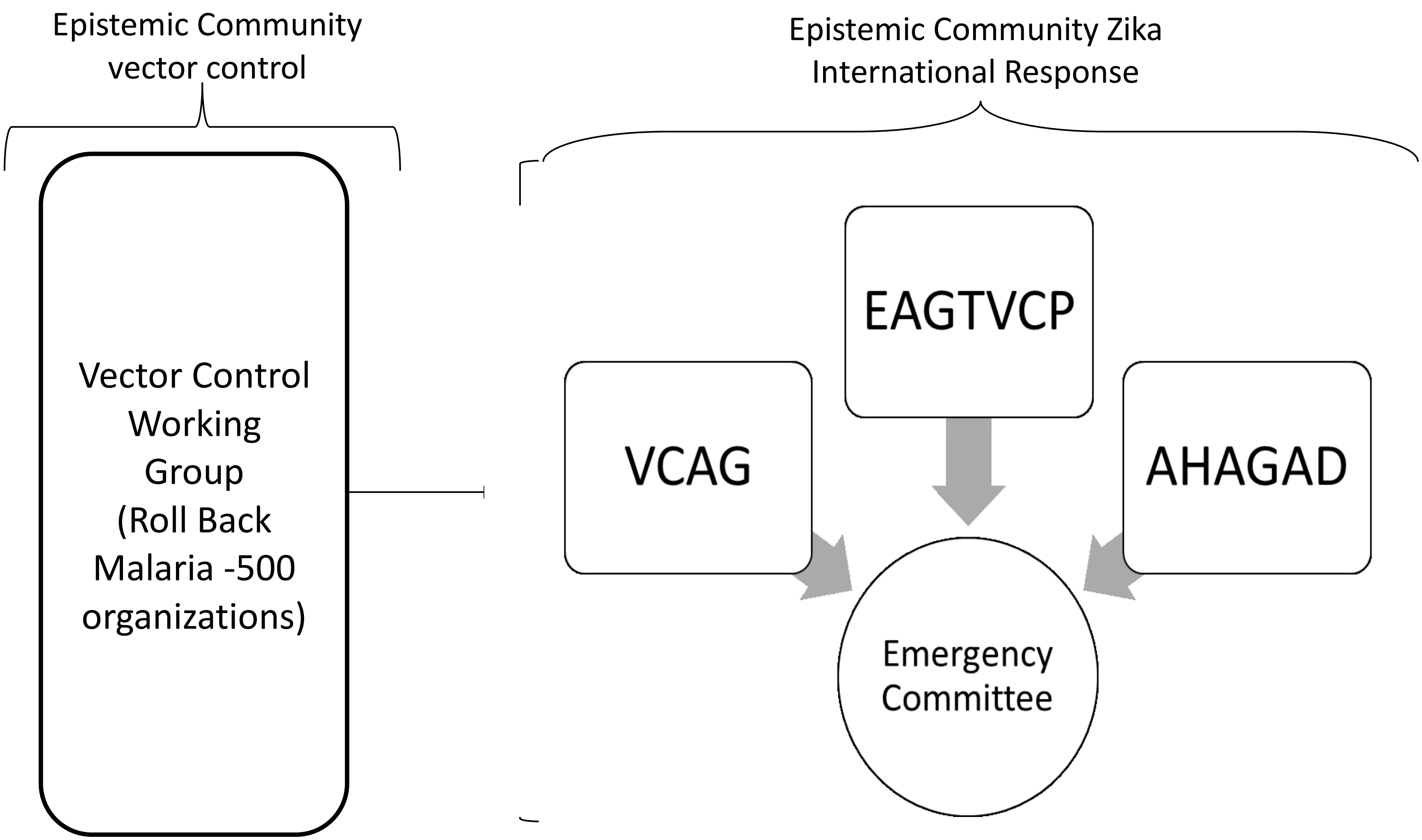

Figure 27. Connection between the Vector Control and Zika epistemic communities.

The connection of the Vector Control Epistemic Community with the Zika Epistemic Community is evident as it is possible to identify the same participants in both communities. In this case, in 2016 and 2017, the VCWG (Roll Back Malaria) meetings had as part of their agenda discussions about the Zika outbreak. Some of the experts participating in the Zika expert groups (or institutions) partook in those meetings. From the 69 experts participating in the subgroups previously identified, 4 of them directly participated in the VCWG meetings, and 8 of the institutions represented in the Zika epistemic community sent one or more representatives to the VCWG meetings. Table 55 summarizes this information.

Expert or institution participating in VCWG and member of Zika Epistemic Community	Country
Mark Rowland	UK
Molly Robertson	USA
Steven W. Lindsay	UK
Janet Hemingway	UK
Ghana Health Service	Ghana
Imperial College London	UK
Centers for Disease Control and Prevention	USA
London School of Hygiene and Tropical Medicine	UK
University of Malaya	Malaysia
Ministry of Health and Family Welfare	India
UNICEF	USA
Harvard T.H. Chan School of Public Health	USA

Table 55. Members of the Vector Control epistemic community directly participating in the Zika epistemic community.

In addition to these experts and institutions, Pedro Alonso, Director of the Global Malaria Programme at WHO, participated in these meetings, and he has been one of the most important actors in the Zika response and for the creation of a vector control strategy.

Dissemination of updated information and research was considered the basis of the response to Zika (573). The international response itself emphasized the importance of improving data sharing, research protocols, and in general, in the dissemination of research and development. Members of the core Zika epistemic community actively published and shared information to increase the global knowledge about the virus and the disease, as well provide better data for policymaking. Scholars such as David L. Heymann, Heather Ferguson, Annelies Wilder-Smith, Kamran Khan, Robert Steffen, Claudia Torres Codeco, and Immo Kleinschmidt published about the disease and related topics (vector control, travel medicine, malaria) during the outbreak.

Dissemination of research and findings by the epistemic community members was extensive and increased since 2015. According to Etienne et al., PubMed had records of only 112 journal articles mentioning Zika between 1952 and 2014 (568). After 2015, scholars published more than 1300 articles (568).

The WHO regularly consulted the epistemic community, and as a result, it issued more than 20 documents covering all aspects of the response (635). The WHO created the Zika Open Repository "to allow open and early access to Zika-related research manuscripts that are awaiting publication in peer-reviewed journals," this mechanism also improved dissemination (596). In addition to this initiative, the WHO, on 25 October 2016, presented the Zika Virus Research Agenda "to support the generation of the evidence needed to inform essential public health guidance and actions to prevent and limit the impact of Zika virus and its complications" (636,567). The agenda identified critical areas of research and recognized the importance of science for guiding the response and targeting critical areas such as case investigations and ecological, case-control, and cohort studies (636). Finally, the WHO Blueprint for Action to Prevent Epidemics presented a strategy for facilitating and promoting more scientific research, in which Zika is a priority (568).

Dissemination processes also required access to data, and the samples from Brazil were critically important to understand the link between microcephaly and the Zika virus.

There were some controversies regarding access to samples and use of data. Some experts blamed Brazil for not sharing the virus fast enough, whereas Brazilian scientists felt their foreign peers did not provide enough collaboration (637,638).

Members of the epistemic community also participated directly in the response as members of the expert missions sent to countries affected by Zika. PAHO led around 83 missions with 177 experts, which included neurologists, neonatologists, obstetricians, epidemiologists, virologists, and experts in research and health services, to provide information and advice based on the most updated research (639,573,568). The office also organized more than 20 technical workshops (567). The GOARN deployed experts in the Americas. It collaborated with Brazil to assess the situation and the cases with microcephaly (573). The Western Pacific Regional Office (WPRO) also deployed experts, including epidemiologists, entomologists, and risk communication experts (573). In Africa, the regional office sent a team to investigate and assess the situation in the continent with the participation of professionals from different disciplines (567).

Finally, the epistemic community participated through the Strategic Response Framework, which includes 60 partners, including governments, international organizations, NGOs, research institutions, and universities. Appendix N.1 outlines the participating institutions. All these partners included experts in their activities related to the response. The most significant contributors were the US CDC, which monitored and coordinated the response to Zika providing experts in different areas, including arboviruses (573). The CDC's staff was deployed in different parts of the world to collaborate at the local, national, and international levels in all the aspects of the outbreak (573).

8.3.2.3 Institutionalization of bureaucratic power

As in previous cases, participation in decision making was mainly through the Emergency Committee. The influence of the epistemic community, however, extended beyond the WHO EC. For instance, after the EURO's consultation, the WHO European regional office developed a training curriculum to increase awareness of invasive mosquitoes and vector-borne diseases, following the publication of the Zika Risk Assessment for European Region (WHO Zika Response). Additionally, more than 2015 experts collaborated in guidance documents published by the WHO (567).

The WHO mobilized more than 250 experts at "meetings and in working groups to produce guidance, set research priorities, and advise on surveillance and response strategies" (596) The WHO and its regional offices also organized expert groups to tackle the outbreak. Table 56 presents a list of these meetings.

Meeting	Date and location	Comments
WHO Regional Office for Europe (EURO) Regional Technical Consultation on Zika virus	June 2016, Lisbon, Portugal,	WHO Zika Response
Scientific Consultation on Zika Virus Vaccine Development, organized by National Institute of Allergy and Infectious Diseases (NIAID) and WHO	10–11 January 2017, Geneva	List of participants Annex O
WHO workshop, Efficacy trials of ZIKV Vaccines: endpoints, trial design, site selection	June 1-2, 2017, Geneva.	Group of about 30 experts in epidemiology, regulatory, preclinical and clinical vaccine trials, and mathematical modelling, in a workshop on planning for Zika vaccine efficacy trials. List of participants Annex O
Sexual transmission of ZIKV meeting of experts	Geneva, Switzerland, 20–21 March 2017	List of participants annex O
Meeting of from PAHO / WHO, producers/ developers of new technologies, non-profit organizations, universities, and research institutes of the United the External Evaluator Group of New Technologies (GE) for the control of Aedes spp.	December 5 - 6, 2017, in Washington, D.C.	Created as a recommendation of the Technical Advisory Group on Entomology of Public Health and Vector Control of PAHO. GE's work is complementary to the WHO Vector Control Advisory Group (VCAG / WHO) and provides support and advice to PAHO evaluating new and complementary tools for vector control. Twenty-five people attended the meeting form the United States (USA), Brazil, Mexico, the United Kingdom, and Colombia.

Table 56. Meetings Zika outbreak.

Besides the meetings and derived from the Research Agenda, the WHO organized other technical consultations, including meetings from the Vector Control Advisory Group, presented in Table 57.

Meeting	Date/Location	Comments
WHO global consultation on research related to Zika virus infection	Geneva, 7–9 March 2016.	The meeting had 130 experts from 27 countries, and its focus was on improving surveillance and development of multi tests for Zika, chikungunya, and dengue (640)
Management of complications and development of the Zika virus causality framework meeting	Geneva, 17-19 March 2016),	This group worked on the linkage of Zika with neurological syndromes
Vector Control Advisory Group meeting (special meeting)	Geneva, 14-15 March 2016	
Seventh meeting of the vector control advisory group (VCAG)	Geneva, Switzerland, 24–26 October 2017	
WHO scoping meeting	Geneva, 23–24 February 2017	Ethical issues associated with vector-borne diseases.
Sixth meeting of the vector control advisory group (VCAG)	Geneva, Switzerland, 26–28 April 2017	
WHO Expert Advisory Group,	Château de Penthes, Geneva, 24–25 April 2017	Design of epidemiological trials for vector control products,
The fifth meeting of the vector control advisory group (VCAG)	Geneva, Switzerland, 2–4 November 2016	

Table 57. Meetings expert groups Zika.

In March 2016, the WHO launched a public consultation on research related to the Zika virus infection. During the three days of the meetings (7-9 March), experts from different areas and affiliations participated in accelerating the development of products for diagnostic and treatment of Zika virus disease. The group reflected on the difficulties of detecting a highly asymptomatic disease, and that represents a great danger for pregnant women (630). They discussed in vitro diagnostics, vector control, therapeutics, and data sharing and regulation (596,567). Participants in this consultation developed target product profiles (TPP) to develop diagnostic tests in-vitro and laboratory evaluation requirements

(567,630). The experts and stakeholders in this meeting came from different institutions, including[lxv]:

- World Health Organization (WHO)
- UNICEF Supply Division
- Pan American Health Organization (PAHO)
- Foundation for Innovative New Diagnostics (FIND)
- London School of Hygiene and Tropical Medicine (LSHTM)
- Medecins Sans Frontieres (MSF)
- TDR Special Programme for Research and Training in Tropical Diseases
- Fundacão Oswaldo Cruz (Fio-Cruz)
- The United States Human and Health Services (US HHS)
- Institute of Tropical Medicine (ITM), Belgium
- Gerência-Geral de Tecnología de Produtos para a Saude (ANVISA), Brazil
- Paul-Ehrlich-Institut, Germany
- Institut Pasteur, France
- Instituto de Diagnóstico y Referencia Epidemiológicas (InDRE), México
- Centers for Disease Control and Prevention (CDC), Puerto Rico
- Federal Service on surveillance in health care (Roszdravnadzor), Russia
- The National Institute for Biological Standards and Control (NIBSC), United Kingdom
- London School of Hygiene & Tropical Medicine, United Kingdom
- Erasmus MC, The Netherlands
- Foundation for Innovative New Diagnostics, Switzerland
- US Food and Drug Administration, United States of America
- Instituto Evandro Chagas, Brazil

Members of the epistemic community from these institutions actively participated in expert groups and advised the WHO. With the results of this first public meeting, the WHO held a consultation for regulatory expectations and requirements of ZIKV vaccines for use during an emergency from 6–7 June 2016, in Geneva, Switzerland. The meeting brought experts together once again to discuss regulatory issues that would allow the development of

[lxv] Full list of participants is included in Annex O

candidates for a vaccine in the short term (641) (See Appendix N for a full list of participants).

The International Zika Summit was held in Paris on 24-25 April 2016. It was co-sponsored by the WHO, Institute Pasteur, and CDC. It included around 600 experts from different fields to share research that could be used for policymaking (642).

Experts were incorporated in national delegations during different conferences and events organized by the WHO, such as the WHA 70th, in which the Global Vector Control Response was approved and adopted by all member States. The inclusion of the topic in the OAS also increased the integration of members from the epistemic community into national delegations.

Key members of the epistemic community supported the actions implemented by the WHO but also underlined the importance of scientific evidence. One of them, Bruce Aylward, Assistant Director-General at WHO, actively participated in the international response to Zika. He guided the WHO's handling of travel advice, and he insisted on focusing on advising governments on the importance of providing information for lowering the risk of getting Zika, instead of promoting travel bans (572). Aylward was also involved in the drafting of a research agenda.

Another vital member was Anthony Fauci, Director of the National Institutes for Allergy and Infectious Diseases (NIAID) at the National Institutes of Health (NIH) in the USA, who led the NIAID efforts, along with the CDC, in the collaboration for developing effective diagnostic tools and a vaccine (572). He worked as the NIH's spokesperson and insisted on the importance of more research and funding on Zika. He is also a well-known scholar in the area of infectious diseases and has published a vast number of academic articles, including research and comments about the Zika outbreak (643,644).

All these factors shape the Zika epistemic community and its capability to influence international cooperation during the response. Table 58 summarizes these characteristics.

	Indicator	Zika
1. Knowledge	Agreement on a common definition of the problem and possible solutions	There was no initial agreement about the link between Zika and neurological conditions. There was an agreement, however, about the risk that represented the possible existence of this link.
	Clear identification of a common policy goal	There was a policy goal regarding vector born diseases and the importance of vector control.
2.Socialization of ideas	Structure	The structure has the WHO as the central node. PAHO is a node for the Americas, and the other regional offices also act as nodes. Membership is broad and worldwide.
	Dissemination mechanisms	Due to the lack of information, the dissemination of scientific research has been critical for the response. The epistemic community has tried to increase R&D and provide as much evidence as possible to establish control measures.
	Participation in the international response	Many members of the Epistemic Community participating in the international response as experts and advisors.
3.Institutionalization of bureaucratic power	Participation in the policy process.	The WHO and other international organizations formed multiple expert groups for increasing analysis and generating evidence, where the participation of the epistemic community was critical.
	Experts and other professionals from the epistemic community in decision-making positions	Experts form an integral part of the process mainly through the Emergency Committee. Some policy entrepreneurs in crucial positions also helped to advance the epistemic community's ideas.

Table 58. Characteristics Zika epistemic community.

8.4 The International Response

Doctors in the northeast region of Brazil detected cases of unknown diseases since 2013. These professionals may have been the first to identify the symptoms of the Zika virus after reviewing reports of the 2013 outbreak in French Polynesia (637). These doctors notified the health authorities, but officers from the Brazilian Health Ministry were cautious and decided to wait and analyze all possible options before considering the possibility of Zika (637). The work of these experts, collecting and sending samples to the SUS, however, is praised as the action that allowed for the identification of the virus, and soon after, its notification (611).

Brazil notified the first cases to PAHO on May 2, 2015. On May 7, PAHO issued an "epidemiological alert" informing of the presence of cases of Zika virus in Brazil. Brazilian authorities ensured that scientific knowledge always guided the government's decisions.

Early in the outbreak, doctors dealing with the Zika virus-infected patients believed there was a link between the virus, the increase of cases with Guillain-Barré syndrome, and microcephaly. On November 17, 2015, the Oswaldo Cruz Foundation confirmed the presence of the virus in the amniotic fluid of an expectant mother whose baby showed signs of a viral infection. On November 28, the Brazilian government confirmed the link between the virus and microcephaly after testing another baby (637).

During this process, the Oswaldo Cruz Foundation requested collaboration from international partners. Scientists sent the information about the results to the US CDC in Atlanta for confirmation, but, according to some of these experts, the laboratory refused to accept Brazilian scientists' work and instead requested samples to perform the analysis by themselves (637).

As a result of its novelty, Zika brought a high level of uncertainty, mainly due to the link with neurological diseases (593). Faced with evidence of an outbreak yet uncertainty regarding its origin and projected impact, the PAHO and WHO pursued a decision-making process guided by science (568). The WHO deployed on November 30, a group of scientists from PAHO to investigate the situation in Brazil. The Pan American Health Organization (PAHO/WHO) issued an alert to intensify surveillance for Zika cases related to the Aedes aegypti mosquito, requesting governments to be vigilant of possible Zika infections (568,597). As well, it mobilized experts to Brazil to support the local and national authorities investigating cases and their causes. The international response in the Americas, therefore, began before the PHEIC declaration, under the PAHO leadership (597,567). The WHO, however, did not call an EC on Zika Virus until February 2016. Regardless of PAHO's work in the region, some scholars criticized the WHO for not convening an Emergency Committee soon after Brazil's notification of cases and not considering the outbreak an immediate global threat (597).

On February 1st, 201, the WHO Director-General organized the first meeting of the Emergency Committee. After this, the Zika EC recommended to the WHO Director-General to declare the Zika outbreak a PHEIC. The WHO made the official statement the same day, declaring the events in South America a PHEIC, due to evidence on the likelihood of congenital malformations and neurological disorders associated with the Zika virus (594,568). According to EC members, "a causal relationship between Zika infection during pregnancy and microcephaly is strongly suspected, though not yet scientifically proven. All experts agreed on the urgent need to coordinate international efforts to investigate and understand this relationship better" (619). The members of the Emergency Committee made clear that the precautionary principle guided their initial recommendation, based on what they *did not* know about the virus (593).

After the EC recommendations, the WHO DG decided to start the international response and issued a formal declaration. The declaration derived from a global strategy to delineate actions and request financial resources for the international response. Countries also needed to determine if the virus was introduced to their territory, monitor the spread of the virus once detected, and monitor any complications (582). Using the National Focal Points established under the IHRs, countries notified the WHO of laboratory-confirmed cases (98).

The best available research guided the EC's recommendations. These included: stronger surveillance of Zika virus infection with the rapid development and sharing of diagnostics; improved communication about the risks of outbreaks of Zika; implementation of vector control measures to decrease exposure to bites from the *Aedes aegypti* mosquito; and guidance for pregnant women to enable them to make informed decisions regarding their pregnancy (593). Table 59 summarizes the main recommendations of the EC that show their effort to both.

Meetings	EC Main Recommendations
First meeting 1 February 2016	Enhanced surveillance regarding microcephaly and other neurological disorders and to research new clusters of microcephaly and determine if they are related to Zika infection; Surveillance of Zika cases and transmission; and development of diagnostic tools; Increased risk communications; and provision of information to risk populations (pregnant women and women considering getting pregnant). Implementation of vector control measures to reduce exposure; Intensified research for vaccines, treatments, and diagnostics; No travel or trade restrictions necessary and continue sharing of data on all aspects of the outbreak.
Second meeting 8 March 2016	Clinical care: following cases of pregnant women exposed to the virus; Research & product development: increased research and development efforts to produce a vaccine and to find new control measures.
Third meeting 14 June 2016	Updated its advice specifically for international traveling suggested advising pregnant women no to travel to areas with ongoing outbreaks and to ensure safe sexual practices for their partners in case of traveling to these places. The Committee requested WHO provide regular updates on travel with recent information on the nature and duration of risks associated with Zika virus infection. The committee expressed that new evidence confirmed the virus could spread internationally and establish new transmission chains in areas where the vector was present.
Fourth meeting 2 September 2016	Reaffirmed previous recommendations and "acknowledge their concern for the long-term impact of Zika virus and recommended developing an appropriate infrastructure and response plan within the World Health Organization to provide longer-term coordination and accountability for ensuring an effective response." The Committee "emphasized the need for a better scientific understanding of Zika virus epidemiology, clinical disease, and prevention, recommending a focus on several new research issues along with other issues recommended previously"
Fifth meetings 18 November 2016	Recommended establishing a longer-term response mechanism that delivers the strategic objectives already identified in the Zika Strategic Response Plan. Based on this advice, the Public Health Emergency of International Concern (PHEIC) was ended.

Table 59. Summary recommendations Emergency Committee on Zika (645)

On February 14, 2016, the WHO launched the Strategic Response Framework and Joint Operations Plan in which the organization presented a comprehensive plan for preventing, detecting, and responding to Zika (WHO 2016). The strategy outlined the resources needed for its implementation, as well as the roles and responsibilities of several partners, including UN agencies, operating under overall WHO leadership. The strategy estimated the resources required to finance the response to this outbreak.

As part of the Plan, the UN created the UN Zika Response Multi-Partner Trust Fund

(MPTF), a multi-agency pooled-funded mechanism to finance UN agencies involved in the response and the WHO. The MPTF supported the Zika Strategic Response Framework and provided a tool to finance critical priorities (646,647). The MPTF aimed to provide a better allocation of resources and donor coordination by defining specific goals and areas of work (647). The international response included investment in resources for surveillance, diagnostics, and treatment, as well as education. The strategy emphasized investment in research and development to provide sound scientific evidence for policymaking and for guiding the response (613,593). Between 2016-2017, the WHO/PAHO received US$24.9 million in direct contributions (646). The UK created a Zika research fund with an initial budget of US$1.4 million, and the US president requested US$1.8 billion to Congress for Zika response activities (587).

Regardless of the scarce information, the lack of drugs and vaccines for treating the disease, and the probability that the mosquito could expand geographically, the WHO and its member states were able to increase their knowledge of the disease and established measures to control the outbreak (648). The EC provided recommendations, and governments complied with most of them. Measures were based on prevention of contagion by isolating cases and reducing vector-contact. Other recommendations were established, such as an increasing campaign in the media to advise of possible sexual transmission. Travel advisories were issued warning people going to tropical destinations and alerting them of the potential risks in case of being infected. In particular, women were warned of the danger of contracting the disease while pregnant, or if they were considering getting pregnant in the short-term (569,582).

In the region of the Americas, PAHO/WHO-led the response, conducting more than 86 missions to 30 countries with 177 experts (568,639). In 2015, the member of the Organization of American States (OAS) endorsed and publicly supported the activities already implemented by the WHO and the PAHO. They recognized the Strategic Response Framework and Joint Operations Plan as the main guidelines for the response and the expert guidance led by PAHO in the region. As well, it recognized the importance of collaboration at the technical level in different areas. The resolution was a political declaration in which the OAS member states recognized and endorsed the actions established by the epistemic community and committed themselves to facilitate this community's work to control the mosquito spreading Zika in the region (649). Countries in the Americas officially reported 753,703 cases as of March 2017 (568). The World Bank estimated in 2016 that economic losses for Latina America could reach US $3.5 billion (650).

The limited information and fear of the consequences led some to consider Zika a threat to national security, and some countries used the military to combat the outbreak – Brazil, Ecuador, and Cuba (650). This conceptualization may have helped to mobilize more resources in a short period (650).

The community was also able to influence changes in global norms with the adoption of the VCAG's proposal for a Global Vector Control Response, which was drafted in the context of the Zika outbreak. This document set the policy priorities for the period 2017-2030, encouraging WHO's State Members to implement a comprehensive strategy for vector control. It underlined the need for collaboration at the international, regional, local, and community levels as well as with other sectors using the "One Health" approach, more human resources for control activities, and investment in research (627). The strategy was unanimously adopted by all member states at the 70th World Health Assembly in May 2017 under resolution WHA70.16. (651,652). The strategy established as its main goal to reduce mortality by vector-borne disease at least 75% by 2030 (651).

In the case of Zika, the international community was less reluctant to adopt the measures proposed by the experts, providing this network with its support without questioning its recommendations. The WHO neither considered restrictions to travel nor trade, but it recommended advising pregnant women about traveling to areas where the mosquito was detected (572). Governments provided information to their citizens about the risk of Zika infections and their consequences. There were, however, some debates regarding global commitment with the international response and its adherence to scientific-based recommendations.

Some scholars criticized national responses, arguing that national governments supported their decision on political prerogatives rather than science. As an example, the Brazilian government was blamed for not establishing proper measures to protect the population and for not strengthening its work with international organizations for political reasons (611,653). Similarly, in the United States, the measures implemented were seen as being opposed to the experts' recommendations. In this case, Dr. Anthony Fauci, the head of the National Institute of Allergy and Infectious Diseases in the National Institutes of Health, publicly declared that "we really need to up our game (654)", referring to the overall US response to Zika.

The measures that focused on pregnant women and those planning on getting pregnant, especially those living in the affected areas, were also questioned by some experts. Some believed that the WHO should have issued an advisory recommending women to delay pregnancy or even to seek abortion in those countries where cases of babies with congenital disabilities were increasing (637). Nonetheless, countries that suggested to their population not to get pregnant (Colombia and Ecuador) (569,597,655,588) were under the scrutiny of women's rights, human rights, and gender equality advocates. Their claims questioned the lack of access to essential health services and abortion in many of these countries (650), and the countries' decisions that limited women's right to choose and decide over their bodies limiting their sexual and reproductive rights (613,656). Some governments alerted pregnant women or whoever was trying to become pregnant about the risk of traveling to countries with the Zika virus. However, travel alerts were also controversial, given that they may result in economic loss due to a decrease in tourism.

The participation of an epistemic community was an important factor in influencing the levels of cooperation. To determine how the Zika Epistemic Community influenced the level of international cooperation requires connecting the analysis of the international response and the characteristics of the Zika epistemic community. The process defined in chapter 4 considers four main phases for the international response. All these phases were, to some degree, influenced by the participation of an epistemic community. Figure 28 presents the interconnection between the elements previously explained and the process of the international response to the Zika outbreak.

Identification of disease

- The epistemic community's members participated in the identification of the disease and its link to neurological disorders (GBS, microcephaly), and its transmission mechanisms (mosquitoes, sexual transmission, mother to fetus).

  The emphasis on research and the agreement on the causal link between Zika virus and microcephaly were elements provided by the epistemic community that allowed it to start an assessment of the event.

  Their cohesiveness and structure as a network with experience in similar diseases, working together in strategies and mechanisms to address similar problems (vector control) facilitated the identification of the problem, and the mobilization of their own resources to increase research.

International Assessment

- The assessment was in general accepted by the international community since it resonated with policy process and members of the epistemic community were also well-known experts in the field of vector control.

  The event then was declared a PHEIC by the Director General of the WHO in February 2016, after the first meeting of the Emergency Committee , triggering an international response.

  As such, the EC recommended to declare the event a PHEIC on the basis that as a relatively unknown disease, the scarce evidence and that the vector transmiting it was extending geographically, the implementation of urgent measures to manage the outbreak were necesary through coordinated international collaboration.

Definition of th event as PHEIC

- After the identification, the elements provided by the epistemic community were taken to the Emergency Committee. This group was integrated by members of the epistemic community

  Their consensus on their knowledge about the disease and the areas that needed more research proved their cohesiveness as a group and reinforced their expert position.

  Due to that, the community (represented in the EC) was able to present critical arguments regarding the dangers of Zika and its potential to spread worldwide as well as the threat it represented.

  .

International response

- The international response started after the WHO officially declared the outbreak a PHEIC.
- During the response, the epistemic community continued providing information to better define policy interventions and measures to control and contain the outbreak.
- It also continued conection to the policy process with the participation of its members in working or expert groups organized by the WHO and other institutions at the national, regional and international level.
- The connectivity and structure of the network helped the community to expand its influence which facilitated the participation of more experts in the response through mechanisms such as GOARN.

Figure 28. Process of the international response to the Zika outbreak and the epistemic community.

The phases presented in this process are broken down in Table 60 into specific activities to measure the level of international cooperation in the international response. The arrangement of the activities in the analytical tool presented in chapter 4, as well as the indicators, also permits us to specify how the epistemic community contributed to those activities.

ACTIVITY	MEASURE	THE EPISTEMIC COMMUNITY	ZIKA	LEVELS OF COOPERATION
I. International Participation				
PROBLEM	1. Type of meetings at WHO and other settings.	The EC was composed of a subgroup of the epistemic community that had a *consensual agreement on the importance of the possible connection between the Zika virus and those neurological disorders.*	The Emergency Committee (EC) was convened by the Director-General under the International Health Regulations (2005) on 1 February 2016 (619) after Brazil provided notification of a recent cluster of microcephaly and other neurological disorders later found to be associated with Zika virus transmission (619).	5
	2.If there were actions implemented as a result of those meetings	Based on *a consensus within members of the epistemic community, the EC agreed that the outbreak had the characteristics of a Public Health Emergency of International Concern (PHEIC*).	After the First Meeting, the Committee advised the Director-General that the recent cluster of microcephaly and other neurologic disorders reported in Brazil should be called a PHEIC (619). It was acknowledged that the relationship between these disorders was suspected, but it had yet to be scientifically proven (657), and the declaration would release more resources for R&D.	6
RESPONSE	Time frame after notification	The epistemic community agreed that a fast response was necessary, given the level of uncertainty. This consensual knowledge was transmitted to the global level.	The WHO launched the Global Zika Strategic Response Framework and Joint Operations Plan, two weeks after the PHEIC declaration. The EC advised that measures be immediately implemented given the scarce evidence and necessity to gather more information.	4
NO. OF COUNTRIES	Level of participation	The participation of these actors also contributed to increasing the epistemic community's influence, given that, through them, some members of the group had direct involvement in the response (Chap. 8.4.2).	According to the WHO at least 60 partners worked in the Zika response (658) (including GOARN and the Partners for the Zika response - a network of different organizations, governments, universities, and NGOs). These partners took over different roles and tasks in the response.	4

Table 60. Levels of cooperation in the international response to Zika outbreak

ACTIVITY	MEASURE	THE EPISTEMIC COMMUNITY	ZIKA	LEVELS OF COOPERATION
II. International assistance				
TECHNICAL A.	Type of participation in international missions.	Members of the epistemic community participated in some of these missions directly or through the partner organizations, which helped to *socialize their ideas and influence the process*.	By December 2016, the WHO/PAHO and GOARN had deployed 175 experts on 80 separate missions to 30 PAHO countries and territories. PAHO organized 22 workshops at the regional level (587). In Africa, WHO/ WHO Regional Office for Africa deployed a multidisciplinary team to identify operational gaps, support the country's response, and help to finalize a national response plan (587).	5
FINANCIAL ASSISTANCE	The amount of money provided as financial assistance to address the emergency	Part of the funding was directed to increase research, as a direct consequence of *the epistemic community recommendation to produce more information* about the virus and the outbreak (policy goal).	Immediately after the WHO declaration of Zika as a PHEIC, countries started to provide funding to assist different areas.	4
TREATMENTS	Type of population getting treatments	The epistemic community had worked hard to develop a vaccine in a short time, *disseminating its knowledge*, and it has contributed to improving research protocols for vaccines at the WHO (635).	The population had access to treatments, especially in America. The vaccine is still not available (572), and the candidates are currently under trials (659).	3
PROVISION	1. How fast was the deployment of assistance once the outbreak started	In Brazil, national experts *collaborated since the beginning with international specialists and authorities through the organizations and the epistemic community* (639).	The WHO, through its regional office, mobilized and deployed assistance to different countries. The Regional Office of the Americas, PAHO, deployed experts with the support of GOARN to assist Brazil and other countries with outbreaks.	6
	2.Medical supplies and materials	There is no specific information about the epistemic community participating in this activity.	Some of the international assistance also provided medical supplies. PAHO provided material to improve the detection of the virus in laboratories, and it has built strategic warehouses in the Bahamas to supply material to Caribbean countries (587).	6

Table 60. Levels of cooperation in the international response to the Zika outbreak (cont.)

ACTIVITY	MEASURE	THE EPISTEMIC COMMUNITY	ZIKA	LEVELS OF COOPERATION
III. Scientific response				
SAMPLES	If countries have shared virus samples	Members of the epistemic community have insisted on the importance of sharing data and research to speed up this process and *disseminate information*. They have been working on the development of a vaccine (595).	Given the importance placed on the development of a vaccine, virus samples have been widely shared (659).	4
R&D	1.If data is disseminated on time	The epistemic community has been actively involved in this area since the beginning, and it continues working *to produce information and scientific evidence* (660)*, including its participation in the WHO Consultation of 2016 about research on the Zika virus* (661).	The WHO had played a significant role in ensuring that data and information are disseminated on time to the public in general as well to the people doing research, policymakers, doctors, etc. The WHO also established in October 2015 the Zika Virus Research Agenda to support the generation of evidence and research to implement strategies (587,635). Zika is one of the priority diseases in the new WHO Research and Development Blueprint (398).	4
	2.Phases of the research during the outbreak	The epistemic community *is continuously producing research and socializing its ideas through its member's participation in the international fora where these issues are discussed*.	Research is ongoing, and WHO has led the research agenda by publishing about 20 documents on topics related to the control and management of the disease (587). There are still many aspects that are unknown and in the early stages of research. The WHO has made clear that a vaccine would be developed in the long term (572,641).	4
IV. Policy adoption				
SURVEILLANCE	If countries implemented systems to allowed constant notification of possible cases	Since some of the members of the epistemic community *are part of governments and work directly in areas in charge of epidemiology and surveillance, the epistemic community has reached an exceptional level of institutionalization of its bureaucratic power,* and this helped to increase the awareness in their own countries.	In general, countries have complied with IHRs and the WHO, continuously reporting cases, and reinforcing their surveillance system (594).	5
NOTIFICATION	How long did countries wait to notify the WHO after identifying the cases?	Since there was no Zika epistemic community at that moment, experts from other areas were involved in the diagnoses and analyses of the virus.	The Zika virus was detected in the Americas for the first time in 2014. The virus was isolated in Brazil in late March 2015. In October 2015, the Brazilian Ministry of Health notified the WHO about the occurrence of the increased number of infant microcephaly on October 23, 2015 (583).	5

Table 60. Levels of cooperation in the international response to the Zika outbreak (cont.)

ACTIVITY	MEASURE	THE EPISTEMIC COMMUNITY	ZIKA	LEVELS OF COOPERATION
IV. Policy adoption				
POLICY CONVERGENCE	How broad were the recommendations adopted and implemented?	The recommendations regarding specific measures to be adopted in countries with outbreaks have been broadly accepted and, similarly, other countries followed measures suggested by the WHO (662,648). The *power gained by the epistemic community helped to influence this*.	Since the beginning, the WHO announced its adherence to scientific evidence, and the Plan reflected the importance of that and the integration of experts as an essential component for the response.	5
	The degree of adoption of international norms.	Most of the domestic and international responses were guided *by scientific evidence and the epistemic community advice.*	There has been a general acceptance of the measures proposed by the WHO, and most countries have complied and adopted the measures suggested (662).	4

Table 60. Levels of cooperation in the international response to the Zika outbreak (cont.).

The analysis of the level of cooperation in the international response to the Zika virus permits establishing a measure of the level of cooperation. In general, this cooperation can be described as medium/high. It is also possible to identify the participation of an epistemic community in most parts of the process.

8.5 Influence of an epistemic community in the level of cooperation.

The case of Zika displays a medium/high level of cooperation. Although there may have been other factors influencing this level of cooperation, this research found evidence of an epistemic community that contributed to increased cooperation to make this response a successful one. The epistemic community originated from the network of professionals working in vector control. The Zika epistemic community formed during the outbreak; however, the members of the group had worked together for years with vector-borne diseases, and they were able to transfer that knowledge to respond to Zika. The community's members knew each other and had previously developed connections within and outside the network. Although their interactions in the past were not related to Zika, they were connected and interrelated by their expertise and work in the broad field of vector control. They used their connections to socialize the epistemic community's ideas, disseminate its knowledge, and reach policymakers.

The community had limited knowledge about the virus and its health effects as well as a less clear policy goal regarding the disease. This group of people, however, agreed on the importance of the initial evidence, and the probable link between the Zika virus and neurological syndromes. They were convinced that the possibility of such a relationship required maximizing international efforts to promote more research to be able to control the outbreak. Their arguments were fundamental to convincing the WHO and its member states to start a coordinated response.

The Zika epistemic community structure was centralized in the WHO as part of the general vector control strategy. The WHO regional offices, however, worked as a hub not only for supporting the work of WHO in the region but also for the epistemic community, facilitating its participation in the Americas. The epistemic community's work was aligned with the policy process, which enabled the integration of its advice and policy recommendations to the international response.

The exchange of information and the promotion of research activities helped to speed up the identification of cases and take preventive measures. Increasing research for understanding the disease and developing treatments and vaccines became the central component of the outbreak's international response. The epistemic worked to produce information to fill the gaps in R&D necessary for the international response.

The Zika outbreak brought international attention to an area neglected by policymakers and researchers. Therefore, it renewed the global interest in diseases that are transmitted by vectors, and given current globalization phenomena (climate change, urbanization, conflict), these diseases are increasing their threat level worldwide. The Zika epistemic community influenced cooperation. It provided information and knowledge (and it continues to do so) related to the virus and the conditions associated with it. It was able to create coherence with the policy system and influence the policy process.

Chapter 9: Conclusions

Scholars have previously explored the relevance of epistemic communities' characteristics in influencing international cooperation. This research broadens the understanding of how these actors can affect variation in the level of cooperation, introducing a theoretical framework consistent with Haas' approach. The proposed model centred in those characteristics that these actors possess to modify the international policymaking process, given that epistemic communities are embedded in the system of global health governance.

This research applied the theoretical framework to analyse the international response to four recent infectious disease outbreaks. The international response to disease outbreaks requires a mix of elements to make this a successful activity. The response, however, does not always achieve an optimal level of cooperation. To establish variation across cases, the study designed a model, conceptualizing cooperation as a spectrum divided into six levels.

The present chapter summarizes the findings of the four cases and explains how epistemic communities contribute to different levels of international cooperation in each one of the international responses. Then, it will analyse if the evidence is consistent with the proposed theoretical framework. Finally, it will explain the implications of this study and its relevance.

9.1 Comparison of the international response among the four cases

With the instrument designed to analyse cooperation (chapters 3 and 4), the study examined the components of the international responses selected for this research. The data obtained from each case made it possible to compare the level of cooperation. Table 61 presents the assessment on the level of cooperation in the international response across cases.

MEASURE	OUTBREAK- INTERNATIONAL RESPONSE			
	H1N1 2009	MERS 2012	Ebola 2014	ZIKA 2015
I.INTERNATIONAL PARTICIPATION				
PROBLEM 1	6	3	0	5
PROBLEM 2	6	3	2	6
RESPONSE	6	2	1	4
NO. OF COUNTRIES	6	1	5	4
II.INTERNATIONAL ASSISTANCE				
TECHNICAL ASSISTANCE	6	2	4	5
FINANCIAL ASSISTANCE	6	0	5	4
TREATMENTS	3	2	0	3
PROVISION 1	6	2	1	6
PROVISION 2	6	2	2	6
III.SCIENTIFIC RESPONSE				
SAMPLES	6	1	3	4
R&D 1	6	2	3	4
R&D 2	6	3	4	4
IV. POLICY CONVERGENCE				
SURVEILLANCE	6	3	2	5
NOTIFICATION	6	4	4	5
POLICY CONVERGENCE 1	2	4	2	5
POLICY CONVERGENCE 2	4	4	4	4

Table 61. Comparison levels of cooperation in the international response to four disease outbreaks.

After measuring the aggregate level of cooperation, the results exhibit the presence of different levels for each case. Table 62 presents an aggregate measure of cooperation for each case.

OUTBREAK	AVERAGE LEVEL OF COOPERATION
A(H1N1) Influenza	**5.43**
MERS	**2.37**
EBOLA	**2.62**
ZIKA	**4.62**

Table 62. The aggregate level of international cooperation in the response to four disease outbreaks.

For the purpose of comparison, this research provides similar weights for all elements of the response. Due to this, the level of cooperation assigned to the Ebola case is in a medium-low range, since the model took into consideration the actions undertaken by the international community after the outbreak had spun out of control.

9.2 Epistemic communities' characteristics and their effects in variation in international cooperation

To analyse the presence of variation across the four cases, my model of epistemic communities measured three main characteristics of an epistemic community -knowledge, socialization of ideas, and institutionalization of bureaucratic power. In the four cases, the study established the existence of an epistemic community, and all of them displayed the characteristics described in chapter 4. However, measuring these characteristics, the study found evidence that these varied across cases. Table 63 summarizes these conclusions.

	Indicator	Influenza	MERS	Ebola	Zika
Knowledge	Agreement on a common definition of the problem and possible solutions	Explicit agreement and consensual knowledge about the issue and solutions.	Some disagreements about the pandemic potential.	Partial consensual knowledge about the characteristics of the outbreaks —with disagreements about the level of severity.	Consensual knowledge about the potential risk of the virus and the need to implement quick actions.
	Clear identification of a common policy goal	The common goal has been for a long time to control and contain the spread of the influenza virus in a short period.	The common goal was established later in the outbreak.	The policy goal was reached when the outbreak had not been declared a PHEIC.	The policy goal regarding the importance of vector control was assumed as the policy goal for Zika epistemic community

Table 63. Characteristics epistemic communities across cases.

	Indicator	Influenza	MERS	Ebola	Zika
Socialization of ideas	Structure	Network structure with different nodes, and the WHO as an essential participant. Subnetworks also facilitated the transmission of information.	Small epistemic community, its members, are mostly found in Middle East countries and in places that have research capabilities like the USA, Canada, and Australia.	Network depended highly on the WHO's information. It was small with some international participation but mostly from developed countries.	The WHO was the central node. PAHO is a node for the Americas, and the other regional offices also act as nodes. Membership is broad and worldwide.
	Dissemination mechanisms	Use of multiple mechanisms to disseminate their knowledge through scientific publications, experts' conferences, and directly in meetings with decision-makers.	Limited use of mechanisms, fewer studies available, mostly at the regional level. There were also problems with access to data and withholding of information	Limited research disseminated throughout a few publications. Before the outbreak, a few studies were available. During the outbreak, research increased.	Dissemination of scientific research has been critical for the response and one of the main goals. The epistemic community has tried to increase R&D to establish control measures.
	Participation in the international response	Broad involvement of epistemic community's members in international organizations and governments, including GOARN.	Participation of the community has been through the WHO-GOARN	Participation in the international response mainly through GOARN.	Participation of many members of the Epistemic Community as experts and advisors.

Table 63. Characteristics epistemic communities across cases (cont.)

	Indicator	Influenza	MERS	Ebola	Zika
Institutionalization bureaucratic power	Participation in the policy process.	Members of the epistemic community were the main participants in multiple conferences and experts' groups organized to guide the international response.	There was a small number of international conferences devoted to MERS-CoV, although the community was continually participating.	After the PHEIC declaration, members of the epistemic community participated in the WHO's technical and scientific groups.	The WHO and other international organizations formed multiple expert groups for increasing analysis and generating evidence.
	Experts and other professionals from the epistemic community in decision-making positions	The epistemic community had many members in crucial positions, and they were central actors in the Emergency Committee.	The participation was mainly through the Emergency Committee.	The epistemic community participated through the Emergency Committee and as an advisory group to the WHO.	Experts participated in the Emergency Committee. Some policy entrepreneurs in crucial positions also helped to advance the epistemic community's ideas.

Table 63. Characteristics epistemic communities across cases (cont.)

These characteristics suggest that the influenza pandemic epistemic community is a well-established community. Its members have worked together for decades, increasing the network's connections over time, expanded its roles, and improving the transmission of information inside and outside the network. The evolution and growing importance of the topic of influenza over time has attracted more members to the community, increasing the number of experts working in the subject, and participating directly in the decision-making process. The strategic interest in the influenza pandemic has also promoted the emergence of regional and sub-regional networks in the field. These networks work together and create synergies with the WHO but do not depend on the organization to connect and collaborate. The WHO, however, remains as the coordinator in the process of influenza pandemic governance.

The influenza epistemic community's consensual knowledge guided most of the medical and non-medical interventions throughout a structure that facilitated the exchange of information among its members. The network's interactions have also increased over time, creating trust and more personal relationships, improving its members' understanding of the problem, and their willingness to work together to find solutions. The influenza epistemic community is embedded in the system of influenza governance; as such, its members have prominent positions in the policy-making process that have helped them to institutionalize its bureaucratic power. These characteristics made it possible for the network to have a central role in the international response to the influenza outbreak of 2009. Its members participated in policymaking positions facilitating their governments' involvement in the response and influencing the level of cooperation by assuming a central role in the implementation of actions and decisions. Therefore, the influenza epistemic community was a powerful actor in the response to pandemic influenza.

The influenza epistemic community has been vital in the creation, implementation, and translation of norms at the national and international levels. Their expertise and technical understanding of the problem, their research, and the analysis of influenza viruses and past outbreaks have been essential for the building of an international system of influenza governance. The epistemic community has improved the system by supporting actions to strengthen it.

In contrast, the Ebola epistemic community included professionals that had worked together for years, but the community remained as a small group, linked mainly through the WHO. The Ebola epistemic community members were less directly involved in policymaking and dependent on the WHO's information. During the pandemic outbreak in

West Africa, the epistemic community had problems participating in the response, given its limited access to other actors outside the WHO. There were disagreements among its members, notable with experts from MSF, that weakened the epistemic community's influence. Before the outbreak, the epistemic community's members were mostly located at the global level, with no participants at the local or regional levels. The lack of connections and participation at these levels provided fewer opportunities to diffuse the epistemic community's ideas and limited the access of domestic health workers to international experts' advice. The epistemic community increased its membership and improved its connections after the outbreak spun out of control, and the international community had to implement urgent measures. In this stage, the Ebola epistemic community strengthened its position, improving its connections with other actors– such as NGOs- and actively participated in the international mobilization. The epistemic community increased its influence power at the end of the outbreak, but it did not necessarily influence more cooperation.

In the Ebola case, the level of international cooperation in the second stage was mostly a consequence of an urgent need to manage a situation that was already out of control and the fears of having more cases outside West Africa. This prompted the implementation of different actions aiming to contain the virus in the region and to avoid more exported cases. The epistemic community's influence on the level of cooperation was, therefore, marginal since it could not intervene earlier in the outbreak. It neither helped to reduce the number of deaths early in the epidemic nor contributed to halting the transmission sooner. At the end of the epidemic, the level of cooperation increased as a result of the international deployment led by the UN. Finally, the late intervention had to go beyond treating the situation as a global health issue, requiring the mobilization of humanitarian and military actors to control the events.

The Ebola epistemic community has had a lower success in influencing a stronger system to address Ebola outbreaks. The risk created by recent outbreaks, however, has increased awareness and interest in the disease.

In the case of MERS-CoV, the epistemic community participating in the response was relatively young. Members of the coronaviruses epistemic community merged into this community early in the outbreak. The network was small, with fewer interactions and reduced connectivity. As a community, it was unable to create an initial consensus. Instead, it provided contradictory arguments about the risk associated with the disease. Problems with access to data, competition, and lack of trust among its members impacted its organization. This epistemic community's capacity to influence and be part of the policymaking process was then affected by its problems to produce comprehensible and consensual technical and scientific arguments strong enough to convince others. It was a small structure, with a few members and confined participation in the field. The epistemic community was also centralized in the Arab peninsula, and a lot of its work was affected by political interference. Its involvement in response to the outbreak was overshadowed by other circumstances that effected its influence in the level of cooperation. The MERS epistemic community has gained influenced in the Middle East, but its participation has not had a significant impact on international cooperation to address this type of disease.

In contrast, the Zika epistemic community was able to influence and guide the response to the outbreak, even with the limited knowledge about the disease, its potential complications, and transmission mechanisms. This network found a great demand for its advice and information from the beginning of the outbreak. The epistemic community, however, early in the outbreak, established a consensus about the potential risk of the disease. Its arguments were strong enough to prompt an international response. The network was more technically and scientifically oriented, with broad experience in diseases transmitted by vectors. This helped it out to quickly produce the scientific evidence required for policymaking in the Zika outbreak. The epistemic community's advice was translated promptly into international actions that were accepted by the international community, leading to a high level of cooperation.

The Zika epistemic community originated from the Vector Control epistemic community, which showed an exceptional level of flexibility to adapt its expertise and its influence to prompt an international response. The Zika epistemic community was able to build strong and coherent arguments, showing a high level of cohesiveness and an explicit internal consensus. Even though Zika's outbreak brought a new and challenging scenario, the epistemic community was able to translate and adapt existing policies, norms, and agreements to address the situation and convince the international community to act.

These cases showed consistent results, even when all the outbreaks originated from diseases that had pandemic potential, and the same norms and institutions were implemented to manage them, the epistemic communities showed heterogeneity. Figure 29 illustrates this relationship.

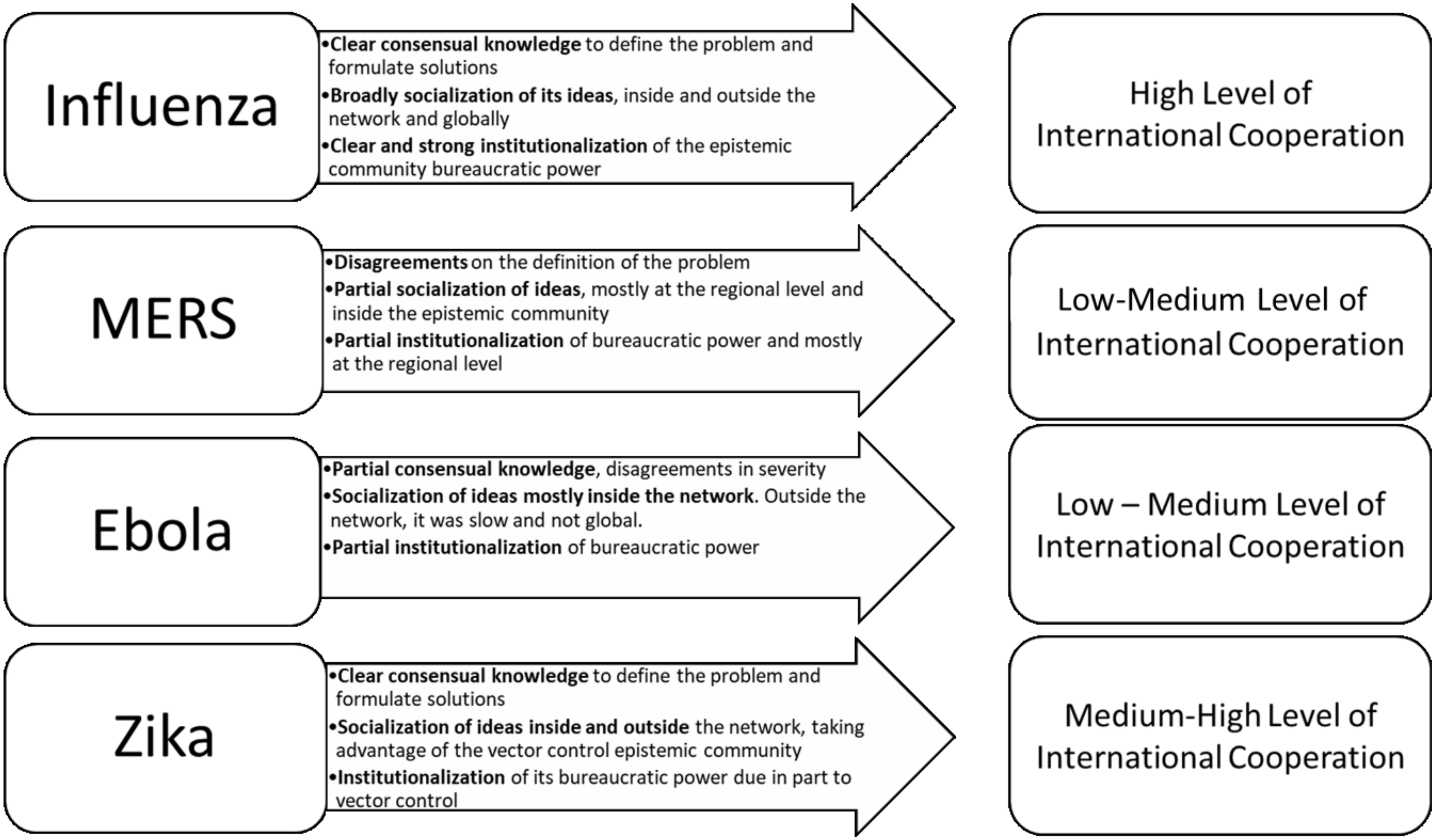

Figure 29. Relationship epistemic communities and the level of international cooperation for each case.

Epistemic communities influenced a high level of cooperation when there was a proven consensual knowledge and policy goal. They socialized their ideas inside and outside their networks to reach policymakers and institutionalized their bureaucratic power. Epistemic communities with problems to achieve consensus in the risk level of the outbreak, with less ability to influence and limited access to the policy process, were less successful in inducing higher levels of cooperation. Each one had different capacities, causing an unequal impact on the level of cooperation in each outbreak.

9.3 The WHO and epistemic communities in global health

In the field of infectious diseases, an on-time, well-coordinated, international response to a disease outbreak with high levels of cooperation becomes crucial to reduce the negative impact of a sudden epidemic that can quickly spread out of control. The experience with the SARS in 2003 was a clear example of the importance of international cooperation in the control of emerging and re-emerging diseases. It reinforced the importance of establishing and following measures that are provided in an open and transparent environment, based on science and clear evidence rather than on fear and secrecy. With that in mind, governments have trusted the WHO as the global leader to produce policies based on scientific evidence, and all actors in the international system usually agree to implement them. As such, more professionals participate in the WHO's decision-making process, taking advantage of new technologies for sharing data, and connecting across the world (593). The WHO, however, has a dual role. It can be the enabler and promoter of epistemic communities' participation in the policymaking process, but it also protects countries' national interests, which can limit the epistemic communities' strength.

There are different reasons why this occurs. For instance, epistemic communities in global health, as networks, are embedded in international organizations and governments. Global epistemic communities related to infectious diseases are mainly connected through the WHO (Interviews 1, 2, 6, 12). This entity usually coordinates and organizes activities and interventions by the network. When the epistemic community depends highly on the WHO, it can weaken its capacity to improve cooperation; whereas when the epistemic community has connections at different levels, and its relationship and coherence with the policy process depends less on the WHO, it can reach other actors (Interview 6). The WHO also works for nation-states, and it represents their interests, and it responds to their demands. It must guarantee that its resources are used following these actors' interests.

Even though it is in the best interest of this organization to have access to the best and most updated specialized advice and provide evidence-based policies, it tends to rely on a group of experts from specific institutions. These experts frequently are the same people forming epistemic communities, and they rely on the WHO to have access to the system of global governance and other experts. Because of the WHO's predisposition to consult a specific group of institutions, it frequently leaves out others who can contribute to the system of governance and enhance the epistemic community's position and connectivity (Interview 1,2). This problem was evident in the Ebola response. Dr. Matshidiso Moeti, the WHO Regional Director for Africa, pointed out that the WHO "needed to improve our (the WHO's) internal capacity and we (the WHO) need to mobilize regional and global expertise from other institutions or individuals who know WHO's tools and can be deployed rapidly when the need arises (549)".

The failure in the Ebola response, however, might have changed the paradigm in the international response to infectious diseases. One aspect that this disease brought to the light is the changing nature of infectious diseases, their patterns of adaptation, and the real impact of globalization, interconnections, and international travel. A well-known disease whose experts can recognize and treat due to what they know about it, suddenly changes because of the human interactions, modifying its transmission patterns. This was also the case with Zika. Therefore, Ebola opened a discussion about how to create a system that can respond and adapt to these changes (interview 12).

As part of this debate, there is an increasing concern for more integration of the local level to the international level. The influenza pandemic epistemic community has moved towards this since professionals all around the world are connected to the system of influenza governance due to the scope of the network. The disconnection between the national-local levels and the international levels required the integration of more experts to these networks and the creation of subnetworks that can effectively communicate during outbreaks. One of the experts interviewed suggested that the first way to do this is through the education of family doctors and using technology to connect them (Interview 12). It is also important to make global health policy accessible to local actors without having to depend on national governments exclusively.

9.3.1 The system of pandemic governance and politics

Another important consideration is the interference of politics in the response to pandemics. Global health has increased its political profile. The WHO was created to hold technical and political negotiations (663), combining technical experts and decision-makers. There has been an effort to depoliticize the WHO, but the efforts have not been successful (663). In pandemic outbreaks, however, decisions should be guided by sound scientific knowledge and technical advice from professionals with expert knowledge, so "it is important that political authorities at the highest level understand obligations and commitments that they have made when adopting the International Health Regulations (549)".

Political support is necessary to access information and share it with professionals. The WHO has as a disadvantage, however, that many times, governments appeal to national sovereignty to limit cooperation and intervention from international organizations (98). In this regard, Laud Boateng, District Director of Health Services in Ghana, mentioned: "only what gets political support gets measured (98)". This was also stated by the Review Committee on the Role of the IHRs 2005 in the Ebola Outbreak Response, which mentions in its report that "Lack of political and government authority can lead to delays in information-sharing, notification and other reporting (…)" (127).

The influenza epistemic community has been one of the few able to downplay this problem. In some cases, the influenza experts seem to be highly involved in global health politics (as an example is the PIP negotiation, which was highly political and where the epistemic community was vital for the result[66]). This has facilitated to move forward the epistemic community's agenda and increased its influence, but it has also made it less flexible even when its resources and position have the potential to improve the system of governance for infectious diseases. This aspect, however, needs to be explored further.

Therefore, epistemic communities' influence in the level of international cooperation can be constrained by contextual and systemic factors, the traditional role of the WHO, the

[66] The PIP's outcome is considered a success given that it reached an agreement for a potential mechanism that transfers benefits to countries where influenza samples originated. Nonetheless, some scholars questioned if this agreement will actually work during an emergency (99,722)

system of global governance, and the politics within the WHO and among its member states.

9.4 The relevance of the study and policy implications

The results presented in this study uncovered factors that are relevant to the study of international cooperation and epistemic communities. In this regard, this research:

1. Provided an analysis of the characteristics of epistemic communities. These characteristics have been previously discussed in the literature, but most of the time, they are identified as fixed features. This research, however, identified that the characteristics making an epistemic community capable of influencing a policy process vary across them.
2. Presented a model to measure epistemic communities. Having an instrument with qualitative indicators improves the analysis of an epistemic community. With this model, the research was able to categorize each of the four epistemic communities analyzed and to compare them.
3. Provides a precise analysis of the relationship between the epistemic community and changes in policy outcomes. The model that qualifies and measures an epistemic community's characteristics provides a feasible instrument to understand this link better and allows a more in-depth analysis of how these networks can modify policy outcomes and to what extent they can do it.
4. Provides new clues of how non-state actors can influence policymaking and modify outcomes at the international level. In this case, the study of epistemic communities emphasizes that these networks are embedded in the system of global health governance. Therefore, they have access to the process and opportunity to influence it and, potentially, to change it.

5. Does not imply that epistemic communities by themselves can entirely change international cooperation. The findings, however, show that some epistemic communities can potentially improve cooperation.
6. Recognizes the potential that some epistemic communities have and provides a framework to continue studying these actors.
7. Demonstrates the potential of studying international cooperation as a spectrum. The categorization of cooperation at different levels increases the potential to analyse how to improve cooperation, not merely facilitate it.

These elements are essential considerations to continue the study of epistemic communities and international cooperation. At the policy level, information derived from this analysis could potentially be applied to changing the system of global health governance.

For instance, the current system of global health governance has the WHO as its centre. This organization has continuously worked as a technical actor trying to build international consensus in global health policy. The WHO, however, is having a crisis in governance, given the increasing number of global health problems that require the organization’s active involvement while it is going through a financial crisis, and its resources are declining. Along with this, the WHO is facing a dilemma concerning its role in global health. This problem is particularly noticeable in the international response to infectious diseases where the WHO must act as the worldwide coordinator guided by technical and scientific rationales, a role that is usually constrained by hierarchy, politics, lack of transparency, among other things. In this conflicting system of governance, epistemic communities are actors with the potential to cut across politics and organizations if the WHO effectively decentralizes its technical roles. This could be possible by endowing the WHO regional offices with more resources and decision-making control and reducing the central control performed by the WHO in Geneva. As well, the WHO could contribute to the creation of more regional or sub-regional networks of experts, without having to control them. The WHO is starting a process where it seems that the organization favours the building of more of these networks (13).

Another policy implication that has also been recognized at the WHO is the need to connect the global and local levels. In the management of a disease outbreak, connectivity across levels of governance can potentially improve the global response. When local actors understand that disease outbreaks can have global repercussions, they will be able to look for information and collaboration in different places and levels. To increase the engagement of local actors with the global system of governance, first, it is necessary to review the education system and to ensure that all health science students have a general understanding of the global health system of governance and its connections to the local and national levels. In this regard, epistemic communities are structures that include professionals from different fields and levels of governance.

Given that epistemic communities are embedded in the system of global health governance, the decentralization of the technical functions held by the WHO could also help to increase the number of epistemic communities and to strengthen them. The WHO should open its system to collaborate with experts from all around the world regardless of where they come from or if the institution they are part of is recognized or famous. Paradoxically, even though the WHO is an organization created for nation-states with worldwide representation, at the technical level, it collaborates only with a selected number of institutions. There are nodes -academic and institutional- working with the WHO, central in the formation of epistemic communities in global health such as the LSHTM, Institute Pasteur, or the US CDC. Whether this could be justified or not, in the end, it has limited the participation of other professionals and other institutions that have the expertise to advance global health policy.

In terms of the isolation of politics from the participation of an epistemic community, the cases show that it is hard to eliminate political influence during the response to disease outbreaks. At the same time, it is essential to recognize that politics play a critical role, and they facilitate the participation of epistemic communities. The fact that experts, however, are not apolitical also creates challenges for the analysis of their role and for the creation of policies and mechanisms that can provide technical solutions. Therefore, this research recognizes the importance of politics, but it also acknowledges that more research is necessary to understand better the role of experts with political interest and how politics influences an epistemic community's participation in the policy process.

Finally, although some epistemic communities, such as the influenza network, have a clear global representation, others are more centralized in specific regions such as in developed countries. Consequently, experts from places like Africa are less likely to participate in these networks, even though many infectious diseases with pandemic potential severely affect this continent. It is important then to understand the concentration of these actors in certain countries or institutions and the repercussion of the future of international cooperation in global health in the face of more complex challenges.

Appendices

Appendix A. Semi-structured interview guide

A. General

1) Do you consider yourself as part of a community of experts/policymakers working in the area of infectious diseases?
2) Would you consider a member of a community working specifically with a disease (which one?) or in general?
3) Where and how often do you meet?
4) Who organizes the meeting?
5) How do the members of the network convene?
6) Who are members of the network?
7) How could you describe collaboration within this network/community?
8) What type of mechanisms do you use to work together?
9) Would you consider these mechanisms formal or informal (informal being mostly based on personal relationships)?
10) Do you consider that as a community, do you act together to influence policymaking at the national or international level?
11) How would you qualify the power level that as a community you have for influencing policymaking?
12) Do you consider that some individual members of the community have more power to influence policymaking than others? Why?
13) Would you consider that during a health emergency such as a pandemic, the community has a stronger power to influence decision making at the national and international levels? If the answer is yes, could you elaborate on why or how this happens?

B. Case studies general (Influenza pandemic/Ebola/MERS/Zika)

• In general terms, on a scale of 0 to 6 (being cero an indication of a lack o response with non-or almost non-collaboration/ international cooperation and six a response with the highest possible level of collaboration) how would you assess the response to the H1N1 influenza outbreak in 2009/Ebola 2014/MERS 2012/Zika 2015? Why would you consider that?

• Could you compare the previously mentioned outbreaks and explain, in your opinion, how the international system to respond to pandemics has improved or not? What has been different since the first outbreak assessed under the 2005 IHR?

• Would you consider there is a consensual agreement in the community regarding the risk of influenza pandemic/Ebola/MERS/Zika? Yes/No Why?

• Were you collaborating or working directly with a government or international organization during any of these outbreaks?

• Which one? /What was your role there?

• To what extent your opinions and advice were incorporated into the response?

• Did your advice and opinions were previously discussed with other experts or participants in the response that are also members of the community? If yes, could you explain how and if it did happen previous to the emergency or during the emergency?

• How would you describe the role of this community in the craft of international policies related to the topic?

• Which have been the areas of major disagreements among the expert's community?

• Which have been the areas/topics of consensual agreement among the expert's community?

• How would you describe this community's ability to promote collaboration among countries in this topic?

• What is the extent of collaboration that exists between your country and the WHO (in this topic)?

• What is the extent of influence that your opinion as an expert has had in the definition of your country's national position?

• Did you participate in international meetings related to the outbreak? Which ones? Could you explain how those meetings were relevant for the response and decision making?

• After the outbreak, have you continued interacting with experts and other colleges to assess the outbreak and/or to elaborate policies to prevent future outbreaks?

• How often does interaction occur?

• How would you assess the role of the WHO as the main coordinator of the international response to these outbreaks?

• From your point of view, how would you assess states' collaboration during the international response to these outbreaks?

• Regardless of the level of collaboration that existed during these outbreaks, do you consider that experts and other professionals intervening in the emergency were the main factors promoting these collaborations (rather than the institutions)?

• If your answer is yes to the previous question, would you consider this happened because of the formal mechanisms in place to built networks of international collaboration or because of the informal ties that these actors have developed through a constant interaction over time, working in these areas? Please elaborate.

• How do you believe scientific collaboration has influenced the response and, in general, decision
making?

Appendix B. Distribution of cases SARS per country

Country/ Area	No. of cases	No. of deaths
Australia	6	0
Canada	251	43
China	5327	349
China, Hong Kong Special Administrative Region	1755	299
China, Macao Special Administrative Region	1	0
China, Taiwan	346	37
France	7	1
Germany	9	0
India	3	0
Indonesia	2	0
Italy	4	0
Kuwait	1	0
Malaysia	5	2
Mongolia	9	0
New Zealand	1	0
Philippines	14	2
Republic of Ireland	1	0
Republic of Korea	3	0
Romania	1	0
Russian Federation	1	0
Singapore	238	33
South Africa	1	1
Spain	1	0
Sweden	5	0
Switzerland	1	0
Thailand	9	2
United Kingdom	4	0
United States	27	0
Viet Nam	63	5
Total	8096	774

Distribution of SARS cases and deaths per country.
Source: WHO 2003, Global Alert and Response (GOARN)

Appendix C. GOARN Worldwide partners

ORGANIZATION	COUNTRY
Institut Pasteur (IP), Algeria	Algeria
Instituto Nacional de Enfermedades Virales Humanas J.MAIZTEGUI (INEVH)	Argentina
ARM Network (Australian Response MAE Network)	Australia
Australasian College for Infection Prevention and Control (ACIPC), formerly AICA	Australia
Burnet Institute for Medical Research and Public Health	Australia
College of Public Health, Medical and Veterinary Sciences, James Cook University	Australia
CSIRO Australian Animal Health Laboratory	Australia
Doctors Without Borders - Australia (MSF)	Australia
Doherty Institute	Australia
Faculty of Health Sciences, Curtin University of Technology	Australia
Institute for Glycomics - Griffith University, Gold Coast Campus, Queensland	Australia
National Centre for Epidemiology and Population Health (NCEPH), The Australian National University (ANU)	Australia
Office of Health Protection, Department of Health (DOHA)	Australia
PathWest Laboratory Medicine WA	Australia
The University of New South Wales, Sydney	Australia
Westmead Hospital	Australia
Medical University of Vienna, Centre for Public Health	Austria
Institute of Epidemiology, Disease Control and Research (IEDCR)	Bangladesh
International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b)	Bangladesh
The University of the West Indies	Barbados
Federal Public Service - Health, Food Chain Safety and Environment (FPS)	Belgium
Institute of Tropical Medicine (ITM)	Belgium
Médecins Sans Frontières - Belgium (MSF Belgium)	Belgium
Médecins Sans Frontières - International Office (MSF)	Belgium
Scientific Institute of Public Health Belgium	Belgium
Instituto Evandro Chagas (IEC)	Brazil
ProEpi	Brazil
Universidade Federal do Rio de Janeiro	Brazil
Centre National de Transfusion Sanguine (CNTS) - Burkina Faso	Burkina Faso
Institut Pasteur (IP), Cambodia	Cambodia
Public Health Agency of Canada (PHAC)	Canada
Chinese Centre for Disease Control and Prevention (China CDC)	China
Guangdong Provincial Centre for Disease Control and Prevention	China
Centre for Health Protection (CHP), Department of Health	Hong Kong SAR
The Chinese University of Hong Kong	Hong Kong SAR

ORGANIZATION	COUNTRY
University of Hong Kong	Hong Kong SAR
WHO Regional Office for Africa (AFRO)	Congo
Institut National de Recherche Biomédicale (INRB)	The Democratic Republic of the Congo
Statens Serum Institut (SSI)	Denmark
WHO Regional Office for Europe (EURO)	Denmark
Direction of Epidemiology and Health Information, Ministry of Health Djibouti	Djibouti
CDC Egypt Country Office- NAMRU-3	Egypt
Naval Medical Research Unit, NAMRU-3	Egypt
WHO Regional Office for the Eastern Mediterranean (EMRO)	Egypt
Africa Centres for Disease Control and Prevention	Ethiopia
National Institute for Health and Welfare (THL)	Finland
Aix-Marseille University	France
Association pour le développement de l'épidémiologie de terrain (EPITER)	France
Centre d'épidémiologie et de santé publique des armées (CESPA)	France
EPICENTRE	France
EPIET Alumni Network (EAN)	France
Etablissement de Préparation et de Réponse aux Urgences Sanitaires (EPRUS)	France
European Virus Archive goes Global (EVAg)	France
Fondation Merieux	France
Inserm - European Union West Africa Mobile Lab (EUWAM Lab)	France
Institut Pasteur (IP), International	France
Institut Pasteur (IP), Lyon	France
Laboratory P4 Inserm Jean Merieux	France
Médecins Sans Frontières - France (MSF France)	France
Museum national d histoire naturelle (MNHN)	France
Santé Publique France	France
World Organisation for Animal Health (OIE)	France
Centre International de Recherches Médicales de Franceville (CIRMF)	Gabon
Bernhard Nocht Institute for Tropical Medicine	Germany
Bundeswehr Institute of Microbiology	Germany
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH - SEEG	Germany
European Mobile Laboratory (EMLab)	Germany
Friedrich-Loeffler-Institut – Federal Research Institute for Animal Health (FLI)	Germany
German Armed Forces Medical Service, GER Ministry of Defence	Germany
Institut fuer Virologie, Philipps-Universität Marburg	Germany
Institute of Virology, Charité Berlin	Germany
Johanniter-Unfall-Hilfe e.V. Headquarters Berlin	Germany

ORGANIZATION	COUNTRY
Medical Mission Institute, Department of Tropical Medicine	Germany
Robert Koch Institut (RKI)	Germany
University Hospital Düsseldorf	Germany
National School of Public Health, Central Public Health Laboratory, Greece	Greece
Centro Nacional de Epidemiología, Ministerio de Salud Pública y Asistencia Social	Guatemala
Institut Pasteur (IP), Guyane	Guyana
National Centre for Disease Control (NCDC), India	India
National Institute of High-Security Animal Disease, Bhopal, India	India
National Institute of Virology (NIV), India	India
The INCLEN Trust International	India
WHO Regional Office for South-East Asia (SEARO)	India
Centre for Communicable Diseases Control (CDC) Iran, Ministry of Health and Medical Education (MOH&ME)	Iran
Institute Pasteur (IP), Iran	Iran
Health Protection Surveillance Centre (HPSC)	Ireland
National University of Ireland, Galway	Ireland
Israeli Medical Association (IMA)	Israel
Istituto Superiore di Sanita (ISS)	Italy
National Institute for Infectious Diseases Lazzaro Spallanzani (INMI)	Italy
United Nations Food and Agriculture Organization (FAO)	Italy
Association of Medical Doctors of Asia (AMDA)	Japan
Centre for Infectious Diseases, Nara Medical University	Japan
Department of Public Health, Osaka City University Faculty of Medicine	Japan
Department of Virology, Tohoku University, School of Medicine	Japan
Division of Tuberculosis and Infectious Disease Control, Ministry of Health, Labour and Welfare	Japan
Hokkaido University Research Centre for Zoonosis Control	Japan
Institute of Tropical Medicine, Nagasaki University	Japan
International Medical Centre of Japan	Japan
Japan International Cooperation Agency JICA, Japan Disaster Relief Team (JDR)	Japan
Japanese Red Cross Wakayama Medical Centre	Japan
Kurume University	Japan
Mie National Hospital	Japan
National Centre for Global Health and Medicine, Japan	Japan
National Institute of Infectious Diseases (NIID)	Japan
Osaka University	Japan
Our Lady of Snow Medical Juridical Corporation St. Marys Hospital	Japan
School of Medicine, Niigata University	Japan
Eastern Mediterranean Public Health Network (EMPHNET)	Jordan
Jordan Food and Drug Administration	Jordan

ORGANIZATION	COUNTRY
Amref Health Africa	Kenya
Kenya Medical Research Institute (KEMRI)	Kenya
American University of Beirut Medical Centre	Lebanon
Faculty of Public Health - Lebanese University	Lebanon
Ministry of Public Health, Lebanon	Lebanon
Epidemiology Intelligence Program (EIP), Malaysia	Malaysia
Institute of Health and Community Medicine (IHCM) Universiti Malaysia Sarawak	Malaysia
National Centre for Epidemiological Surveillance and Disease Control, Ministry of Health Mexico	Mexico
Directory of Epidemiology and Control Diseases (DELM) /MOH Morocco	Morocco
Institut Pasteur (IP), Morocco	Morocco
National Public Health Laboratory, Nepal	Nepal
Sukra Raj Tropical and Infectious Disease Hospital	Nepal
Erasmus MC	Netherlands
Médecins Sans Frontières - Holland (MSF Holland)	Netherlands
RIVM, National Institute for Public Health and the Environment	Netherlands
Royal Tropical Institute (KIT), KIT Biomedical Research	Netherlands
Secretariat of the Pacific Community (SPC)	New Caledonia
Institute of Environmental Science and Research Limited (ESR)	New Zealand
Federal University Oye Ekiti	Nigeria
Nigeria Centre for Disease Control (NCDC)	Nigeria
Norwegian Armed Forces Medical Services	Norway
Norwegian Institute of Public Health (NIPH)	Norway
Directorate General for Disease Surveillance and Control, Ministry of Health Oman	Oman
National Institute of Health - NIH Pakistan	Pakistan
Papua New Guinea Institute of Medical Research (PNG IMR)	Papua New Guinea
Instituto Nacional de Salud (NIH Peru)	Peru
National Epidemiology Centre, Department of Health, Ministry of Health Philippines	Philippines
WHO Regional Office for the Western Pacific (WPRO)	Philippines
Ministry of Health Portugal, Office of the Director General of Health	Portugal
National Institute of Health Dr. Ricardo Jorge (NIH Portugal)	Portugal
JW LEE Centre for Global Medicine, Seoul National University College of Medicine	Republic of Korea
Korea Centres for Disease Control and Prevention (KCDC)	Republic of Korea
Reseau des Experts Sanitaires des Eaux (RESEaux)	Reunion
Stavropol Antiplague Research Institute	Russian Federation
King Abdulaziz Medical City, National Guard Health Affairs	Saudi Arabia

ORGANIZATION	COUNTRY
Institut Pasteur (IP), Dakar	Senegal
Ministry of Health, Singapore	Singapore
National University of Singapore (NUS)	Singapore
Program in Emerging Infectious Diseases, Duke-NUS Graduate Medical School	Singapore
Singapore General Hospital	Singapore
Tan Tock Seng Hospital	Singapore
Institute of Virology, Biomedical Research Centre, Slovak Academy of Sciences	Slovakia
Institute of Microbiology and Immunology, Faculty of Medicine, University of Ljubljana	Slovenia
Infection Control Africa Network (ICAN)	South Africa
National Institute for Communicable Diseases (NICD), South Africa	South Africa
Instituto de Salud Carlos III (ISCIII)	Spain
Médecins Sans Frontières - Spain (MSF Spain)	Spain
MediPIET	Spain
Ministry of Health Social Services and Equality, Spain	Spain
Ministry of Health Sudan, National Public Health Laboratory (NPHL)	Sudan
European Centre for Disease Prevention and Control (ECDC)	Sweden
European Programme for Intervention Epidemiology Training (EPIET)	Sweden
Public Health Agency of Sweden	Sweden
GOARN Secretariat	Switzerland
International Committee of the Red Cross (ICRC)	Switzerland
International Council of Nurses (ICN)	Switzerland
International Federation of Red Cross and Red Crescent Societies (IFRC)	Switzerland
International Organization for Migration (IOM)	Switzerland
Medecins Sans Frontieres - Switzerland (MSF Switzerland)	Switzerland
Spiez Laboratory, Federal Office for Civil Protection (FOCP)	Switzerland
Staff Health & Wellbeing Services (SHW), World Health Organization	Switzerland
Swiss Humanitarian Aid Unit (SHA), Swiss Agency for Development and Cooperation (SDC)	Switzerland
United Nations High Commission for Refugees (UNHCR)	Switzerland
The University of Geneva, Faculty of Medicine (HUG)	Switzerland
WHO Department of Evidence and Policy on Environmental Health (EPE)	Switzerland
WHO Department of Food Safety, Zoonoses, and Foodborne Diseases	Switzerland
WHO Emerging and Dangerous Pathogens Laboratory Network (EDPLN)	Switzerland
WHO Epidemic Diseases Clinical Assessment and Response Network (EDCARN)	Switzerland
WHO Global Infection Prevention and Control Network (GIPCN)	Switzerland
WHO The International Food Safety Authorities Network (INFOSAN)	Switzerland
WHO Virtual Interdisciplinary Advisory Group on Mass Gathering	Switzerland
WHO Country Health Emergency Preparedness & IHR (CPI)	Switzerland
WHO Emergency Operations (EMO)	Switzerland

ORGANIZATION	COUNTRY
WHO Executive Director Office	Switzerland
WHO Global Task Force on Cholera Control (GTFCC)	Switzerland
WHO Health Emergency Information & Risk Assessment (HIM)	Switzerland
WHO Infectious Hazard Management (IHM)	Switzerland
WHO Management & Administration (MGA)	Switzerland
WHO Operations Support and Logistics	Switzerland
Armed Forces Research Institute for Medical Sciences (AFRIMS)	Thailand
Bureau of Epidemiology, Surveillance and Response Unit, Ministry of Health Thailand	Thailand
Dengue Unit, Queen Sirikit National Institute of Child Health (QSNICH)	Thailand
International FETP, Thailand	Thailand
Mekong Basin Disease Surveillance (MBDS)	Thailand
Division des laboratoires - Ministère de la Santé et de la Protection Sociale	Togo
Institut National d'Hygiène	Togo
Caribbean Public Health Agency (CARPHA)	Trinidad and Tobago
Institut Pasteur (IP), Tunis	Tunisia
African Field Epidemiology Network (AFENET)	Uganda
Ministry of Health and Prevention, Emergency - Crisis - Disaster Operations Centre	United Arab Emirates
Animal and Plant Health Agency (APHA)	United Kingdom
ISARIC - International Severe Acute Respiratory and Emerging Infection Consortium	United Kingdom
London School of Hygiene and Tropical Medicine (LSHTM)	United Kingdom
MRC Centre for Outbreak Analysis and Modelling, Imperial College London	United Kingdom
Public Health England (PHE)	United Kingdom
Save the Children International	United Kingdom
East African Integrated Disease Surveillance (EAIDSNet), National Institute for Medical Research (NIMR)	United Republic of Tanzania
APEC Emerging Infections Network (EINET)	United States of America
Armed Forces Health Surveillance Branch (AFHSB)	United States of America
Association of Public Health Laboratories (APHL)	United States of America
Centre for Infection and Immunity, Mailman School of Public Health of Columbia University	United States of America
Centers for Disease Control and Prevention (CDC)	United States of America
Chan Zuckerberg Biohub	United States of America
International Epidemiological Association (IEA)	United States of America
International Rescue Committee (IRC)	United States of America
Johns Hopkins University	United States of America
mWater	United States of America

ORGANIZATION	COUNTRY
Training Programmes in Epidemiology and Public Health Interventions Network (TEPHINET)	United States of America
Tulane School of Public Health and Tropical Medicine	United States of America
U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)	United States of America
United Nations Children's Fund (UNICEF)	United States of America
University of Nebraska Medical Centre	United States of America
University of Texas Medical Branch (UTMB)	United States of America
WHO Regional Office for the Americas (AMRO)	United States of America
Clinical Research Unit, Hospital for Tropical Diseases	Viet Nam
National Institute of Hygiene and Epidemiology (NIHE)	Viet Nam
REACTing	

Appendix D. GSIN member countries and experts in 1952

Country	Institution	Lead experts
	WHO INFLUENZA CENTRES	
WHO	World Influenza Centre	Dr. C. H. Andrewes
	Strain Study Centre for the Americas	Dr. T. P. Magill
NIGERIA	Virus Research Institute	
UNION OF SOUTH AFRICA	The South African Institute for Medical Research	Dr. J. H. S. Gear
	University of Cape Town	Prof. M. van den Ende
ARGENTINA	Instituto Bacteriologico Carlos G. Malbran	Dr. A. S. Parodi
BRAZIL	Instituto Oswaldo Cruz	Dr. J. G. Lacorte
CANADA	Laboratory of Hygiene, Department of National Health and Welfare	Dr. F. P. Nagler
	The Connaught Medical Research Laboratories, University of Toronto	Dr. C. E. van Rooyen
CHILE	Instituto Bacteriologico de Chile	Dr. Raul Palacios
JAMAICA	Department of Pathology, University College of the West Indies	Dr. L. Grant
MEXICO	Instituto de Salubridad y Enfermedades Tropicales	Dr. Gerardo Varela
PUERTO RICO	School of Tropical Medicine, University of Puerto Rico School of Medicine	Dr. J. E. Perez
UNITED STATES OF AMERICA	Influenza Information Centre, National Institutes of Health	Dr. Dorland J. Davis
	Communicable Disease Centre, US Public Health Service	Dr. M. F. Schaeffer
	Division of Laboratories, California State Department of Public Health	Dr. E. H. Lennette
	State University of Iowa	Dr. A. P. McKee
	Boston City Hospital	Dr. M. Finland
	Department of Epidemiology, University of Michigan School of Hygiene and Public Health	Dr. T. Francis, Jr.
	Division of Laboratories and Research, New York State Department of Health	Dr. I. J. Gordon
	University of Pittsburgh School of Medicine	Dr. J. E. Salk
EGYPT	Serum and Vaccine Laboratory	Dr. Mohamed Aly Dr. I. M. Hassan
ISRAEL	Hadassah Medical School, The Hebrew University	Dr. H. Bernkopf
AUSTRIA	Bundesstaatliche bakteriologisch-serologische Untersuchungsanstalt	Dr. E. Petrowsky
BELGIUM	Laboratoire Central d'Hygiene	Dr. P. Nelis
DENMARK	Statens Seruminstitut	Dr. J. 0rskov Dr. P. von Magnus
FINLAND	Valtion Serumlaitos	Dr. Kari J. Penttinen
FRANCE	Mlle G. Cateigne, Institut Pasteur	Prof. R. Dujarric de la Riviere Prof. Pierre Lupine
GERMANY (WEST)	Hygienisches Institut der Universitat Marburg	Prof. K. Herzberg
	Bernhard-Nocht-Institut fur Schiffs- und Tropenkrankheiten	Prof. E. G. Nauck
(BERLIN-WEST)	Robert Koch Institut fur Hygiene und Infektionskrankheite	Prof.D. Henneberg

GSIN Members 1952

Country	Institution	Lead experts
GREECE	Central Public Health Laboratory, Ministry of Hygiene	Dr. S. G. Pavlidis
ICELAND	University of Iceland Institute for Experimental Pathology	Dr. B. Sigurdsson
IRELAND	St. Vincent's Hospital	Dr. P. N. Meenan
ITALY	Istituto Superiore di Sanita	Prof. I. Archetti
NETHERLANDS	Instituut voor Praeventieve Geneeskunde	Prof. J. D. Verlinde
	Interne Universiteitskliniek	Prof. J. Mulder
NORWAY	K. W. Wilhelmsen og frues Bakteriologiske institutt	Prof. Th. Thj0tta
PORTUGAL	Dr. Ricardo Jorge Laboratorio de Bacteriologia Sanitaria do Instituto Superior de Higiene	Dr. A. A. C. Sampaio
SPAIN	Escuela Nacional de Sanidad	Dr. F. Perez Gallardo
SWEDEN	Statens bakteriologiska laboratorium	Dr. A. Svedmyr
SWITZERLAND	Institut d'Hygiene, Universite de Geneve	Prof. E. Grasset
	Institut fur Hygiene und Bakteriologie	Prof. C. Hallauer
TURKEY	Refik Saydam Central Institute of Hygiene	Dr. Niyazi Erzin
UNITED KINGDOM	Public Health Laboratory, General Hospital	Dr. L. Hoyle
	Bacteriology Department	Dr. R. H. A. Swain
	Central Public Health Laboratory	Dr. F. 0. MacCallum
YUGOSLAVIA	Bakteriolosko Odelenje, Savezni Epidemiologki Institut	Dr. A. Terzin
	Institute of Microbiology, University of Zagreb	Dr. Jeltka Vesenjak
INDIA	Coonoor	Dr. I. G. K. Menon
	Haffkine Institute	Dr. D. W. Soman
AUSTRALIA	The Commonwealth Serum Laboratories, Department of Health	Dr. W. J. O'Connor
	Walter and Eliza Hall Institute for Medical Research	Sir Macfarlane Burnet
JAPAN	National Institute of Health of Japan	Dr. Saburo Kojima
	WHO INFLUENZA OBSERVERS	
BOLIVIA	Instituto Nacional de Epidemiologia	
DOMINICAN REPUBLIC	Laboratorio de Salud Pública, Secretaria de Estado de Sanidad y Asistencia Publica	Dr. J. J. Ravelo
ECUADOR	Instituto Nacional de Higiene	
PAKISTAN	Bureau of Laboratories, Military Hospital	Dr. M. M. Siddiq Husain
CEYLON	Medical Research Institute	Dr. K. G. B. Stork
FEDERATION OF MALAYA	Institute for Medical Research	Dr. S. R. Savoor
NEW ZEALAND	Division of Public Hygiene, Department of Health	Dr. F. S. MacLean
	University of Otago Medical School	Sir Charles Hercus, D.S.O., O.B.E.
	Auckland Hospital	Dr. Selwyn Hills
PHILIPPINES	Division of Laboratories, Department of Health	

GSIN Members 1952

Appendix E. International Pledging Conferences on Avian and Human Influenza

- Meeting on Case Management and Research on Human Influenza A/H5, Hanoi, May 2005
- 60th United Nations General Assembly, September 2005.
- Meeting of the International Partnership on Avian and Pandemic Influenza Washington, DC, October 6-7, 2005
- Meeting of Health Ministers in Ottawa, Canada on Global Influenza Readiness, October 24-25, 2005.
- Meeting on Avian Influenza and Human Pandemic Influenza, Geneva, Switzerland, 7-9 November 2005.
- Japan-WHO joint meeting on Early Response to Potential Influenza Pandemic, Tokyo, Japan, 12-13 January 2006.
- The International Pledging Conference, Beijing, China, 17-18 January 2006.
- The Vienna Senior Officials Meeting on Avian and Human Pandemic Influenza, 6-7 June 2006
- The 4th International Conference on Avian Influenza, 6-8 December 2006, Bamako, Mali.
- International Technical Meeting on Avian Influenza 27-29 June 2007 Rome, Italy.
- New Delhi International Ministerial Conference on Avian Influenza, 4-6 December 2007, India.
- Sixth International Ministerial Conference on Avian and Pandemic Influenza, 24-26 October 2008, Sharm el-Sheikh, Egypt
- The Seventh International Ministerial Conference Animal and Pandemic Influenza, April 2010, Hanoi, Viet Nam.
- High-Level Technical Meeting to Address Health Risks at the Human-Animal-Ecosystems Interfaces, Mexico City, November 2011.

Appendix F. GOARN partners for pandemic influenza H1N1

GOARN PARTNERS (INSTITUTIONS AND COUNTRIES)
Association of Public Health Laboratories (APHL), USA.
Burnet Institute, Australia.
Caribbean Epidemiology Centre (CAREC), Trinidad and Tobago
Centers for Disease Prevention and Control in Atlanta, USA;
Oficina Regional del CDC para Centroamérica y Panamá (CDC-CAP), Guatemala.
Centre for Infections (CFI) Health Protection Agency (HPA), UK
European Centre for Disease Prevention and Control (ECDC), Sweden, including the European Network for Diagnostics of Imported Viral Diseases (ENIVD), based at the Robert Koch Institute (RKI), Germany; and the European based at the Robert Koch Institute (RKI), Germany; and the European
Programme for Intervention Epidemiology Training (EPIET)
Hospital Clínico, Universidad de Chile
Imperial College, London, UK
Institute of Health and Community Health (IHCH), Universiti Malaysia Sarawak, Malaysia
Institut Pasteur(IP), France and Cayenne, and IP Global Network
Institut National de Veille Sanitaire (InVS), France, and Cellules de l'Institut de veille sanitaire en région (CIRE) Antilles-Guyane.
Instituto de Salud Carlos III, Madrid, Spain
Instituto Nacional de Salud (NIH), Peru
International Epidemiological Association (IEA), Egypt.
London School of Hygiene and Tropical Medicine (LSHTM), UK
Ministries of Health of Argentina, Brazil, Chile, Peru, and Spain
National Influenza Centre, Instituto Nacional de Saúde, Portugal
National Centre for Epidemiological Surveillance and Disease Control Ministry of Health, Mexico
PATH, Nicaragua
Public Health Agency of Canada (PHAC), including the Centre for Emergency Preparedness and Response, Field Epidemiology Training Programme, and National Microbiological Laboratories (NML)
Robert Koch Institute (RKI), Germany.
Universidade Lusófona, Portugal.
The University of Texas - Medical Branch (UTMB), Galveston, Texas, US
University of Valparaiso, Chile.
US Naval Medical Research Unit No. 3 (NAMRU-3)*
United Nations Food and Agriculture Organization (FAO)
World Organization for Animal Health.- Office International des Epizooties (OIE), France

GOARN PARTNERS (INSTITUTIONS AND COUNTRIES)
Medecins Sans Frontieres (MSF) Belgium, France, Holland, Spain, Switzerland, and MSF International
International Federation of Red Cross and Red Crescent Societies (IFRC), Switzerland
International Rescue Committee (IRC), USA
WHO HQ, PAHO, WPRO, and Country Offices in Brazil, Bolivia, Chile, Columbia, Costa Rica, Ecuador, Honduras, Mexico Nicaragua, Panama, and Uruguay.
WHO Clinical Network
WHO Emerging and Dangerous Pathogens Laboratory Network (EDPLN)
WHO Infection Prevention and Control Network
WHO Global Influenza Programme and GISN
WHO Health Action in Crisis, Emergency Response, and Operations
WHO Health Security and Environment
WHO Mediterranean Centre for Vulnerability Reduction (WMC)
WHO Pan American Health Organization (PAHO)
WHO Regional Office for Africa, AFRO
WHO Regional Office for Eastern Mediterranean, EMRO
WHO Regional Office for Europe, EURO
WHO Regional Office for South East Asia, SEARO
WHO Regional Office for the Western Pacific, WPRO

Appendix G. Participants meeting A(H1N1) influenza Cancun 2009

ID	Country/Organization	No. of participants	ID	Country/Organization	No. of participants
1	Germany	8	26	India	1
2	Argentina	3	27	Indonesia	2
3	Interamerican Development Bank	3	28	Israel	2
4	World Bank	1	29	Jamaica	1
5	Belgium	1	30	Japan	2
6	Belize	2	31	Arab League	2
7	Bolivia	1	32	Mexico	122
8	Brazil	3	33	Nicaragua	4
9	Canada	10	34	Nigeria	5
10	CARICOM	1	35	OIE	2
11	USA	38	36	WHO	5
12	Chile	6	37	WHO-PAHO	23
13	China	9	38	Panama	2
14	COMISCA	2	39	Paraguay	1
15	South Korea	3	40	Peru	1
16	Costa Rica	4	41	PNUD	1
17	Cuba	2	42	Portugal	1
18	Ecuador	2	43	UK	5
19	Egypt	8	44	Czech Republic	1
20	El Salvador	3	45	Dominican Republic	1
21	Spain	5	46	Sweden	6
22	European Commission	2	47	Switzerland	2
23	France	3	48	Thailand	1
24	Guatemala	2	49	Trinidad and Tobago	1
25	Honduras	1	50	Uruguay	1
			51	Venezuela	1

Appendix H. Pandemic Influenza Epistemic Community Members

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
Afghanistan	Naseer Stanikzai a.i.	Central Public Health Laboratory		1						
Albania	Silvia Bino	Institute of Public Health		1			1			
Algeria	Fawzi Derrar	Institut Pasteur d'Algérie		1						
Argentina	Jorge Augusto Camara	Instituto de Virologia	1	1						
Argentina	Karina Balbuena	Ministry of Health						1		
Argentina	Vilma Savy	Instituto Nacional de Enfermedades Infecciosas	1							
Argentina	Carlos Alberto Soratti	Ministry of Health			1					
Argentina	Elsa Baumeister	Instituto Nacional de Enfermedades Infecciosas		1						
Argentina	Oreste Luis Carlino	Ministerio de Salud de la Republica de Argentina			1					
Argentina	Osvaldo Uez	Intituto Nacional de Epidemiologia		1						
Australia	Gary Grohmann	Therapeutic Goods Administration						1		
Australia	Ian Barr	Peter Doherty Institute for Infection & Immunity WHO Collaborating Centre for Reference and Research on Influenza	1						1	
Australia	Jennifer Bryant	Department of Health and Ageing						1		
Australia	Jim Bishop	Department of Health and Ageing						1		
Australia	John Mackenzie	Division of Health Sciences, Curtin University				1		1		

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
Australia	Julian Druce	Virus Identification Laboratory, Victorian Infectious Diseases Reference Laboratory (VIDRL)		1						
Australia	Mary Murnane	Department of Health and Ageing						1		
Australia	Naomi Komadina	Peter Doherty Institute for Infection & Immunity							1	
Australia	David Smith	PathWest Laboratory Medicine		1						
Australia	Dominic Dwyer	Institute of Clinical Pathology and Medical Research (ICPMR), Westmead Hospital		1						
Austria	Franz X. Heinz	Medical University of Vienna		1						
Azerbaijan	Vagif Abdullayev	Republican Centre of Hygiene and Epidemiology						1		
Bahrain	Amjad Zaed	Public Health Laboratory		1						
Bangladesh	Mahmudur Rahman	Ministry of Health and Family Welfare		1			1			
Belarus	Liudmila Naroichyk	Republican Centre for Hygiene, Epidemiology and Public Health						1		
Belarus	Natalia Gribkova	Republican Research & Practical Centre for Epidemiology and Microbiology		1						
Belgium	Dirk Cuypers	Ministry of Health			1					
Belgium	Isabelle Thomas	Scientific Institute of Public Health		1						
Belize	Pablo Marín	Ministry of Health			1					
Belize	Paul Edwards	Ministry of Health			1					
Bolivia	Jorge Ramiro Tapia Sainz	Ministry of Health			1					
Brazil	Agenor Alvarez	ANVISA			1					
Brazil	Eduardo Hage Carmo	Ministry of Health					1			

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
Brazil	Carlos Felipe Almeida de Oliveira	Ministry of Health			1					
Brazil	Cristiano Gregis	Agencia Nacional de Vigilancia Sanitaria			1					
Brazil	Terezinha Maria de Paiva	National Influenza Centre, Instituto Adolfo Lutz		1						
Brazil	Wyller Alencar de Mello	National Influenza Centre,Instituto Evandro Chagas, SVS-MS	1	1						
Brazil	Marilda Siqueira	Instituto Oswaldo Cruz		1						
Bulgaria	Neli Korsun	National Laboratory "Influenza and ARD"		1						
Cambodia	Philippe Dussart	Institut Pasteur in Cambodia		1						
Cameroon	Richard Njouom	Centre Pasteur du Cameroun	1	1						
Canada	Anthony Evans	International Civil Aviation Organization (ICAO)				1		1		
Canada	Arlene King	Ontario Ministry of Health and Long-Term Care					1			
Canada	Claude Thibeault	International Air Transport Association (IATA)				1		1		
Canada	David Butler-Jones	Public Health Agency of Canada			1			1		1
Canada	Jane Billings	Public Health Agency of Canada			1					1
Canada	Michael Aubie,	Ministry of Health			1					
Canada	Yan Li	Public Health Agency of Canada		1						
Canada	Brian Evans	Canada Food Inspection Agency			1					
Canada	Elaine Chatigny	Public Health Agency of Canada			1					1
Canada	Francis A. Plummer	Public Health Agency of Canada			1					1
Canada	Leona Aglukkaq	Ministry of Health			1					1
Canada	Ross Upshur	University of Toronto			1					

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
CARICOM	Edwin W. Carrington	CARICOM			1					
Central African Republic	Emmanuel Nakouné a.i.	Institute Pasteur de Bangui		1						
Chile	Álvaro Erazo Latorre	Ministry of Health			1					
Chile	Cecilia Morales	Ministry of Health			1					
Chile	Claudia González	Universidad del Desarrollo			1		1			
Chile	Fernando Otaiza	Ministry of Health				1				
Chile	Jeanette Dabanch				1					
Chile	Maritza Garcia	Ministry of Health						1		
Chile	Rodrigo Fasce	Laboratorio de Virus Respiratorios y Exantematicos,Instituto de Salud Publica de Chile	1	1						
Chile	Rosanna Lagos	Ministry of Health			1					
Chile	Pedro Astudillo	Ministry of Health			1					
Chima	Yuelong Shu	Sun Yat-sen University							1	
China	Dayan Wang		1	1						
China	George Fu Gao	Chinese Centre for Disease Control and Prevention							1	
China	Hualan Chen	Ministry of Agriculture, Harbin Veterinary Research Institute							1	
China	Li Qiuting	International Development Ministry			1					
China	Li Xiang	Ministry of Health			1					
China	Ren Minghui	Ministry of Health			1					
China	Wing Hong Seto	Queen Mary Hospital				1				
China	Yu Lan	Chinese National Influenza Centre							1	

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
China	Yu Wang	Chinese Centre for Disease Control and Prevention					1			
China	Chen Xianyi				1					
China	Chen Zhu	Ministry of Health			1					
China	Shu Yuelong	Chinese Centre for Disease Control and Prevention			1					
China	Xiao Donglou	Ministry of Health	1		1					
China	Yang Weizhong	Chinese Centre for Disease Control and Prevention			1					
Colombia	Juliana Barbosa Ramirez	Instituto Nacional de Salud de Colombia		1						
Costa Rica	Jenny Lara	Laboratorio Nacional de Influenza		1						
Costa Rica	Daniel Salas Peraza				1					
Costa Rica	Marcela Hernández	Hospital Nacional de Ninos			1					
Costa Rica	María Luisa Ávila Agüero	Ministry of Health			1					
Costa Rica	Rossana Garcia Gonzalez	Ministry of Health			1					
Côte d'Ivoire	Paul Odehouri-Koudou	National Institute of Public Hygiene					1			
Côte d'Ivoire	Hervé Kadjo	Institut Pasteur de Côte d'Ivoire		1						
Croatia	Vladimir Drazenovic	Croatian Institute of Public Health	1	1						
Cuba	Betsy Acosta Herrera	Instituto de Medicina Tropical "Pedro Kourí"	1	1						
Cuba	Alina Llop Hernández	Instituto Medico Tropical "Pedro Kuri" de Cuba			1					
Cuba	Luis Estruch Rancaño				1					
Czech Republic	Dana Juraskova	Ministry of Health			1					

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
Czech Republic	Martina Havlickova	National Institute of Public Health, Centre for Epidemiology and Microbiology	1	1						
Democratic People's Republic of Korea	K. Dong Guy	Central Hygienic Anti-epidemic Station		1						
Denmark	Caroline Brown	EURO	1							
Denmark	Dimitriy Pereyaslov	EURO	1							
Denmark	Thea Kølsen Fischer	Statens Serum Institut		1						
Denmarl	Benjamin Turner	QIAGEN Bioinformatics							1	
Dominican Republic	Nelson Rodríguez Monegro	Ministry of Health			1					
Ecuador	Ricardo Cañizares Fuentes	Ministry of Health			1					
Ecuador	Alfredo Bruno Caicedo	Instituto Nacional de Investigación en Salud Pública		1						
Ecuador	Eulalia Narvaez	Ministry of Health			1					
Egypt	Ali Mafi	EMRO/WHO	1							
Egypt	Amel Mohamed Naguib	Central Public Health Laboratory		1						
Egypt	Amr Mohamed Kandeel	Ministry of Health			1		1			
Egypt	Claire A. Cornelius	US Naval Medical Research Unit No. 3 (NAMRU-3)	1							
Egypt	Hassan El Bushra	EMRO/WHO	1							
Egypt	Nagwa El Kholy	Egyptian Organisation for Biological Products and Vaccines (VACSERA)	1							
Egypt	Samir Abdel Aziz El Rafie	Ministry of Health						1		

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
Egypt	Samir Elrfaey				1					
Egypt	Hatem Mostafa El-Gabaly	Ministry of Health and Population			1					
Egypt	Iman Fawzy Mahmoud Farghal	Egyptian Holding Company for Biological Products and Vaccines (VACSERA)		1						
Egypt	Moukhtar Wereida				1					
Egypt	Seham Sadek				1					
El Salvador	Eduardo Suarez Castañeda	Ministry of Public Health and Social Assistance			1					
El Salvador	Fatima Trinidad Valle de Zuñiga	Universidad del El Salvador			1					
El Salvador	Patricia Alberto	Comisión Nacional de la Influenza y Colaboradora Técnica de la Unidad de Epidemiología de El Salvador			1					
El Salvador	Mónica Jeannette Barahona de Gámez	Laboratorio Central Ministerio de Salud Publica "Dr Max Bloch"		1						
Estonia	Kaie Otsmaa	NIC Estonia, Tallinn, Estonia	1							
Estonia	Natalja Kuznetsova	Laboratory for Communicable Diseases		1						
European Union	Angus Nicoll	European Centre for Disease Prevention and Control						1		
European Union	Marc Sprenger	European Centre for Disease Prevention and Control						1		
Fiji	Eric Rafai	Centre for Communicable Disease Control		1						
Finland	Thedi Ziegler	NIC Finland, Helsinki, Finland	1							
Finland	Niina Ikonen	National Institute for Health and Welfare		1						

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
France	Alex Thiermann	Terrestrial Animal Health Code Commission / World Organisation for Animal Health (OIE)						1		
France	Atika Abelin	Sanofi Pasteur						1		
France	Didier Houssin	Ministry of Health						1		1
France	Jacques Berger	Sanofi Pasteur						1		
France	José Joaquín Oreamuno	World Organisation for Animal Health			1					
France	Kate Glynn	World Organisation for Animal Health						1		
France	Keith Hamilton	World Organisation for Animal Health	1							
France	Patricia Leung-Tack	Sanofi Pasteur SA	1					1		
France	Paul Benkimoun	Le Monde						1		
France	Sylvie van der WERF	Pasteur Institute							1	
France	Bruno Lina	Centre National de Référence du Virus Influenza Région Sud		1						
France	Daniel Camus	Ministry of Health and Sports			1					
France	Sylvie Van der Werf	Institut Pasteur		1						
France - Cayenne	Dominique Rousset	Institut Pasteur de la Guyane	1	1						
France-New Caledonia -	Dominique Baudon a.i.	Institut Pasteur de Nouvelle-Calédonie		1						
Gabon	Jean Damascène Khouilla	Director General of Public Health, Health Agency						1		
Georgia	Ann Machablishvili	Centre for Disease Control and Public Health	1	1						
Germany	Albercht Schad	Ministry of Health			1					
Germany	Brunhilde Schweiger	NIC Germany, Berlin, Germany	1							

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
Germany	Gérard Krause	National Public Health Institute, Robert Koch			1			1		
Germany	Joachim Büch	Computational Biology and Applied Algorithmics							1	
Germany	Lars Schaade	Robert Koch Institute						1		
Germany	Martin Beer	Friedrich-Loeffler-Institute, Federal Institute for Animal Health							1	
Germany	Ralf Dürrwald a.i.	Robert Koch-Institute		1						
Germany	Thomas C. Mettenleiter	Friedrich-Loeffler-Institute, Federal Institute for Animal Health							1	
Germany	Thomas Lengauer	Computational Biology and Applied Algorithmics							1	
Germany	Thorsten Wolff	Robert Koch Institute							1	
Germany	Karin Knufmann Happe	Ministry of Health			1					
Germany	Klaus Theo Schröder	Federal Ministry of Health			1					1
Germany	Timo Ulrichs	Ministry of Health			1					
Ghana	Lawson Ahadzie	Ministry of Health				1				
Ghana	William Kwabena Ampofo	National Influenza Laboratory, University of Ghana	1	1						
Greece	Angeliki Melidou	NIC Greece	1							
Greece	Andreas Mentis	Institut Pasteur Hellénique		1						
Greece	Anna Papa-Konidari	National Influenza Centre for N. Greece		1						
Guatemala	Nivaldo Linares	Centres for Disease Control and Prevention			1					
Guatemala	Jesús Oliva Leal	Universidad de San Carlos			1					

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Guatemala	Leticia Castillo Signor	Centro Nacional de Influenza, Laboratorio Nacional de Salud		1						
Guatemala	Víctor Guerra	Viceministro de Salud de Guatemala			1					
Honduras	Carlos Roberto Aguilar Pineda	Ministry of Health			1					
Honduras	Rudvelinda Rivera	Ministry of Health		1						
Hong Kong	Janice Lo	National Influenza Centre, Centre for Health Protection		1						
Hong Kong	Wilina Lim	Centre for Health Protection, Hong Kong, China S.A.R	1							
Hungary	Istvan Jankovics	B. Johan National Centre for Epidemiology		1						
Iceland	Arthur Löve	Landspitali - University Hospital		1						
India	Akhilesh C. Mishra	National Institute of Virology							1	
India	Ghulam Nabi Azad	Ministry of Health and Family Welfare			1					
India	Jagvir Singh	National Centre for Disease Control	1							
India	Mandeep Chadha	NIC India	1							
India	Palliri Ravindran	Ministry of Health					1			
India	Ranjana Deshmukh	Department of Virology		1						
India	Suresh Jadhav	Serum Institute of India and former President of the Developing Countries Vaccine Manufacturers' Network						1		
India	D T Mourya a.i.	National Institute of Virology		1						
India	Usha Soren Singh	National Influenza Centre, Central Research Institute		1						

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Indonesia	Agus Purwandianto	Research and Development in Health Council			1					
Indonesia	Novilia Sjari Bachtiar	PT. Bio Farma Bandung, Indonesia	1							
Indonesia	Ondri Dwi Sampurno	NIC Indonesia, Jakarta, Indonesia	1							
Indonesia	Professor Tjandra Aditama	Ministry of Health					1			
Indonesia	Rini Mulia Sari	PT. Bio Farma Bandung, Indonesia	1							
Indonesia	Vivi Setiawaty	National Institute of Health, Research & Development							1	
Indonesia	Pretty Multihartina	Centre for Biomedical and Basic Technology of Health, National Institute of Health Research and Development		1						
Indonesia	Sunarno Ranu Widjojo				1					
Iran	Mohammad Mehdi Gouya	Ministry of Health and Medical Education					1			
Iran	Talat Mokhtari-Azad	Iranian National Influenza Centre, School of Public Health		1						
Iraq	Imam M. Aufi	National Influenza Centre		1						
Ireland	Cillian De Gascun	National Virus Reference Laboratory		1						
Israel	Avi Israeli	Ministry of Health			1					
Israel	Michal Mandelboim	Ministry of Health		1						
Italy	Ilaria Capua	Istituto Zooprofilattico Sperimentale Delle Venezie							1	
Italy	Isabella Donatelli	NIC Italy, Rome, Italy	1							
Italy	Isabella Monne	Istituto Zooprofilattico Sperimentale delle Venezie							1	

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Italy	Simona Puzelli	NIC Italy, Rome, Italy	1							
Italy	Thomas Jefferson	Cochrane Vaccines Field						1		
Italy	Maria Rita Castrucci	Istituto Superiore di Sanità		1						
Jamaica	Aundré Franklin	Ministry of Health			1					
Jamaica	Sandra Jackson	NIC Jamaica, Kingston, Jamaica	1							
Jamaica	Monica Smikle a.i.	Virology Laboratory, University of the West Indies University of the West Indies		1						
Japan	Hiroyuki Hori	Centro para la Influenza Pandémica de Japón			1					
Japan	Masato Mugitani	Ministry of Health, Labor and Welfare			1			1		
Japan	Masato Tashiro	National Institute of Infectious Diseases, National Institute of Health	1			1			1	
Japan	Nobuhiko Okabe	National Institute of Infectious Diseases					1			
Japan	Seiichiro Fujisaki	National Institute of Infectious Diseases							1	
Japan	Takato Odagiri	National Institute of Infectious Diseases, Influenza Virus Research Centre		1					1	
Jordan	Kamel Abusal	Ministry of Health						1		
Jordan	Asia Adwan a.i.	Laboratory Directorate		1						
Kazakhstan	Gauhar Nusupbaeva	Research-Practical Centre of Sanitary-Epidemiological Expertise and Monitoring		1						
Kenya	Japeth Magana	Centre for Virus Research		1						
Kenya	Philip Muthoka	Ministry of Health						1		
Kirghizstan	Kaliya Kasymbekova	NIC Kirghizstan	1							

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Kuwait	Sarah Al-Qabandi a.i.	Public Health Laboratory		1						
Kyrgyzstan	Gulbarchyn Saparova a.i.	National Virology Laboratory, Ministry of Health		1						
Lao	Phengta Vongphrachanh	National Centre for Laboratory and Epidemiology		1						
Latvia	Natalija Zamjatina	National Microbiology Reference Laboratory, Riga East University Hospital	1	1						
Lebanon	Pierre Zalloua / Nisrine Jamal a.i.	National Influenza Centre		1						
Lithuania	Vilnele Lipnickiene	National Public Health Surveillance Laboratory		1						
Luxemburg	Matthias Opp	Laboratoire National de Santé	1	1						
Madagascar	Jean-Michel Heraud	Institut Pasteur de Madagascar	1	1						
Malaysia	Jamal I-Ching Sam	University of Malaya		1						
Malaysia	Zainah Saat	Virology Unit, Institute of Medical Research		1						
Maldives	Geela Ali	Health Agency						1		
Malta	Christopher Barbara	Mater Dei Hospital		1						
Mauritius	Sanjiv Rughooputh	Department of Molecular Biology and Virology Central Health Laboratory		1						
Mexico	Dante Salazar	PAHO/WHO			1					
Mexico	Gisela Barrera Badillo	Ministry of Health	1							
Mexico	Hugo Lopez-Gatell Ramirez	Ministry of Health			1			1		1
Mexico	J.J Gomez-Camacho	Ministry of Foreign Affairs						1		
Mexico	Jose Ángel Cordova Villalobos	Ministry of Health			1					1

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Mexico	Jose Francisco Mauricio Garcia	Ministry of Health			1					
Mexico	José Ignacio Santos	National Autonomous University of Mexico					1			
Mexico	Julio Manuel Suárez	PAHO/WHO			1					
Mexico	Magdy Martínez-Solimán	PNUD			1					
Mexico	Mauricio Hernandez Avila	Ministry of Health			1					1
Mexico	Pablo Kuri Morales	Mexican Society of Public Health			1					1
Mexico	Philippe Lamy	PAHO/WHO			1					
Mexico	Rogelio Pérez Padilla	Ministry of Health			1	1				
Mexico	Sergio Garay	PAHO/WHO			1					
Mexico	Celia Alpuche	Ministry of Health			1					1
Mexico	Alejandro Macias Hernandez	National Institute Medical Sciences and Nutrition			1					
Mexico	Irma Lopez Martinez	Ministry of Health		1						
Mexico	Samuel Ponce de Leon	BIRMEX			1					
Mongolia	Pagbajab Nymadawa	NIC Mongolia, Ulaanbaatar, Mongolia	1							
Mongolia	Y. Buyanjargal a.i.	National Centre for Communicable Diseases, Ministry of Health		1						
Montenegro	Zoran Vratnica	Public Health Institute of Montenegro		1						
Morocco	Amal Barakat	Institut National d'Hygiène		1						
Morocco	Fatima El Falaki	NIC Morocco, Rabat, Morocco	1							
Morocco	Omar El Menzhi	Ministry of Health					1			
Myanmar	Htay Htay Tin a.i.	National Health Laboratory		1						

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Nepal	Bishnu Upadhyay	NIC Nepal, Kathmandu, Nepal	1							
Nepal	Garib Das Thakur	Department of Health Services						1		
Nepal	Geeta Shakya	National Public Health Laboratory		1						
Netherlands	Jan De Jong	NIC Netherlands, Rotterdam, Netherlands	1							
Netherlands	Ron A.M. Fouchier	Erasmus Medical Centre							1	
Netherlands	Marion Koopmans	Erasmus Medical Centre		1						
New Zealand	Andrew Forsyth	Ministry of Health					1			
New Zealand	Sue Huang	National Influenza Centre, Institute of Environmental Science and Research		1						
New Zealand	Margaret C. Croxson	Auckland City Hospital		1						
Nicaragua	Angel Balmaceda Echeverria	Ministry of Health		1						
Nicaragua	Guillermina Maria Kuan Montes	Centrode Salud "Socrates Flores" de la Ciudad de Managua			1					
Nicaragua	Guillermo González González	Ministry of Health			1					
Nicaragua	Miguel Orozco	Universidad Nacional Autónoma de Nicaragua			1					
Nicaragua	Wendy Cecilia Idiaquez Mendoza	Ministry of Health			1					
Nigeria	Abdulsalami Nasidi	Federal Ministry of Health					1			
Nigeria	D. Olaleye	University College Hospital		1						
Nigeria	Babatunde Osotimehin	Ministry of Health			1					
Nigeria	Henry Akpan	Ministry of Health			1					
Nigeria	J. I. Jiya	Ministry of Health			1					

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Nigeria	Shaibu Belgore	Ministry of Health			1					
Norway	Bente Angell-Hansen	Ministry of Foreign Affairs						1		
Norway	Bjørn Iversen	Norwegian Institute of Public Health						1		
Norway	Else JB Andersen	Ministry of Health and Care Service						1		
Norway	Ine Mǻreng,	Ministry of Foreign Affairs						1		
Norway	Morten Randmæl	Directorate of Health						1		
Norway	Olav Hungnes	Norwegian Institute of Public Health	1	1						
Norway	Preben Aavitsland	Norwegian Institute of Public Health					1			
Oman	Said Ali Saif Al Baqlani	NIC Oman	1							
Oman	Amina Al Jardani	Central Public Health Laboratory		1						
Pakistan	Muhammad Akbar Chaudhry	Fatima Jinnah Medical College				1				
Pakistan	Birjees Mazher Kazi	National Institute of Health		1						
Panama	Brechla Moreno A. a.i.	Instituto Conmemorativo Gorgas de Estudios de la Salud		1						
Panama	Eduardo Lucas Mora	Ministry of Health			1					
Panama	Gladys Guerrero	Ministry of Health			1					
Papua New Guinea	Amanda Lang a.i.	Institute of Medical Research		1						
Paraguay	Esperanza Martínez	Ministry of Health and Social Assistance			1					
Paraguay	Cynthia Vazquez a.i.	Laboratorio Central de Salud Publica		1						
Perú	Oscar Ugarte Ubilluz	Ministerio de Salud			1					

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Peru	Victoria Guttierez Peceros a.i.	Instituto Nactional de Salud		1						
Philippines	Marilla G. Lucero	NIC Philippines	1							
Philippines	Socorro P Lupisan	Research Institute for Tropical Medicine		1						
Poland	Lidia B. Brydak	National Influenza Centre		1						
Portugal	Francisco George	Ministry of Health			1					
Portugal	Raquel Guiomar	National Influenza Reference Laboratory		1						
Qatar	Ajayeb Al-Nabet	Hamad Medical Corporation		1						
Republic of Korea	Chun Kang a.i.	Centres for Laboratory Control of Infectious Disease		1						
Republic of Moldova	Constantin Spinu	National Influenza Centre		1						
Romania	C. Apetrei	University of Medicine & Pharmacy		1						
Romania	Viorel Alexandrescu	Cantacuzino Institute		1						
Romania	Costin Cernescu	Romanian Academy		1						
Russian Federation	Andrey B. Komissarov	Research Institute of Influenza							1	
Russian Federation	Elena Burtseva	NIC Russian Federation	1							
Russian Federation	Ludmila Tsybalova	NIC Russian Federation	1							
Russian Federation	Petr Grigorievich Deryabin	D.I. Ivanovsky Research Institute of Virology, Ministry of Health		1						
Russian Federation	Yuri Fedorov	Federal Service for Surveillance of Consumer Rights Protection and Human Well-Being					1			
Russian Federation	Anna A. Sominina	Ministry of Health		1						

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Samoa	Palanitina Tuipuimatagi Toelupe	Ministry of Health					1			
Senegal	Aboubacry Fall	Ministry of Health						1		
Senegal	André Basse	Embassy of Senegal in France				1				
Senegal	Mbayame Ndiaye Niang	Institut Pasteur de Dakar	1	1						
Serbia	Jasminka Nedeljkovic	Institute of Immunology, Vaccine and Sera "Torlak"	1	1						
Serbia	Vera Jerant-Patic	Institute of Public Health		1						
Singapore	Sebastian Maurer-Stroh	Bioinformatics Institute, Agency for Science, Technology, and Research							1	
Singapore	Soo Sim Lee	Regional Emerging Disease Intervention Centre (REDI)	1							
Singapore	Raymon Lin Tzer Pin	Ministry of Health		1						
Slovakia	Edita Staroňová	Public Health Authority of the Slovak Republic		1						
Slovenia	Katarina Prosenc	Laboratory for Public Health Virology, National Laboratory for Health, Environment, and Food	1	1						
South Africa	Diana Hardie	University of Cape Town		1						
South Africa	Florette Treurnicht	National Institute for Communicable Diseases	1	1						
South Africa	Kuku Voyi,	University of Pretoria					1			
South Korea	Jae-Hee Jeon	Ministry of Health, Welfare, and Family Affairs			1					
South Korea	Kim You Churl	Ministry of Health			1					
South Korea	Lee Jong Koo	Korena CDC			1					
Spain	Carmen Amela Heras	Ministry of Health and Social Policy and National IHR Focal Point						1		

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Spain	Carmen Varela Santos	Eurpean CDC			1					
Spain	Dirk Glaesser	United Nations World Tourism Organization;						1		
Spain	Ildefonso Hernández Aguado	Ministry of Health			1					
Spain	Jaime Segura Social	Ministry of Health			1					
Spain	María Jesús García González				1					
Spain	Raúl Ortiz de Lejarazu	Universidad de Valladolid		1						
Spain	Tomàs Pumarola	Universidad de Barcelona	1	1						
Spain	Trinidad Jiménez Garcí-Herrera	Ministry of Health			1					
Spain	Inmaculada Casas	Centro Nacional de Microbiología, ISCIII		1						
Sri Lanka	Geethani Wickramasinghe	NIC Sri Lanka	1							
Sri Lanka	Jude Jayamaha a.i.	Medical Research Institute		1						
Sudan	Babiker Magboul	Federal Ministry of Health						1		
Sudan	Hayat Salah Eldin Khogali a.i.	Federal Ministry of Health		1						
Sweden	Eeva Broberg,	European Centre for Disease Prevention and Control (ECDC)	1							
Sweden	Frederik Lennartsson	Ministry of Health			1					
Sweden	Irene Nilsson-Carlsson	Ministry of Health			1					
Sweden	Maria Brytting	NIC Sweden, Solna, Sweden	1							
Sweden	María Larsson	Ministry of Health			1					
Sweden	Mia Brytting	Institute for Communicable Disease Control							1	

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Sweden	Mia Brytting	Public Health Agency Sweden		1						
Switzerland	Amos Bairoch	University of Geneva							1	
Switzerland	Andrin Oswald	Novartis						1		
Switzerland	Anne Huvos	World Health Organization HQ	1							
Switzerland	Anthony Mounts	World Health Organization HQ	1							
Switzerland	Belinda Hall	World Health Organization HQ	1							
Switzerland	Bruce Plotkin	World Health Organization HQ			1					
Switzerland	Catherine Steele	F. Hoffman-La Roche Ltd						1		
Switzerland	Christian Fuster	World Health Organization HQ	1							
Switzerland	Cindy Aiello	World Health Organization HQ	1							
Switzerland	Daniel Koch	World Health Organization HQ			1					
Switzerland	David Reddy	F. Hoffman-La Roche Ltd						1		
Switzerland	Ellah Frodeman	World Health Organization HQ	1							
Switzerland	Guenael Rodier	World Health Organization HQ			1					
Switzerland	Hande Harmanci	World Health Organization HQ	1							
Switzerland	Helena Rebelo de Andrade	World Health Organization HQ	1							
Switzerland	Ian Smith	World Health Organization HQ			1					
Switzerland	Javier Penalver Herrero	World Health Organization HQ	1							
Switzerland	Katelijn Vandemaele	World Health Organization HQ	1							
Switzerland	Keiji Fukuda	World Health Organization HQ			1					
Switzerland	Maja Lièvre	World Health Organization HQ	1							
Switzerland	Margaret Chan	World Health Organization HQ			1					
Switzerland	Niteen Wairagkar	World Health Organization HQ	1							
Switzerland	Richard Neher	Computational Modeling of Biological Processes							1	

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Switzerland	Sylvie Briand	World Health Organization HQ	1							
Switzerland	Terry Besselaar	World Health Organization HQ	1							
Switzerland	Thomas Zeltner	Ministry of Public Health			1					
Switzerland	Tristan Chevignard	World Health Organization HQ	1							
Switzerland	Un-Yeong Go	World Health Organization HQ	1							
Switzerland	Varja Grabovac	World Health Organization HQ	1							
Switzerland	Wenqing Zhang	World Health Organization HQ	1							
Switzerland	Wenqing Zhang	World Health Organization HQ							1	
Switzerland	Samuel Cordey	University of Geneva Hospitals		1						
Syrian Arab Republic	Hazzaa Al Khalaf	Public Health Laboratories		1						
Tanzania	Fausta Mosha	National Health Laboratory Quality Assurance and Training Centre		1						
Tanzania	Miriam Mantoya	NIC Tanzania	1							
Thailand	Kumnuan Ungchusak	Ministry of Public Health					1			
Thailand	Malinee Chittakanpitch	National Influenza Centre, National Institute of Health	1	1						
Thailand	Pathom Sawanpanyalert	National Institute of Health Department of Medical Sciences							1	
Thailand	Supamit Chunssuttiwat	Ministry of Public Health				1				
Thailand	Tawee Chotpityasunondh	Ministry of Health			1					
Trinidad and Tobago	Victoria Morris Glasgow	Caribbean Epidemiology Centre	1	1						
Tunisia	Awatef El Moussi	Laboratory of Microbiology	1							
Tunisia	Amine Slim	Laboratoire de Microbiologie	1	1						

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Turkey	Gulay Korukluoglu	National Influenza Centre, Ministry of Health		1						
Uganda	Sam Zaramba	Ministry of Health					1			
Uganda	Julius Lutwama	Uganda Virus Research Institute (UVRI)		1						
Ukraine	Alla Mironenko	National Academy of Medical Science of Ukraine	1	1						
UK	Ian Brown	International Reference Laboratory for Avian Influenza, Animal and Plant Health Agency							1	
UK	Catherine Thompson	Public Health England	1							
UK	Rod Daniels	WHO Collaborating Centre for Reference and Research on Influenza	1							
UK	Alan J. Hay	The Francis Crick Institute							1	
UK	Patricia Ann Troop	Public Health England					1			
UK	Pamela Molyneaux	Aberdeen Royal Infirmary		1						
UK	Paul Flynn	United Kingdom Labour Party and Representative at the Council of Europe						1		
UK	Penelope Irving	Ministry of Health			1					
UK	Peter Coyle	Regional Virus Laboratory, Royal Victoria Hospital		1						
UK	Andrew Rambaut	University of Edinburgh							1	
UK	Anthony Waddell	Durham	1							
UK	B. Carman	Gartnavel General Hospital		1						
UK	David Harper	Department of Health			1			1		1
UK	David L. Heymann	Centre on Global Health Security, Chatham House						1		
UK	David Salisbury	Department of Health						1		

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UK	Fiona Godlee	British Medical Journal						1		
UK	Jo Newstead	Public Health England			1					
UK	John W. McCauley	The Francis Crick Institute London	1						1	
UK	John Wood	National Institute for Biological Standards and Control				1				
UK	Tony Colgate	IFPMA/ Novartis	1					1		
UK	Vicki Gregory	The Francis Crick Institute							1	
UK	Maria Zambon	Public Health England		1		1				
UK	Meirion Evans	Universidad de Cardiff			1					
UK	Neil Morris Ferguson	Imperial College Faculty of Medicine				1				
UK	Nigel Lightfoot	Public Health England			1					1
UK	Norbert Hehme	GlaxoSmithKline						1		
USA	Giselle Santos Burgoa	USAID			1					
USA	Calvin Teel	USAID			1					
USA	Alba Ma. Ropero	PAHO/WHO			1					
USA	Alexander Klimov	Centers for Disease Control and Prevention	1							
USA	Ann C. Moen	Centers for Disease Control and Prevention	1							
USA	Carlos del Río	Centers for Disease Control and Prevention			1					
USA	Catherine B. Smith	Centers for Disease Control and Prevention							1	
USA	César Ramírez	PAHO/WHO			1					
USA	Ciro Ugarte	PAHO/WHO			1					
USA	Craig N. Shapiro	State Department			1					
USA	Cuahtémoc Ruiz Matus	PAHO/WHO			1					

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USA	Daniel S. Miller	Centers for Disease Control and Prevention			1					
USA	David J. Spiro	US Department of Human Health and Services	1							
USA	Emerson Edwards	State Department			1					
USA	Emily Carter	Inter-American Development Bank			1					
USA	Flor Trillo	PAHO/WHO			1					
USA	Gary Brunette	Centers for Disease Control and Prevention			1					
USA	Gerardo Chowell	Escuela de Evolución Humana y Cambio Social			1					
USA	Harvey V. Fineberg	Institute of Medicine					1			
USA	Humberto Montiel	PAHO WHO			1					
USA	Ilse Rodel	PAHO WHO			1					
USA	Isabella Danel	CDC Guatemala			1					
USA	Jacqueline M. Katz	Centers for Disease Control and Prevention		1					1	
USA	Jay McAuliffe	Centers for Disease Control and Prevention			1					
USA	Jean Luc Poncelet	PAHO/WHO			1					
USA	Jon Andrus	PAHO/WHO			1					
USA	José Luis Varela	PAHO/WHO			1					
USA	Juan Ignacio López	State Department			1					
USA	Kathleen Sebelius	US Department of Human Health and Services			1					1
USA	Katryn Kohl	Centers for Disease Control and Prevention			1					
USA	Kei Kawabata	Inter-American Development Bank			1					

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USA	Leano Romeo	USAID			1					
USA	Lupita Vázquez	USAID			1					
USA	M. Anne Yu	Centers for Disease Control and Prevention			1					
USA	Ma. Teresa Rivera	PAHO WHO			1					
USA	Martin Cetron	Centers for Disease Control and Prevention					1			
USA	Mary Hoelscher	Centers for Disease Control and Prevention	1							
USA	Mike Osterholm	University of Minnesota						1		
USA	Mirta Roses Periago	PAHO/WHO			1					
USA	Nancy Alvey	USAID			1					
USA	Nancy Cox	Centers for Disease Control and Prevention			1	1			1	
USA	Natasha Jessn	Inter-American Development Bank			1					
USA	Otavio Oliva	AMOR	1							
USA	Peter Houck	Centers for Disease Control and Prevention			1					
USA	Radm W. Craig Vanderwagen	State Department			1					1
USA	Ray R. Arthur	Centers for Disease Control and Prevention			1					
USA	Rebecca Garten	Centers for Disease Control and Prevention							1	
USA	Richard J. Webby	St. Jude Children's Research Hospital							1	
USA	Rick Bright	Biomedical Advanced Research and Development Authority	1							
USA	Robert Blanchard	USAID	1							

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USA	Robert G. Lofties	State Department			1					
USA	Robert Lee	PAHO WHO			1					
USA	Rodger Garner	USAID			1					
USA	Stacey Schultz-Cherry	WHO Collaborating Centre for Studies on the Ecology of Influenza	1							
USA	Stephen Blount	Centers for Disease Control and Prevention			1					
USA	Stephen Redd	Centers for Disease Control and Prevention			1			1		
USA	Steve Waterman	Centers for Disease Control and Prevention			1					
USA	Steven Adams	Centers for Disease Control and Prevention			1					
USA	Thomas R. Frieden	Centers for Disease Control and Prevention			1					
USA	Timothy M. Uyeki	Centers for Disease Control and Prevention			1					
USA	Trevor Bedford	Fred Hutchinson Cancer Research Centre							1	
USA	Viridiana Cruz	PAHO/WHO			1					
USA	Winston Hide	Harvard School of Public Health							1	
USA	Xiyan Xu	Centers for Disease Control and Prevention	1							
USA	Christoph Kurowski	World Bank			1					
USA	H.F. Maassab			1						
USA	L. Grady	Virology Diagnostic Services Laboratory of Zoonotic Diseasesvice and Virology, New York State Department of Health		1						

Country	Member	Institution	GISN 2010	Collabor. Centres 2018	Cancun Influenza 2009	EC Influenza	CRIHR Influenza	Review H1N1	GSAID	GHSI
USA	John Janda	Viral and Rickettsial Disease Laboratory		1						
USA	Arnold Monto	University of Michigan				1				
USA	David Nabarro	United Nations System Influenza Coordination						1		
Uruguay	Raquel Rosa	Ministry of Public Health			1					
Uruguay	Hector Chiparelli	Ministry of Health		1						
Venezuela	Esperanza Briceño a.i.	Instituto Nacional de Higiene		1						
Viet Nam	Dang Quang Tan	Ministry of Health						1		
Viet Nam	Dang Tho Nguyen	National Centre for Veterinary Diagnostics	1							
Viet Nam	Mai Le	NIC Viet Nam	1							
Viet Nam	Le Quynh Mai	National Institute of Hygiene and Epidemiology		1						
Viet Nam	Nguyen Thanh Long	Pasteur Institute		1						
Zambia	Andros Theo	Virology/Immunology Lab	1							
Zambia	Mwaka Monze	Ministry of Health		1						
Egypt	Ali Yahaya	AFRO/WHO	1							
Philippines	Jeffrey Partridge	WPRO/WHO	1							
India	Rajesh Bhatia	SEARO/WHO	1							

Appendix I. MERS-CoV number of cases

Country	Number of laboratory-confirmed cases MERS CoV
Algeria	2
Austria	2
Bahrain	1
China	1
Egypt	1
France	1
Germany	3
Greece	1
Iran	6
Italy	1
Jordan	28
Kuwait	4
Lebanon	2
Malaysia	3
Netherlands	2
Oman	12
Philippines	2
Qatar	19
Republic of Korea	185
Saudi Arabia	1768
Thailand	3
Tunisia	3
Turkey	1
United Kingdom	4
United Arab Emirates	86
United States of America	2
Yemen	1
Total	2144

Countries reporting MERS cases. Source: The World Health Organization website (460)

Appendix J. MERS-CoV Epistemic Community

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Afghanistan	Adel Salman Alsayyad	Ministry of Health						1
Afghanistan	Ghulam Eshan Sharifi	Ministry of Public Health						1
Afghanistan	MAmjad Ghanim Mohamed	Ministry of Health Manama						1
Afghanistan	Muna Sayed Jawad Al Musawi	Ministry of Health						1
Afghanistan	Naqibullah Ziar	Ministry of Public Health						1
Afghanistan	Zahra Jasim Hasan Khamis	Public Health Laboratory Ministry of Health						1
Australia	John Lowenthal,	Emerging Infectious Diseases, CSIRO Animal Health Laboratory				1		
Australia	Chris Baggoley	Australian Department of Health and Ageing	1					
Bangladesh	Mahmudur Rahman	Institute of Epidemiology, Disease Control and Research and National Influenza Centre, Ministry of Health and Family Welfare	1					
Belgium	Birgit Van Tongelen,	European Commission				1		
Canada	Neill K. Adhikari	Centre Sunnybrook Research Institute					1	
Canada	Robert A. Fowler	Director, Clinical Epidemiology and Health Care Research Institute of Health Policy, Management and Evaluation Dalla Lana School of Public Health					1	
Canada	Theresa Tam	Public Health Agency of Canada	1					

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Canada		Mont Sinai Hospital						
Chile	Claudia Gonzalez	Clínica Alemana-Universidad del Desarrollo, and Partner-Director Epi-Sur Consultores	1					
China	Linqi Zhang,	Department of Basic Medical Sciences, Tsinghua University				1		
China	Wenjie Tan,	China CDC				1		
China		Faculty of Medicine						
Denmark	Caroline Sarah Brown	WHO Regional Office for Europe			1			1
Djibouti	Houssein Youssouf Darar	Ministry of Health						1
Djibouti	Neima Moussa Ali	Ministry of Health						1
Djibouti	Robleh Mahmoud Barreh	Ministry of Health						1
Djibouti	Souleiman Nour Ayeh	Peltier Hospital, Ministry of Health						1
Egypt	Abeer Eltelmissany	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Ahmed Abdelwahab	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Ala Alwan	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Amel Mohamed Najeib Hasanin	Public Health Laboratories Cairo						1
Egypt	Amina Benyahia Chaieb	World Health Organization Regional Office for the Eastern Mediterranean						1

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Egypt	Dalia Samhouri	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	David Bramley	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Omneya Aboul Seoud	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Samir Abdel Aziz Reffaey	Ministry of Health and Population						1
Egypt	Samir Ben Yahmed	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Zein Elabideen El Taher El Kamel							1
Egypt	Guenael R. Rodier	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Hala Esmat	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Heidi Rizk	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Jaouad Mahjour	World Health Organization Regional Office for the Eastern Mediterranean						1

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Egypt	Jehane Khadr	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Kareem Elhadary	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Mona Aly Yassin	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Weaam El Metenawy	World Health Organization Regional Office for the Eastern Mediterranean						1
Egypt	Ali R. Mafi	World Health Organization Regional Office for the Eastern Mediterranean		1				
Egypt	Ali M. Zaki	Ain Shams University			1			
Egypt	Catherine Smallwood	World Health Organization Regional Office for the Eastern Mediterranean		1				1
Egypt	Langoya Opoka	World Health Organization Regional Office for the Eastern Mediterranean		1				1
Egypt	Mamunur Malik	World Health Organization Regional Office for the Eastern Mediterranean		1				1
France	Didier Che	French Institute for Public Health Surveillance						1
France	François Salicis	Minister of Health						1
France	Arnaud Fontanet	Institut Pasteur		1				

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
France	Sylvie van der Werf	Institut Pasteur, CNRS and University Paris Diderot Sorbonne Paris Cité		1				
France	Grounalan Pavade	World Organization for Animal Health (OIE)				1		
France	Maria Van Kerkhove,	Centre for Global Health, Institut Pasteur, Paris				1		
France	Bernard Faye	French Agricultural Research Centre for International Development	1					
France	Benoît Guéry	Universitaire de Lille Paris		1				1
France	Jean-Claude Manuguerra	Institut Pasteur		1				1
Georgia	Paata Imnadze	National Centre for Disease Control and Public Health	1					
Germany	Brunhilde Schweiger	Robert Koch Institut						1
Germany	Clemens Wendtner	Klinikum Schwabing						1
Germany	Osamah Hamouda	Robert Koch Institut						1
Germany	Anna Kuehne	Robert Koch Institute		1				
Germany	Benjamin Blümel	Robert Koch Institute		1				
Germany	Udo Buchholz	Robert Koch Institute		1				
Germany	John Ziebuhr	Justus Liebig University Giessen			1			
Germany	Christoph Conrad	Paul-Ehrlich-Institut				1		
Germany	Michael Muhleback	Paul Ehrlich Institute				1		
Germany	Christian Drosten	University of Bonn Medical Centre		1	1	1		
Hong Kong	David SC Hui	The Chinese University of Hong Kong		1				
Hong Kong	J. S. Malik Peiris	The University of Hong Kong		1				

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Hong Kong	Leo L.M.Poon	The University of Hong Kong			1			
Hong Kong	Patrick C. Y. Woo	The University of Hong Kong			1			
Hong Kong	Malik Peiris	University of Hong Kong, Faculty of Medicine, Hong Kong					1	
Indonesia.	Tjandra Aditama	Ministry of Health	1					
Iran	Adnan Nawar Khistawi	Ministry of Health						1
Iran	Mohammad Nasr Dadras	Ministry of Health and Medical Education						1
Iran	Payman Hemmati	Ministry of Health and Medical Education						1
Iran	Talat Mokhtar-azad	School of Public Health Teheran University of Medical Sciences						1
Iraq	Hayder Hashim Naser	Ministry of Health						1
Iraq	Muthana Ibrahim Abdul Kareem Al Dulaimi	Ministry of Health						1
Ireland	Anton Tikhonov,	Organic Vaccines				1		
Ireland	Patrick Rambaud,	Organic Vaccines				1		
Italy	Giovanni Rezza	Istituto Superiore di Sanità		1				
Italy	Isabella Donatelli	Istituto Superiore di Sanità		1				
Italy	Moulay Ahmed El Idrissi Hamzi,	Food and Agriculture Organization of the United Nations				1		
Jordan	Assad Yahya Rahhal	Ministry of Health						1
Jordan	Najwa Hamed Jarour	Ministry of Health						1
Jordan	Aktham Jeries Haddadin	Ministry of Health		1				1

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Jordan	Mohammad Mousa Abdallat	Ministry of Health		1				1
Jordan	Sultan Mohammed Abdalla Al Qasrawi	Ministry of Health		1				1
Kuwait	Maher Younes Saleh							1
Kuwait	Mussab Ibrahim Al-Saleh	Ministry of Health						1
Kuwait	Qais Alduwairi	Ministry of Health						1
Kuwait	Sami Al Nasser	Ministry of Health						1
Lebanon	Hassan Mohamad Mallah	Ministry of Public Health						1
Lebanon	Layal Hussein Cheaitani	Ministry of Public Health						1
Lebanon	Rita Farah	Ministry of Public Health						1
Libya	Abdunnabi Ahmed Rayes	Ministry of Health						1
Libya	Mohamed Najeb Smeo	Ministry of Health						1
Libya	Omar Ramadan ElAhmer	Ministry of Health						1
Malaysia	Fadzilah Kamaludin	Ministry of Health	1					
Morocco	Abdel Aziz Barkia	Ministry of Health						1
Morocco	Mohamed Rhajaoui							1
Morocco	Naima El Mdaghri	Pasteur, Ministry of Health						1
Netherlands	Ab Osterhaus	Erasmus MC		1				
Netherlands	Chantal Reusken			1				
Netherlands	Alexander E. Gorbalenya,	Leiden University Medical Centre			1			
Netherlands	Eric J. Snijder	Leiden University Medical Centre			1			
Netherlands	Raoul J. de Groot	Faculty of Veterinary Medicine, Utrecht University			1			

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Netherlands	Ron A. M. Fouchier	Erasmus MC		1	1			
Netherlands	Marion Koopmans	Erasmus Medical Centre		1		1		
Netherlands	Bart L. Haagmans	Erasmus MC		1	1	1		
Nigeria	Oyewale Tomori	Redeemer's University	1					
Norway	Nadia G. Tornieporth,	CEPI – Coalition for Epidemic Preparedness Innovations					1	
Norway	Bjørn-Inge Larsen	Ministry of Health and Care Services	1					
Oman	Idris Saleh Ali Al-Obaidani							1
Oman	Said Al Baqlani Acting	Ministry of Health						1
Oman	Salah T. Al Awaidy	Ministry of Health	1					
Palestine	Abdallah Daoud Zahran	Ministry of Health						1
Palestine	Diaa Obeid Hjaija	Ministry of Health						1
Palestine	Ibrahim Mohamed Salem	Ministry of Health						1
Palestine	Nedal Ghuneim	Ministry of Health						1
Qatar	Muna A.Rahman Al Maslamani	Hamad Medical Corporation						1
Qatar	Said Hamed Said Al Dhahry	Hamad Medical Corporation						1
Qatar	Hamad Eid Al-Romaihi	Supreme Council of Health		1				
Qatar	Said H.S. Al Dhahry	Hamad Medical Corporation		1				
Qatar	Adeel A. Butt Medicine Department	Hamad Medical Corporation					1	
Qatar	Elmoubasher Abu Baker Abd Farag	Ministry of Public Health					1	

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Qatar	Mohammed Mohammed Al-Hajri	Supreme Council of Health		1		1	1	1
Republic of Korea	In-Kyu Yoon	International Vaccine Institute				1		
Republic of Korea	Jerome H. Kim,	International Vaccine Institute				1		
Republic of Korea	Joel Maslow,	GeneOne Life Science Inc,				1		
Republic of Korea	Young Park,	GeneOne Life Science, Inc.				1		
Republic of Korea	Youngmee Jee,	Centre for Immunology and Pathology, Centre for Disease Control and Prevention				1		
Saudi Arabia	Fahad Al Rabiah							1
Saudi Arabia	Hatem Makhdom Qadhy	Ministry of Health						1
Saudi Arabia	Jaafar Al Tawfik	Ministry of Health						1
Saudi Arabia	Khalid Marghlani	Ministry of Health						1
Saudi Arabia	Gwen M. Stephens	Ministry of Health			1			
Saudi Arabia	Abdulaziz Bin Saeed	Ministry of Health				1		
Saudi Arabia	Ahmad Salah Hersi	Ministry of Health				1		
Saudi Arabia	Hail Mater Alabdely	Ministry of Health				1		
Saudi Arabia	Ahmed Mohammed Hakawi,	Infection Prevention and Control Directorate, Ministry of Health					1	
Saudi Arabia	Yaseen M. Arabi	Ministry of the National Guard, Health Affairs					1	
Saudi Arabia	Raafat Faisal Alhakeem			1				1
Saudi Arabia	Abdullah Mufareh Assiri	Ministry of Health		1		1		1
Saudi Arabia	Ziad Memish	Ministry of Health	1	1	1			1
Scotland	J Kenneth Baillie	University of Edinburgh		1				

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Senegal	Babacar Ndoye		1					
Singapore	Christine Qiuhan Gao	Singapore Armed Forces		1				
Singapore	Junxiong Pang	National University of Singapore		1				
Singapore	Karen Tan		1					
South Korea	Yae-Jean Kim	Sungkyunkwan University School of Medicine, South Korea					1	
South Korea	Myoung-don Oh	Department of Internal Medicine, National University College of Medicine				1	1	
South Sudan	Gregory Wani Dumo	Ministry of Health						1
Spain	Isabel Sola	Spanish National Research Council			1			
Spain	Luis Enjuanes	Campus de la Universidad Autonoma de Madrid			1	1		
Sudan	Ahmed Hagar Ahmed	Ministry of Health						1
Sudan	Dina AbdulHammed Abdulla							1
Sudan	Sara Ahmed El Tigani El Hag Abdalla	Ministry of Health						1
Switzerland	Keiji Fukuda	World Health Organization HQ						1
Switzerland	Sergey Eremin	World Health Organization HQ						1
Switzerland	Gregory Anton Hartl	World Health Organization HQ						1
Switzerland	Maurizio Barbeschi	World Health Organization HQ						1
Switzerland	Christopher John Oxenford	World Health Organization		1				
Switzerland	Elizabeth Mumford	World Health Organization		1				
Switzerland	Erika Garcia	World Health Organization		1				
Switzerland	Gilles Poumerol	World Health Organization		1				

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Switzerland	Maxwell Charles Hardiman	World Health Organization		1				
Switzerland	Molly Siwula	World Health Organization		1				
Switzerland	Nicolas Isla	World Health Organization		1				
Switzerland	Sebastien Bruno Francois Cognat	World Health Organization		1				
Switzerland	Sergey Romualdovich Eremin	World Health Organization		1				
Switzerland	Stéphane Alexandre L. Hugonnet	World Health Organization		1				
Switzerland	Stéphane De La Rocque	World Health Organization		1				
Switzerland	Bernadette Murgue	World Health Organization HQ				1		
Switzerland	David Wood,	World Health Organization HQ				1		
Switzerland	Davide Corti,	Humabs BioMed SA				1		
Switzerland	Marie-Paule Kieny	World Health Organization HQ				1		
Switzerland	Nadia Passini	Humabs BioMed SA				1		
Switzerland	Peter Beyer	World Health Organization HQ				1		
Switzerland	Sylvie Briand,	World Health Organization HQ				1		
Switzerland	Tony Stewart,	World Health Organization HQ				1		
Switzerland	Vasee Moorthy,	World Health Organization HQ				1		
Switzerland	Ana Maria Henao Restrepo	World Health Organization HQ					1	
Switzerland	Cassandra Kelly-Cirino	FIND					1	
Switzerland	Karene Yeung	World Health Organization HQ					1	
Switzerland	Konstantin Volkmann	World Health Organization HQ					1	
Switzerland	Maria Van Kerkhove	World Health Organization HQ					1	
Switzerland	Pierre-Stéphane Gsell	World Health Organization HQ					1	

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
Switzerland	Anthony Wayne M.	World Health Organization HQ		1				1
Switzerland	Bruce Jay Plotkin	World Health Organization HQ		1				1
Switzerland	Nahoko Shindo	World Health Organization		1				1
Switzerland	Patrick Anthony Drury	World Health Organization HQ		1				1
Switzerland	Pierre B.H. Formenty	World Health Organization HQ		1				1
Switzerland	Cathy Roth	World Health Organization HQ		1		1		1
Switzerland	Peter Ben Embarek	World Health Organization HQ		1		1		1
Tunisia	Habib Ghedira							1
Tunisia	Mohamed Besbes	Ministry of Health						1
Tunisia	Mokhtar Mohamed Zorraga	Ministry of Health						1
Tunisia	Noureddine Achour	Ministry of Health						1
Tunisia	Fekri Abroug	Fattouma Bourguiba Hospital		1				
Tunisia	Afif Ben Salah	Institut Pasteur de Tunis		1				1
Tunisia	Amine Slim	Charles Nicolle Hospital		1				1
UK	Maria D. Van Kerkhove	Imperial College London		1				
UK	Neil M. Ferguson	Imperial College London		1				
UK	Benjamin W. Neuman	University of Reading			1			
UK	Monica Galiano	Public Health England (formerly Health Protection Agency)			1			
UK	Eric Pelfrene	Anti-Infectives and Vaccines, European Medicines Agency				1		
UK	Ruth Harvey	Department of Virology, National Institute for Biological Standards and Control, Health Protection Agency				1		

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
UK	Simon Cauchemez	Imperial College London				1		
UK	Marco Cavaleri						1	
UK	Peter W. Horby	University of Oxford, UK					1	
UK	W. John Edmunds	London School of Hygiene and Tropical Medicine					1	
UK	Richard Pebody	Public Health England		1			1	1
UK	Maria Zambon	Public Health England	1	1	1			1
UMG	Gerd Sutter	Institute for Infectious Diseases and Zoonoses Ludwig-Maximilians-Universität				1		
United Arab Emirates	Fatma Mahmood El Attar	Health Authority						1
United Arab Emirates	Laila Hussain El Jasmi	Ministry of Health						1
United Arab Emirates	Mahmoud Mohamed Fikri	Ministry of Health						1
United Arab Emirates	Farida Ismail Al Hosani,	Ministry of Health		1			1	1
USA	Kashef Ijaz	Centers for Disease Control and Prevention						1
USA	Maria Morales-Betoulle	Centers for Disease Control and Prevention						1
USA	Mayar Maged Said	U.S. Naval Medical Research Unit No. 3 (NAMRU-3)						1
USA	Rana A. Hajjeh Director	Centers for Disease Control and Prevention						1
USA	Alice M. Shumate	Centers for Disease Control and Prevention		1				
USA	Lisa E Hensley			1				
USA	Thomas Briese			1				
USA	W. Ian Lipkin	Columbia University		1				

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
USA	William B. Karesh	EcoHealth Alliance		1				
USA	Ralph Baric	University of North Carolina			1			
USA	Stanley Perlman	University of Iowa			1			
USA	Susan Baker	Loyola University Medical Centre			1			
USA	Andrea Gambotto	University of Pittsburgh, School of Medicine				1		
USA	Barney S. Graham	National Institutes of Health				1		
USA	David Kaslow	PATH				1		
USA	Eddie Sullivan	SAB Biotherapeutics, INC				1		
USA	Erik Stemmy	DMID/NIAID				1		
USA	James Cummings	Emerging Infectious Diseases, Novavax				1		
USA	Kayvon Modjarrad	US Military HIV Research Program, Walter Reed Army Institute of Research				1		
USA	Kent Tseng Chien-Te	University of Texas				1		
USA	Mary Kosinski	U.S. Department of Health and Human Services				1		
USA	Matt Freiman	University of Maryland School of Medicine				1		
USA	Rick Bright	Biomedical Advanced Research & Development Authority (BARDA), US Health and Human Services				1		
USA	Robin Robinson	Biomedical Advanced Research and Development Authority, Deputy Assistant Secretary for Preparedness				1		
USA	Sebastian Wanless	Brighton Biotech				1		

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
USA	Tomas Cihlar					1		
USA	Uwe Staerz	Geffex Inc.				1		
USA	Wayne Marasco	Harvard Medical School				1		
USA	Amy C. Sims	University of North Carolina					1	
USA	Ira M. Longini	University of Florida,					1	
USA	John T. Watson	Centers for Disease Control and Prevention USA					1	
USA	Martha C. Nason	National Institute of Allergy and Infectious Diseases					1	
USA	Natalie E.	Department of Biostatistics University of Florida					1	
USA	Peter M. Dull	Bill and Melinda Gates Foundation					1	
USA	Philip R. Krause	Center for Biologics Evaluation and Research, US Food and Drug Administration					1	
USA	Susan S. Ellenberg	University of Pennsylvania Perelman School of Medicine					1	
USA	Thomas R. Fleming	School of Public Health, University of Washington					1	
USA	Tim Uyeki	National Centre for Immunization and Respiratory Diseases Centres for Disease Control and Prevention					1	
USA	Maha Talaat	Disease Prevention, Global Disease Detection and Response Centre, United States Naval Medical Research Unit, No.3. Egypt	1					
USA	Martin Cetron	Centres for Disease Control and Prevention	1					

Country	Name	Institution	EC-MERS	MERS CoV RG	CSG ICTV	WHO MERS R&D	WHO BP VT	Inter country meeting
USA	Gabriel N. Defang	U.S. Naval Medical Research Unit No. 3 (NAMRU-3)		1				1
USA	Susan I. Gerber	Centres for Disease Control and Prevention		1				1
USA	Frederick G. Hayden	Division of Infectious Diseases and International Health, University of Virginia School of Medicine				1	1	
Yemen	Abdulhakim Ali Al Kuhlani	Ministry of Public Health and Population						1
Yemen	Mahmoud Abdullah Ogaili	Ministry of Public Health and Population						1
Yemen	Mohammed Abdullah Al Dawla							1

EC-MERS: Emergency Committee; MERS CoV RG: MERS CoV Research Group; CSG ICTV: Coronavirus Study Group (CSG) of the International Committee on Taxonomy of Viruses; WHO MERS R&D: WHO Consultation on MERS CoV R&D; WHO BP VT: WHO consultation on MERS-CoV vaccine and therapeutics

Appendix K. Ebola Epistemic Community

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Australia	Chris Baggoley	Australian Government Department of Health	1							
Australia	Michael Selgelid	Monash University	1							
Belgium	D. Thonon	Fonds Medical Tropical							1	
Belgium	G. Van Der Groen	Institut de Medicine Tropicale							1	
Belgium	J. Burke,	Fonds Medical Tropical							1	
Belgium	J. F. Ruppol	Fonds Medical Tropical							1	
Belgium	Michel Van Herp	Médecins Sans Frontières			1					1
Belgium	Peter Piot	London School of Hygiene and Tropical Medicine		1					1	1
Belgium	R. Declerq	Fonds Medical Tropical							1	
Belgium	Rosa Crestani	Médecins Sans Frontières			1					
Belgium	S. R. Pattyn	Institut de Medecine Tropicale,							1	
Belgium	S. Van Nieuwenhove	Fonds Medical Tropical							1	
Belgium	Sister G. Ghysebrechts	Catholic Mission							1	
Belgium	Sister M. Ronsmans	Catholic Mission							1	
Belgium	Sister M. Witvrouwen	Catholic Mission							1	
Brazil	Luiz Loures	UNAIDS		1						
Canada	Anthony Evans	International Civil Aviation Organization	1							

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Canada	Gary Kobinger	National Microbiology Laboratory, Public Health Agency of Canada			1	1				1
Canada	Sgt G. Colbourne	Royal Canadian Army							1	
Canada	Theresa Tam	Public Health Agency of Canada	1							
Canada	Robert Fowler	Sunnybrook Medical Centre								1
Chile	Fernando Otaiza	Ministry of Health	1							
Democratic republic of Congo	Jean-Jacques Muyembe	National Institute of Biomedical Research	1	1						
Democratic Republic of Sudan	Ali Ahmed Idris	Ministry of Health					1			
Democratic Republic of Sudan	Anthony Lagu Gillo	Ministry of Health					1			
Democratic Republic of Sudan	Babiker el Tahir	Ministry of Health					1			
Democratic Republic of Sudan	Isiaih Mayom Deng	Ministry of Health					1			
Democratic Republic of Sudan	Noel Logo Warille	Ministry of Health					1			
Democratic Republic of Sudan	Oliver Duku	Ministry of Health					1			
Democratic Republic of Sudan	Pacifico Lolik	Ministry of Health					1			

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Democratic Republic of Sudan	William Renzi Tembura	Ministry of Health					1			
Denmark	Christiana Salvi	WHO/EURO			1					
Denmark	Guenael Rodier	WHO/EURO			1					
Egypt	Hassan El Bushra Ahmed	WHO/EMRO			1					
Egypt	Martin Opoka	WHO/EMRO			1					
Federal Republic of Germany	J. Knobloch	Tropeninstitut					1			
France	Alain Epelboin	National Centre for Scientific Research and National Museum of Natural History	1		1					
France	D. Courtois,	Hopital " A Laveran "							1	
France	G. Dujeu	Institut de Medecine Tropicale							1	
France	G. Raffier	Mission Medicale Francaise							1	
France	M. Germain	Office de la Recherche scientifique et technique outre-mer							1	
France	Noël Tordo	Department of Virology, Unit of the Biology of Emerging Viral Infections (UBIVE), National Reference Centre - Institut Pasteur, Lyon				1				
France	P. Sureau,	Institut Pasteur							1	
France	Sylvain Baize	Institutet Pasteur								1
France	Jean-Francois Delfraissy	INSERM								1

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Gabon	Eric Leroy	Institute for Development Research (IRD) International Centre for Medical Research in Franceville			1	1				
Germany	Stephan Gunther	Bernhard-Nocht-Institut for Tropical Medicine (BNI), University of Hamburg				1				1
Ghana	William Ampofo	University of Ghana	1							
Ghinea	Keita Sakoba	Ministry of Health						1		
Guinea	Boubacar Diallo	Ministry of Health						1		
Guinea	Emmanuel Heleze	Ministry of Health						1		
Guinea	Mandy Kader Konde,	Institute of Research Guinea								1
Guinea	Pepe Bilivogui	Ministry of Health						1		
Kenya	B. Teelock	World Health Organization					1			
Kenya	C. R. Jones	Ministry of Health					1			
Kenya	D. H. Smith	Ministry of Health					1			
Kenya	R. B. Highton	Medical Research Council					1			
Kenya	Vincent Anami	Centre for Disaster and Humanitarian Assistance Medicine, Uniformed Services University of the Health and Sciences, Friends International Centre	1							
Liberia	John Mike Mulba	Ministry of Health						1		
Liberia	Luke Bawo	Ministry of Health						1		
Liberia	Moses Massaquoi	Ministry of Health						1		
Liberia	Moussa Koné	Ministry of Health						1		

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Liberia	Sakoba Keita	Ministry of Health						1		
Liberia	Stephen Gbanyan	Ministry of Health						1		
Liberia	Tolbert Nyenswah	Ministry of Health						1		
Nenya	Rosemary Sang	Kenya Medical Research Institute (KEMRI)				1				
Nigeria	Abdusalam Nasidi	Ministry of Health						1		
Nigeria	Faisal Shuaib	Ministry of Health						1		
Nigeria	Oyewale Tomori	Redeemer's University	1							
Pakistan	Michael Ryan	National Emergency Operations Centre		1	1					
Portugal	Maria João Martins	Ministry of Health	1							
Republic of Congo	Adama Berthé	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Adamou Alzouma Yada	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Ali Ahmed Yahaya	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Bréhima Koumaré	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Celia Woodfil	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Denis Kandolo,	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Florimond Tshioko	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Kader Kondé	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Mamadou-Lamine Koné	WHO/AFRO, DPC/CSR			1					

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Republic of Congo	Mamoudou Djingarey	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Nestor Ndayimirije	WHO/AFRO, DPC/CSR			1					
Republic of Congo	Yokouidé Allarangar	WHO/AFRO, DPC/CSR			1					
Republic of Zaire	M. L. Muyingi	Clinique Kinoise							1	
Republic of Zaire	A. Koth	Service d'Hygiene							1	
Republic of Zaire	Dr Mandiangu	Fonds National d'Action Medicale et Sociale							1	
Republic of Zaire	Dr. Omombo	Service d'Hygiene							1	
Republic of Zaire	Dr. Tshibamba	Service d'Hygiene							1	
Republic of Zaire	K. Nguete	Commissaire d'Etat de la Sante Publique							1	
Republic of Zaire	Kintoki Vita	Universite Nationale du Zaire							1	
Republic of Zaire	M. Massamba								1	
Republic of Zaire	M. Matundu	Service d'Hygiene							1	
Republic of Zaire	M. Mbuyi	Universite Nationale du Zaire							1	
Republic of Zaire	M. Miatudila	Fonds Medical de Coordination							1	
Republic of Zaire	Muyembe Tamfum	Universite Nationale du Zaire							1	
Saudi Arabia	Abdullah Al-Assiri	Minister of Health for Preventive Health	1							

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Senegal	M. Comet	Institut Pasteur, Dakar					1			
Senegal	Amadou Sall	Institut Pasteur, WHO Collaborating Centre for arboviruses and viral hemorrhagic fevers				1				
Senegal	Awa Marie Coll Seck	Ministry of Health		1						
Senegal	Cheikh Ibrahima Niang	Cheikh Anta Diop University		1						
Sierra Leone	Amara Jambai	Ministry of Health and Sanitation	1					1		
Sierra Leone	Roland M. Conteh	Ministry of Health						1		
South Africa	Janusz Paweska	National Institute for Communicable Diseases, WHO Collaborating Centre for Reference and Research on Viral Haemorrhagic Fevers and Arboviruses				1				
South Africa	Lucille Blumberg	National Institute for Communicable Diseases, National Health Laboratory Service, Johannesburg, South Africa	1							
South Africa	M. Isaacson	South African Institute for Medical Research							1	
South Sudan	P. L. Giacometti	World Health Organization					1			
Spain	Dirk Glaesser	World Tourism Organization	1							
Sudan	R. Khan	World Health Organization					1			
Switzerland	Albert Mbule Kadiobo	WHO						1		
Switzerland	Alex Gasasira	WHO						1		

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Switzerland	Alice Croisier	WHO						1		
Switzerland	Andreas Reis	WHO/Headquarters, IER/ETH			1					
Switzerland	Asiya Odugleh-Kolev	WHO/Headquarters, HSE/GAR			1					
Switzerland	Bruce Aylward	WHO						1		
Switzerland	Carmen Pessoa-Silva,	WHO/Headquarters, HSE/GAR			1					
Switzerland	Caroline Fuhrer	WHO						1		
Switzerland	Cathy Roth	WHO/Headquarters, HSE/GAR			1					
Switzerland	Christopher Dye	WHO						1		
Switzerland	Daniel Kertesz	WHO						1		
Switzerland	Deo Nshimirimana,	WHO						1		
Switzerland	Dominique Legros,	WHO/Headquarters, HSE/GAR			1					
Switzerland	Emmanuel Musa	WHO						1		
Switzerland	Eric Bertherat	WHO/Headquarters, HSE/GAR			1			1		
Switzerland	Eric Nilles	WHO						1		
Switzerland	Francis Kasolo	WHO						1		
Switzerland	Isabelle Nuttall	WHO						1		
Switzerland	Jean-Christophe Azé	WHO/Headquarters, HSE/GAR			1					
Switzerland	Jean-Marie Dangou	WHO						1		
Switzerland	Jered Markoff	WHO						1		
Switzerland	Jethro Magwati Chakauya	WHO						1		
Switzerland	Joel Myhre	WHO						1		

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Switzerland	Jonathan Polonsky	WHO						1		
Switzerland	Jordi Sacristan	WHO/Headquarters, HSE/GAR			1					
Switzerland	Kamal Ait-Ikhlef	WHO/Headquarters, HSE/GAR			1					
Switzerland	Keiji Fukuda	WHO						1		
Switzerland	Kennedy Chitala	WHO						1		
Switzerland	Marie-Charlotte Bouësseau	WHO/Headquarters, IER/ETH			1					
Switzerland	Mark Humphrey Van Ommeren	WHO/Headquarters, NMH/MSD/MER			1					
Switzerland	Mikiko Senga	WHO						1		
Switzerland	Neil M. Ferguson	WHO						1		
Switzerland	Niluka Wijekoon Kannangarage	WHO						1		
Switzerland	Olivier Ronveaux	WHO						1		
Switzerland	Olushayo Olu	WHO						1		
Switzerland	Patrick Drury	WHO/Headquarters, HSE/GAR			1					
Switzerland	Peter Graaff	WHO						1		
Switzerland	Philippe Barboza	WHO						1		
Switzerland	Philippe Calain	Médecins Sans Frontières			1					1
Switzerland	Pierre Formenty	WHO/Headquarters, HSE/GAR			1			1		
Switzerland	R. Collas	World Health Organization							1	
Switzerland	Ravi Santhana Gopala Krishnan	WHO						1		
Switzerland	Rick Brennan	WHO						1		

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
Switzerland	Robert Steffen	WHO Collaborating Centre for Travellers' Health, University of Zurich	1							
Switzerland	Rui Vaz	WHO						1		
Switzerland	S. Adrien	World Health Organization							1	
Switzerland	Scott Pendergast	WHO						1		
Switzerland	Sergey Eremin	WHO/Headquarters, HSE/GAR			1					
Switzerland	Stéphane Hugonnet	WHO/Headquarters, HSE/GAR			1					
Switzerland	Sylvie Briand	WHO						1		
Switzerland	Thibaut Jombart	WHO						1		
Switzerland	Thomas Grein	WHO/Headquarters, HSE/GAR			1					
Switzerland	Tim Eckmanns	WHO						1		
Switzerland	William Perea,	WHO						1		
Switzerland	Zabulon Yoti	WHO						1		
Thailand	Viroj Tangcharoensathien	Ministry of Public Health		1						
Uganda	Julius Lutwama	Uganda Virology Research Institute				1				
Uganda	Sam Zaramba	Ministry of Health	1	1						
UK	Anne Cori	Imperial College London						1		
UK	Chris Lane	Public Health England						1		
UK	Christl A. Donnelly	Imperial College London						1		
UK	Harriet Mills	Imperial College London						1		
UK	Isobel Blake	Imperial College London						1		

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
UK	Maria D. Van Kerkhove	Imperial College London						1		
UK	Pierre Nouvellet	Imperial College London						1		
UK	Steven Riley	Imperial College London						1		
UK	Tini Garske	Imperial College London						1		
UK	A. Baskerville	Microbiological Research Establishment					1			
UK	Andrew Winbow	International Maritime Organization	1							
UK	C. C. Draper	London School of Hygiene and Tropical Medicine					1			
UK	D. I. H. Simpson	London School of Hygiene and Tropical Medicine					1			
UK	D. S. Ridley	Hospital for Tropical Diseases					1			
UK	E. T. W. Bowen	Microbiological Research Establishment					1			
UK	G. Lloyd	Microbiological Research Establishment					1			
UK	G. S. Platt	Microbiological Research Establishment					1			
UK	John Edmunds	London School of Hygiene and Tropical Medicine								1
UK	L. McArdle	Microbiological Research Establishment					1			
UK	Mark Salter	Public Health England	1							
USA	D. Conn	US Peace Corps							1	
USA	D. P. Francis	Harvard School of Public Health					1			
USA	David L. Heymann	Centre on Global Health Security, Chatham House (Centers for Disease Control)		1					1	

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
USA	Dr. Scott Dowell,	The Bill and Melinda Gates Foundation								1
USA	H. Wulff	Centers for Disease Control and Prevention							1	
USA	J. B. McCormick	Centers for Disease Control and Prevention							1	
USA	J. G. Breman	Centers for Disease Control and Prevention							1	
USA	J. Kennedy	USAID							1	
USA	J. V. Lange	Centers for Disease Control and Prevention							1	
USA	James LeDuc	University of Texas Medical Branch	1							
USA	K. M. Johnson	Centers for Disease Control and Prevention							1	
USA	Lisa Hensley	National Institutes of Health								1
USA	M.K. White	Centers for Disease Control and Prevention							1	
USA	Martin Cetron	Centers for Disease Control and Prevention	1							
USA	P.A. Webb	Centers for Disease Control and Prevention							1	
USA	Peter Jahrling	National Institutes of Health								1
USA	Pierre Rollin	Centres for Disease Control and Prevention			1					
USA	S. 0. Foster	Centers for Disease Control and Prevention							1	

Country	Member	Institution	EC Ebola	WHO AGEVDR	ES2014	WHO CCDEM	ST 1976	WHO ERT 2014	IC 1976	Informal Consultation Ebola outbreak 2014
USA	Stuart Nichol	Viral Special Pathogens Branch, National Centre for Emerging and Zoonotic Infectious Diseases, Centres for Disease Control and Prevention				1				1
USA	Vincent Covello	Centre for Risk Communication	1							
USA	William H. Foege	Centers for Disease Control and Prevention		1						
Zaire	H. Berquist	Hospital Karawa							1	
Zaire	W. Close	Fonds Medical Tropical							1	
Zimbabwe	Nyaradzayi Gumbonzvanda	World YWCA		1						

EC: Emergency Committee; WHOAGEVDR WHO Advisory Group on the Ebola Virus Disease Response; WHOCCDEM: WHO Collaborating Centres for the diagnosis of Ebola or Marburg VHF. ES2014: Ebola Strategy 2014; ST 1976 Study Team 1976; WHO ERT2014 WHO Ebola Response team 2014; IC1976 International Commission 1976

Appendix L. GOARN Partners Ebola response

GOARN partners responding to the Ebola outbreak 2014-2015
African Field Epidemiology Network
Agence régionale de santé, Pays de la Loire, France
Agence régionale de santé, Rhône-Alpes, France
Agence régionale de santé, Île-de-France, France
Association pour le développement de l'épidémiologie de terrain
Australasian College for Infection Prevention and Control
Australian Response ARM Network
Bernhard Nocht Institute for Tropical Medicine
Bundeswehr Institute of Microbiology
Burnet Institute for Medical Research and Public Health
Caribbean Public Health Agency
Centre for Disease Control, Iran
Centre for Infection and Immunity, Mailman School of Public Health of Columbia University
Centers for Disease Control and Prevention, USA
Centre de Coopération Internationale en Recherche Agronomique pour le développement
Centre International de Recherches Médicales de Franceville
Chinese Centre for Disease Control and Prevention, China
Communicable Disease Control Directorate, Western Australia
Croatian National Institute of Public Health
Department of Public Health, Osaka City University Faculty of Medicine, Japan
Department of Tropical Medicine, Tulane School of Public Health and Tropical Medicine
Department of Virology, Tohoku University, School of Medicine
Division of Tuberculosis and Infectious Disease Control, Ministry of Health, Labour and Welfare
Eastern Mediterranean Public Health Network
École des hautes études en santé publique
Epicentre research and epidemiology
European Programme for Intervention Epidemiology Training, Alumni Network
Etablissement de Préparation et de Réponse aux Urgences Sanitaires
European Centre for Disease Prevention and Control
European Mobile Laboratory Consortium
European Network for Diagnostics of Imported Viral Diseases, Robert Koch Institute
European Programme for Intervention Epidemiology Training
European Virus Archive

GOARN partners responding to the Ebola outbreak 2014-2015
Faculty of Health Sciences, Curtin University of Technology
Federal Ministry of Health, Sudan
Federal Public Service, Health, Food Chain Safety, and Environment
Field Epidemiology Training Program, Malaysia
Field Epidemiology Training Program, Mongolia
Field Epidemiology Training Program, Egypt
French Health Agency for the Indian Ocean
German Armed Forces Medical Service, Ministry of Defence
Health Protection Surveillance Centre
Hokkaido University Research Centre for Zoonosis Control, Japan
Institut de Santé Publique d'Épidémiologie et de Développement
Institut de Veille Sanitaire
Institut Pasteur, Lyon, France
Institut Pasteur, Dakar, Senegal
Institut Pasteur International
Institute of Microbiology and Immunology, Faculty of Medicine, University of Ljubljana
Institute of Tropical Medicine
Institute of Tropical Medicine, Nagasaki University
Instituto de Salud Carlos III
Instituto Nacional de Enfermedades Virales Humanas
International Epidemiological Association
International Federation of Red Cross and Red Crescent Societies
International Medical Centre of Japan
IS Global, Barcelona
Korea Centres for Disease Control and Prevention
Laboratory Inserm Jean Merieux
London School of Hygiene and Tropical Medicine, UK
Médecins Sans Frontières, Belgium
Médecins Sans Frontières, France
Médecins Sans Frontières
Médecins Sans Frontières, Spain
Medecins Sans Frontieres, Switzerland
Ministry of Public Health, Lebanon
Ministry of Health, Brazil
MRC Centre for Outbreak Analysis and Modelling, Imperial College London
Museum National d Histoire Naturelle

GOARN partners responding to the Ebola outbreak 2014-2015
National Centre for Epidemiological Surveillance and Disease Control, Ministry of Health
National Centre for Global Health and Medicine, Japan
National Centre for Epidemiology and Population Health, Australian National University
National Institute for Communicable Diseases, South Africa
National Institute for Infectious Diseases Lazzaro Spallanzani
National Institute of Infectious Diseases
National University of Singapore
Norwegian Institute of Public Health
New South Wales Ministry of Health
Office of Health Protection, Department of Health and Ageing, DOHA
Ontario Medical Association
Ontario Ministry of Health
Osaka University
Pasteur Institute of Iran
PathWest Laboratory Medicine
Public Health Agency of Canada
Public Health England
Robert Koch Institut
Royal Perth Hospital
Ryerson University
Save the Children International
School of Public Health and Community Medicine, University of New South Wales
Shizuoka Cancer Centre Hospital
Spiez Laboratory, Federal Office for Civil Protection
Statens Serum Institut
Tan Tock Seng Hospital
The International Rescue Committee
The University of the West Indies
Training Programmes in Epidemiology and Public Health Interventions Network
U.S. Army Medical Research Institute of Infectious Diseases
United Nations Children's Fund
United Nations Food and Agriculture Organization
United Nations High Commission for Refugees
University Hospital Düsseldorf
University Hospital Limerick
University Hospital of Heidelberg

GOARN partners responding to the Ebola outbreak 2014-2015
University Hospital of South Manchester
University of Geneva
University of Nebraska Medical Centre
University of Texas Medical Branch
United Nations Office for Project Services
Vancouver Coastal Health
WHO Emerging and Dangerous Pathogens Laboratory Network
WHO Global Infection Prevention and Control Network
WHO Virtual Interdisciplinary Advisory Group on Mass Gathering
World Organisation for Animal Health

Appendix M. Distribution of Zika cases in the Americas as of January 2018

Country/Territory	Autochthonous cases confirmed	Imported cases	Incidence Rate	Deaths	Confirmed congenital syndrome associated with Zika
Bermuda	0	6	0.00	0	0
Canada	0	544	0.00	0	1
United States of America	227	5,335	0.07	0	102
Mexico	11,805	15	9.18	0	20
Belize	355	0	636.12	0	0
Costa Rica	2,008	32	200.57	0	19
El Salvador	51	0	192.61	0	4
Guatemala	1,032	0	29.62	0	140
Honduras	308	0	399.18	0	8
Nicaragua	2,795	3	45.20	0	2
Panama	1,253	42	172.91	0	17
Cuba	187	58	1.64	0	0
Dominican Republic	335	0	49.07	0	85
French Guiana	483	10	3979.35	0	1
Guadeloupe	382	0	6615.89	0	5
Haiti	5	0	27.12	0	1
Martinique	21	0	9267.93	0	5
Puerto Rico	40,562	137	1101.93	5	47
Saint Barthelemy	61	0	10660.00	0	0
Saint Martin	200	0	9675.00	0	1
Bolivia	811	4	31.75	0	14
Colombia	9,927	0	223.49	0	248
Ecuador	2,397	15	38.48	0	14
Peru	1,530	22	28.55	0	0
Venezuela	2,413	0	198.49	0	0
Brazil	137,288	0	176.10	11	2,952
Argentina	278	41	1.85	0	5
Chile	0	34	0.00	0	0
Paraguay	20	0	10.93	0	2
Uruguay	0	1	0.00	0	0
Anguilla	23	1	317.65	0	0
Antigua and Barbuda	25	2	601.06	0	0
Aruba	703	7	1676.32	0	0
Bahamas	25	3	140.76	0	0
Barbados	150	0	296.23	0	1

Country/Territory	Autochthonous cases confirmed	Imported cases	Incidence Rate	Deaths	Confirmed congenital syndrome associated with Zika
Bonaire, St Eustatius and Saba	437	0	2688.00	0	0
Cayman Islands	30	11	460.34	0	0
Curacao	2,049	0	4379.19	0	0
Dominica	79	0	1666.22	0	0
Grenada	118	0	408.11	0	2
Guyana	37	0	4.79	0	3
Jamaica	203	0	284.01	0	0
Montserrat	5	0	460.00	0	0
Saint Kitts and Nevis	33	0	1107.55	0	0
Saint Lucia	50	0	528.48	0	0
Saint Vincent and the Grenadines	83	0	579.41	0	0
Sint Maarten (Dutch part)	149	0	957.14	0	0
Suriname	724	0	637.23	4	4
Trinidad and Tobago	718	1	52.52	0	17
Turks and Caicos Islands	25	3	438.46	0	0
Virgin Islands (UK)	53	0	362.86	0	0
Virgin Islands (US)	1,024	2	2125.24	0	0
TOTAL	223,477	6,329	80.41	20	3,720

Zika cumulative cases. SOURCE: PAHO/WHO as presented in Cumulative 04 January 2018, Cases reported by the IHR National Focal Points to the WHO IHR Regional Contact Point for the Americas and through the Ministry of Health websites, 2016-17

Appendix N. Zika Epistemic Community

Country	Name	Institution	EC-ZIKA	Vector Control Advisory Group	SG DET VC Products	WHO Ad-hoc AGAD
Albania	Silvia Bino	Institute of Public Health	1			
Argentina	Fernando Althabe	Institute for Clinical Effectiveness and Health Policy	1			
Australia	Thomas R. Burkot	Australian Tropical Medicine and Rehabilitation Sciences		1		
Australia	Jenny Firman	Department of Health				1
Australia	Michael Selgelid	Monash University	1			
Australia	Richard Russell	Sydney Medical School				1
Australia	Eva-Maria Bennet			1		
Belgium	Marc Coosemans	Institute of Tropical Medicine		1		
Brazil	Pedro Fernando da Costa Vasconcelos	National Institute for Viral Hemorrhagic Fevers	1			
Brazil	Claudia Torres Codeço	Oswaldo Cruz Foundation	1			
Brazil	Estefânia Gastaldello Moreira	Universidade Estadual de Londrina				1
Brazil	João Bosco Siqueira Jr	Universidade Federal de Goiás			1	
Canada	Ansa Jordaan	International Civil Aviation Organization				1
Canada	Anthony Evans	International Civil Aviation Organization	1			
Canada	Kamran Khan	University of Toronto, and Clinician-Scientist St. Michael’s Hospital	1			
Colombia	Maria Mercedes Muñoz Ramírez	Ministry of Health and Welfare, Colombia	1			
France	Frédéric Jourdain	Centre IRD de Montpellier				1
France	Fabrice Chandre	Institut de Recherche pour le développement		1		
France	Férechté Encha-Razavi	Necker-Sick Children’s Hospital, Paris, France	1			
Germany	Anita Plenge-Boning	Institute for Hygiene and Environment, City of Hamburg				1
Ghana	Abraham Hodgson	Ghana Health Service	1			
India	Kalpana Baruah	Ministry of Health and Family Welfare	1			1
India	Ashwani Kumar	National Institute of Malaria Research		1		
Indonesia	Nyoman Kandun	Ministry of Health, Indonesia	1			
Iran	Hassan Vatandoost	School of Public Health		1		
Malaysia	Indra Vythilingam	University of Malaya		1		
Morocco	Mohamed Moussif	Ministry of Health, Morocco				1

Country	Name	Institution	EC-ZIKA	Vector Control Advisory Group	SG DET VC Products	WHO Ad-hoc AGAD
New Zealand	Steven Gay	New Zealand Ministry for Primary Industries, Auckland Biosecurity Centre				1
Nicaragua	Teresa Rodriguez	Universidad Nacional Autónoma de Nicaragua				1
Nigeria	Oyewale Tomori	Redeemer's University				1
Pakistan	Ghazala Mahmud	Fazia Medical College	1			
People's Republic of China	Jianning Zheng	Ningbo entry-exit inspection and quarantine bureau of PRC				1
Rwanda	John I. Githure	Ministry of Health		1		
Senegal	Amadou Alpha Sall	Institut Pasteur de Dakar	1			
Singapore	Duane J. Gubler	Duke-Nus Graduate Medical School	1			
Singapore	K.U. Menon	Ministry of Communications and Information	1			
Singapore	Annelies Wilder-Smith	Nanyang Technological University, Singapore	1			
Spain	Dirk Glaesser	World Tourism Organization	1			
Switzerland	Robert Steffen	Biostatistics and Prevention Institute				1
Switzerland	Thomas Smith	Swiss Tropical Institute		1	1	
Tanzania	Salim Abdulla	Ifakara Health Institute (IHI)		1	1	
Tanzania	Leonard Mboera	National Institute for Medical Research	1			
UK	Steven W. Lindsay	Durham University		1	1	
UK	Azra Ghani	Imperial College London			1	
UK	Alan Boobis	Imperial College London, The Hammersmith Hospital				1
UK	Janet Hemingway	Liverpool School of Tropical Medicine		1		
UK	Hilary Ranson	Liverpool School of Tropical Medicine		1		
UK	David L. Heymann	London School of Hygiene and Tropical Medicine	1			
UK	Mark Rowland	London School of Hygiene and Tropical Medicine			1	
UK	Immo Kleinschmidt	London School of Hygiene and Tropical Medicine		**1**	**1**	
UK	Heather Ferguson	University of Glasgow		1		
USA	Robert Reiner	Institute for Health Metrics and Evaluation		1		
USA	Jennifer Erin Staples	Centres for Disease Control and Prevention	1			
USA	John Painter	Centres for Disease Control and Prevention			1	

Country	Name	Institution	EC-ZIKA	Vector Control Advisory Group	SG DET VC Products	WHO Ad-hoc AGAD
USA	Kim A. Lindblade	Centres for Disease Control and Prevention		1		
USA	Michael Johansson	Centres for Disease Control and Prevention				1
USA	Ryan Wiegand	Centers for Disease Control and Prevention			1	
USA	Audrey Lenhart	Centers for Disease Control and Prevention		1		
USA	Gary Brunette	Centers for Disease Control and Prevention				1
USA	Roger Nasci	Centers for Disease Control and Prevention		1		
USA	Till Baernighausen	Harvard T.H. Chan School of Public Health			1	
USA	Bobby Reiner	Institute for Health Metrics and Evaluation (IHME), University of Washington			1	
USA	James Meegan	National Institute of Allergy and Infectious Diseases, National Institutes of Health,	1			
USA	Molly Robertson	PATH			1	
USA	David O'Brochta	The Foundation for the National Institutes of Health		1		
USA	Rafael Obregón	UNICEF	1			
USA	David O. Freedman	University of Alabama at Birmingham	1			
USA	John C. Beier	University of Miami		1		
USA	Thomas W. Scott			1	1	

EC Zika: Emergency Committee Zika; VCAG: Vector Control Advisory Group; SG DET VC Products Expert Advisory Group on Design of Epidemiological Trials for Vector Control Products; WHO Ad-hoc AGAD: WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases

N.1. Zika participating institutions in the Epistemic Community.

Institution	EC-ZIKA	Vector Control Advisory Group	SG DET VC Products	WHO Ad-hoc AGAD
Centres for Disease Control and Prevention	1	3	2	2
London School of Hygiene and Tropical Medicine	1	1	1	
Durham University		1	1	
Ifakara Health Institute (IHI)		1	1	
International Civil Aviation Organization	1			1
Imperial College London			1	1
Institute for Health Metrics and Evaluation (IHME), University of Washington		1	1	
Liverpool School of Tropical Medicine		2		
Ministry of Health and Family Welfare	1			1
Swiss Tropical Institute		1	1	
Institute of Tropical Medicine		1		
Liverpool School of Tropical Medicine		1		
Nanyang Technological University, Singapore	1			
National Institute of Malaria Research		1		
Necker-Sick Children's Hospital, Paris, France	1			
Oswaldo Cruz Foundation	1			
Australina Tropical Medicine and Rehabilitation Sciences		1		
Biostatistics and Prevention Institute				1
Centre IRD de Montpellier				1
Department of Health				1
Duke-Nus Graduate Medical School	1			
Fazia Medical College	1			
Ghana Health Service	1			
Harvard T.H. Chan School of Public Health			1	
Institut de Recherche pour le développement		1		
Institut Pasteur de Dakar, Senegal	1			
Institute for Clinical Effectiveness and Health Policy	1			
Institute for Hygiene and Environment, City of Hamburg				1
Institute of Public Health	1			
Ministry of Communications and Information	1			
Ministry of Health		1		
Ministry of Health and Welfare, Colombia	1			
Ministry of Health, Indonesia	1			
Ministry of Health, Morocco				1

Institution	EC-ZIKA	Vector Control Advisory Group	SG DET VC Products	WHO Ad-hoc AGAD
Monash University	1			
National Institute for Medical Research, Dar es Salaam,Tanzania	1			
National Institute for Viral Hemorrhagic Fevers	1			
National Institute of Allergy and Infectious Diseases, National Institutes of Health	1			
New Zealand Ministry for Primary Industries, Auckland Biosecurity Centre				1
Ningbo entry-exit inspection and quarantine bureau of PRC				1
PATH			1	
Redeemer's University				1
School of Public Health		1		
Sydney Medical School				1
The Foundation for the National Institutes of Health		1		
UNICEF	1			
Universidad Nacional Autónoma de Nicaragua				1
Universidade Estadual de Londrina				1
Universidade Federal de Goiás			1	
University of Alabama at Birmingham	1			
University of Glasgow		1		
University of Malaya		1		
University of Miami		1		
University of Toronto, and Clinician-Scientist St. Michael's Hospital	1			
World Tourism Organization	1			

EC Zika: Emergency Committee Zika; VCAG:Vector Control Advisory Group; SG DET VC Products Expert Advisory Group on Design of Epidemiological Trials for Vector Control Products; WHO Ad-hoc AGAD: WHO Ad-hoc Advisory Group on aircraft disinsection for controlling the international spread of vector-borne diseases

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