Toward a Comprehensive Postgraduate Surgical Training Program in Saudi Arabia

by

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Abstract

Residency training is a crucial building block for teaching clinical, academic, and professional skills to practice safe and reliable medicine; however, examining the outcome of various training programs has received minimal attention from leading postgraduate medical education journals. Thus, linking the apparent association between surgical training approaches with the quality of postoperative patient outcomes is nearly non-existent.

This three-paper dissertation examines the empirical association between the postgraduate surgical training approaches and patient outcomes, using Canada and Saudi Arabia as the two countries of interest. This thesis also examines the influence of hospital centers as a confounding variable (case volume, board certification, hospital size), and cost-effectiveness created as a result of being treated by a Saudi surgeon who completed his/ her postgraduate training in Canada vs. postgraduate surgical training in Saudi Arabia. The cost-effectiveness calculated in paper two amounts to 9,904,512 Saudi riyals annually in the reduction of postoperative complications for fifteen surgeries per month in favor of the Canadian training system. This large amount can be reinvested in the Saudi training programs to increase the competencies required to match those of the Canadian system. The final paper proposes a ***quality improvement framework*** and standards named “Excellence by Design” to improve training in postgraduate surgical training programs and all postgraduate health training programs within the Kingdom.

The First Paper analyses the difference in patient outcomes based on the empirical association between two surgical approaches administered in two different countries, Canada and Saudi Arabia, and the influence of hospital center characteristics, using multi-variant logistic regression analysis. In addition, evidence collected from patient files was analyzed through using logistic regression where it showed that there is in fact, differences in patient

outcomes based on the board certification training process in favor of the Canadian training system in Cardiac surgery, and no effect on patient outcomes when factoring in the organizational impact on both surgical oncology and neurosurgery.

The Second Paper analyses the incremental cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada. Evidence shows that the Canadian-trained Saudi surgeons were more cost-effective in neurosurgery. At the same time, there was minimal to no difference in cardiac and surgical oncology training programs between the two locations.

The Third Paper uses a multi-institutional qualitative method approach to identify critical factors that need improvement in postgraduate medical and surgical programs within Saudi Arabia. Key findings of this paper indicate that governance of the training process was an essential aspect that needs to be improved within the postgraduate medical and surgical training programs. This elevates the need to have a ***quality improvement framework*** encompassing various aspects of the training process, which this paper proposes as "Excellence by Design" standards in addition to using the PDCA cycle proposed by the ISO-21001. The third paper also attempts to address the uninformed expectation[1] of residents about the residency journey by developing a quality improvement framework adopted as an amalgamation of various frameworks such as ACGME CLEAR, CanERA, NIH Scotland, NIH England.

[1] (Sofear & Firminger, 2005)

“It wasn’t easy … but I did it!”

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This thesis has planted the seed for improvement in Saudi Arabia, when it comes to postgraduate surgical training programs. It was the basis for creating training excellence initiative in the Saudi Commission for Health Specialties, where outcome measurements are now a pivotal element in all postgraduate health training. By focusing this dissertation on the importance of outcome, measurement in healthcare training policy implications will be made in accordance with the new training excellence system that has been implemented. I would like to take this opportunity to thank in the Saudi Commission Secretary General Professor Ayman Abdo for taking this idea and paving the road for smooth implementation.

To Dr. Wesam Abuznadah, Chief Academic Affairs Officer, Saying thank you doesn’t seem to be enough; you have taught me to always build on the positive side of things even when they are falling apart. To be humble and, above all, to always treat others with empathy. You have taught me that hard work would shine on its own, and I wanted to let you know that you were an integral part of me being able to make it to the end. You have resorted to my faith in my abilities and made me a better person, and I am forever grateful for that.

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Preface

The purpose of this dissertation is to examine the empirical link between the board certification in postgraduate surgical training and patient outcomes in two different countries, specifically Canada and Saudi Arabia. The aim is to determine whether there is a difference in patient outcomes based on skills and competencies acquired through training systems in two different locations of training (Canada, Saudi Arabia) while accounting for confounders such as hospital center characteristics, the cost-effectiveness of both training locations in the three chosen surgical specialties (neurosurgery, surgical oncology, and cardiac surgery), and finally propose as a quality improvement framework to improve the current training process based on best practices.

To the best of my knowledge, this work is original, except where acknowledgments and references are made to previous work, and contains three original publishable papers that address postgraduate surgical training.

This dissertation should be of high interest to high-level decision-makers in the Ministry of Health. It should also be of interest to decision-makers in the Saudi Commission for Health Specialties. They are the sole regulatory body responsible for training postgraduate medical and surgical residents.

Due to the level of difficulty endured in collecting data for this thesis, it is highly recommended to create a **National database for Patient Outcomes** that is comprehensive enough to link patient outcomes with physician board certification to enable ease of information extract for similar studies in the future.

Creating a National database would directly contribute to four of the Ministry of Health proposed Model of Care (MoC) themes shown in figure1 below. The proposed database would allow for informed decision-making in the governance of postgraduate health training programs locally and internationally. Further, it would also assist in the provider reform theme, where it would assist in forecasting the specialties that are in demand and find means to attract healthcare providers to fill in the need and develop these required programs to attract more trainees to build the national workforce. In addition, it would also direct workforce development in areas where patients' outcomes do not meet national standards.

Finally, this database would significantly impact financing reforms in postgraduate health training, as to which programs would require scholarships and which programs would remain nationally, and what financing strategies and policies would go into both.

Figure1: Saudi Delivery of Model of Healthcare Transformation[2]

[2] For more information about the model of care kindly refer to the following link https://www.moh.gov.sa/en/Ministry/vro/Documents/Healthcare-Transformation-Strategy.pdf

Introduction

Medical training has gained global attention, which is evident by the size of the investments made in postgraduate training programs.[3] Yet, it appears that the impact and assessment of postgraduate medical and surgical training programs on patients' health outcomes have received minimal attention from leading medical journals. Indeed, according to Prystowsky & Bordage (2001): "Leading journals in medical education contain limited information concerning the cost and products of medical education" (p. 335). In addition, van der Leeuw et al. (2012) stated, "It is not yet known to what extent residency training influences patient outcomes" (p. 2). The authors then explained, "Given the indisputable link between training and care delivery in daily practice, we would expect to find a vast amount of research focusing on the link between residency training and patient outcomes.[4]" A special theme article published in *Academic Medicine* by Chen, Bauchner, & Burstin (2004) indicated that during a review of 600 articles on medical education, the authors discovered only four studies that measured patient clinical outcomes.

Surprisingly, few studies would measure the link between medical training and patient clinical outcomes. This information would be beneficial for evaluating the effectiveness of medical training programs. Kalet et al. (2010) stated that to identify educational-specific patient outcomes, researchers must be able to isolate causal links between physicians' training and patient outcomes. Van der Leeuw et al. (2012) confirmed this view by stating, "It is, therefore, essential to assess aspects of residency training through patient outcomes to evaluate the direct and future effects of global investments made in training programs" (p. 2).

The difficulty in measuring medical training when linking it to patient outcomes stems from the fact that patient outcomes depend on many other contextual factors that could

[3] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 9).
[4] (Van der Leeuw et al., 2012, p. 2).

vary from those related to healthcare institutions and providers, such as hospital settings and healthcare provider skills and experience, to the factors associated to the patients, such as their health status and personal characteristics. Another problem that arises when studying the issue is that many medical training programs have been reformed to focus primarily on educational structures such as the training settings and the type of skills that are minimally required for the residents to pass board exams rather than patient outcomes.[5]

While investigating the link between medical training and clinical outcomes may be challenging, it is essential because effective assessment of postgraduate medical training programs is crucial in obtaining desired positive patient outcomes. It is also a key component in developing and integrating policies that optimize the outcomes through identifying physician core competencies needed for a higher quality of the patient outcome.
The importance of such studies arises from the fact that there has been a strong movement calling for quality measures and more accountability on patient outcomes. Kalet et al. (2010) stated, "The quality of care that the public receives is determined to some extent by the quality of medical education students and residents receive.[6]" Further, "JCAHO[7] has moved from evaluating an organization's capability of providing care, to its actual performance (or outcome) in delivering care[8].

[5] (Griffith, Rich, Hillson, & Wilson, 1997).
[6] (Kalet et al., 2010, p. 844)
[7] Joint Commission on Accreditation of Healthcare Organizations
[8] (Frattali, 1990-1991, p. 6).

Healthcare System in Saudi Arabia

Saudi Arabia was founded on September 23, 1932, as a welfare state. According to article 31 of the Saudi Constitution, its government is obliged to provide “free healthcare services to all Saudis[9].” The country had an estimated population of 35.34 million in 2021[10]. Its total expenditure on health as a Gross Domestic Product (GDP) percentage was 2.8% in Quarter 4, 2020.

Reliance on health care has shifted from traditional medicine to a modern healthcare system. This has created a need to establish medical colleges to supply the health market with a sufficient number of healthcare providers. The first and the oldest Saudi medical college was established at King Saud University in Riyadh in 1967. Eight years later, two more colleges were established: the medical colleges in King Abdul Aziz University and King Faisal University. Since 1975, the number of medical colleges has risen from five to 21[11].

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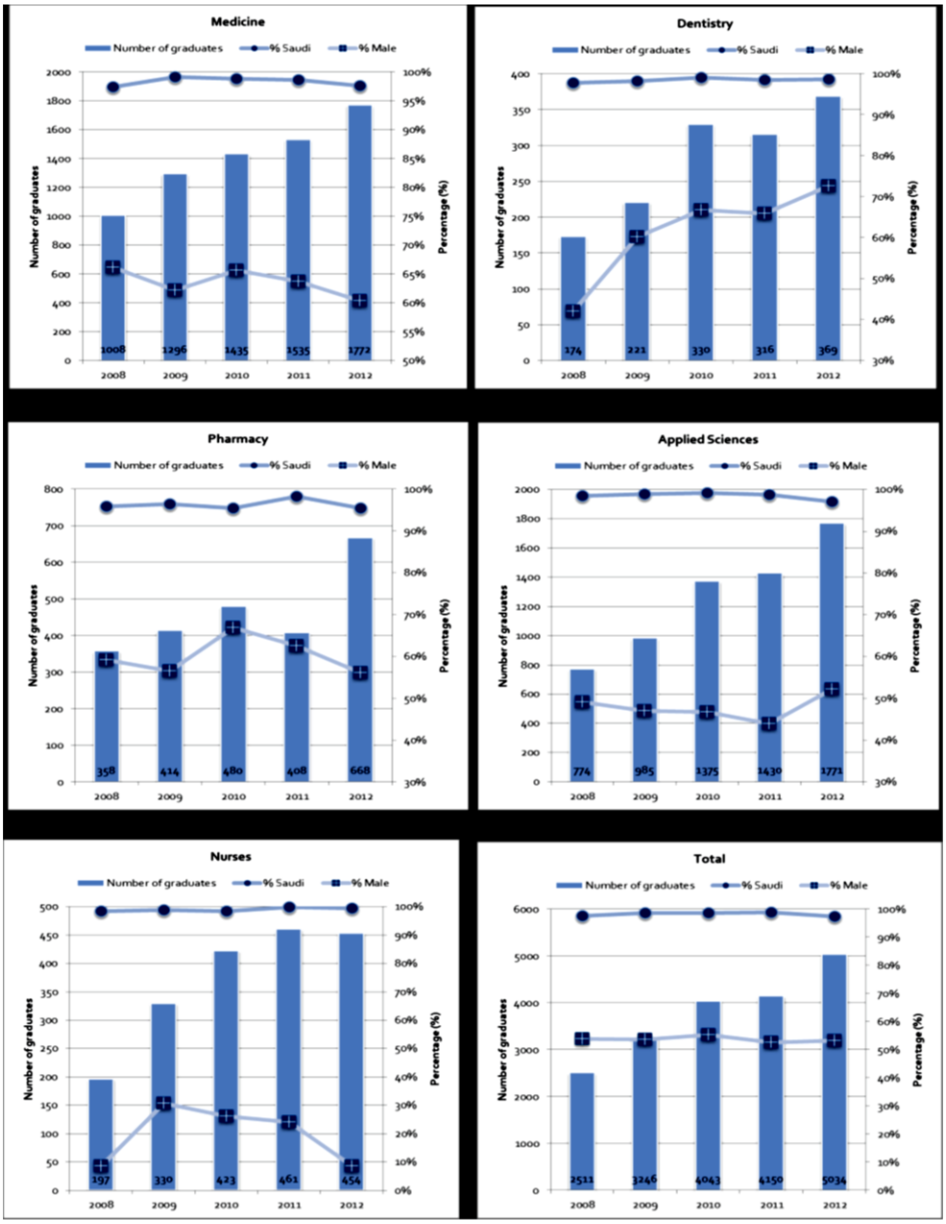
[9] (Albejaidi, 2010, p. 798).

[10] (General Authority Of Statistics (Kingdom of Saudi Arabia), 2021)

[11] Figure 1 shows the trends in the number of graduates from these medical schools (in addition to other health professionals) by gender and nationality between 2008 and 2012 (MOH, 2012, p. 98). In this time period, the number of graduating physicians rose from 1,008 to 1,772 per year.

Figure 1: Trends in Number of Saudi Graduates in Various Health Care Professions (MOH, 2012, p. 98)



Saudi Arabia's healthcare system is three-tiered. The pie-chart shown in Figure 2 depicts the three-tier system in percentages. Here, 59.5% of healthcare facilities in Saudi Arabia are funded and administered by the Ministry of Health, while the other 40% are divided: 31.5% are privately owned and financed hospitals. The remaining 9% are hospitals owned and managed by other governmental agencies, such as the Ministry of Defense and the Ministry of Higher Education[12].

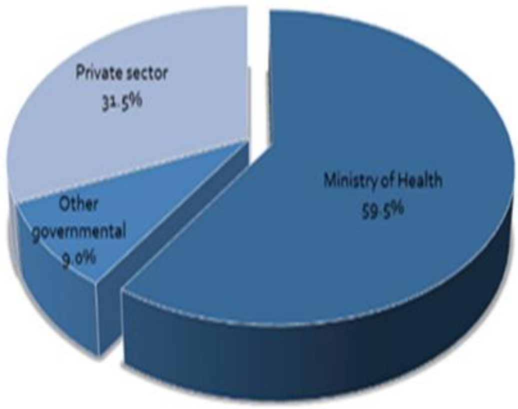


Figure 2: Saudi Arabian Three-Tiered healthcare system

As this dissertation focuses on the postgraduate training of surgeons, it would be helpful to provide some statistical data on this medical specialty. Table 1 shows the actual number of Saudi surgeons currently practicing in Saudi Arabia in the three subspecialties I chose for this study (neurosurgery "ventriculoperitoneal (VP) shunt insertion and VP shunt revision"; surgical oncology "colon cancer; breast cancer;" and cardiac surgery "CABG").

To ensure the improvement of the quality of medical care provided to patients, the Ministry of Health established a rigorous training program through establishing the Saudi Commission for Health Specialties in 1982. However, no formal postgraduate training for surgeons existed before that, and the only option available then was to send graduates abroad for training. The first graduates of these foreign training programs then assisted in

[12] (MOH, 2012, p. 87).

establishing the first domestic postgraduate training programs for surgeons. However, even in 2021, Saudi Arabia relied heavily on foreign training programs for surgeons due to the technological advances available to them abroad. In cooperation with medical cities[13] and the Ministry of Higher Education, the Ministry of Health offers various scholarship programs that allow Saudi surgeons to be trained abroad. These scholarships are available to medical graduates with GPAs above 95% who can find a residency position in North America or Europe.

Table 1: Physicians & Dentists in All KSA Health Sectors by Specialty, Gender, and Nationality in 2012 (MOH, 2012, p. 92)

	MOH						Other Governmental Sector						Private Sector*						Total KSA					
Specialty	Saudi Males	Saudi Females	Non-Saudi Males	Non-Saudi Females	Total	%Saudi	Saudi Males	Saudi Females	Non-Saudi Males	Non-Saudi Females	Total	%Saudi	Saudi Males	Saudi Females	Non-Saudi Males	Non-Saudi Females	Total	%Saudi	Saudi Males	Saudi Females	Non-Saudi Males	Non-Saudi Females	Total	%Saudi
General Practitioner	1148	792	2941	1202	6083	32	546	358	507	175	1586	57	101	32	2123	741	2997	4	1795	1182	5571	2118	10666	28
Dentistry	966	530	1152	336	2984	50	416	333	243	97	1089	69	254	98	3363	2214	5929	6	1636	961	4758	2647	10002	26
Internal medicine	403	145	1527	385	2460	22	285	123	270	66	744	55	56	6	1261	243	1566	4	744	274	3058	694	4770	21
Surgery	497	163	2365	398	3423	19	397	81	312	27	817	59	52	1	855	21	929	6	946	245	3532	446	5169	23
Orthopedics	111	2	750	16	879	13	148	7	141	3	299	52	40	-	638	5	683	6	299	9	1529	24	1861	17
Urology	80	1	328	15	424	19	97	6	80	2	185	56	29	-	324	6	359	8	206	7	732	23	968	22
Cardiothoracic surgery	15	-	93	3	111	14	47	3	105	5	160	31	5	-	29	-	34	15	67	3	227	8	305	23
Neurosurgery	43	7	177	8	235	21	58	4	59	5	126	49	15	-	59	2	76	20	116	11	295	15	437	29
Plastic surgery	19	7	106	12	144	18	45	4	27	4	80	61	24	2	65	2	93	28	88	13	198	18	317	32
E.N.T.	105	27	365	31	528	25	129	28	105	5	267	59	49	14	646	48	757	8	283	69	1116	84	1552	23
Ophthalmology	182	64	375	90	711	35	141	65	101	18	325	63	89	10	471	102	672	15	412	139	947	210	1708	32
OBS/GYN	77	270	777	912	2036	17	105	200	108	252	665	46	74	58	324	1546	2002	7	256	528	1209	2710	4703	17
Cardiology	54	12	390	54	510	13	90	11	194	14	309	33	25	3	295	26	349	8	169	26	879	94	1168	17
Chest diseases	11	7	202	18	238	8	29	2	31	1	63	49	20	-	153	8	181	11	60	9	386	27	482	14
Skin & venereology	93	52	149	47	341	43	87	54	22	13	176	80	56	11	436	315	818	8	236	117	607	375	1335	26
Neurology	41	22	62	7	132	48	46	25	51	9	131	54	11	1	69	6	87	14	98	48	182	22	350	42
Public Health	25	7	117	17	166	19	15	30	35	14	94	48	7	-	6	6	19	37	47	37	158	37	279	30
Tropical Medicine	18	10	44	8	80	35	19	7	11	2	39	67	8	-	36	6	50	16	45	17	91	16	169	37
Radiology	115	47	432	80	674	24	152	83	168	21	424	55	12	6	609	168	795	2	279	136	1209	269	1893	22
Laboratory	32	49	373	248	702	12	46	55	71	18	190	53	9	7	493	264	773	2	87	111	937	530	1665	12
Anesthesia	50	20	898	168	1136	6	133	40	453	36	662	26	12	2	496	80	590	2	195	62	1847	284	2388	11
Physical medicine	28	8	134	36	206	17	16	6	10	8	40	55	3	-	69	47	119	3	47	14	213	91	365	17
Pediatrics	419	252	1478	591	2740	24	339	209	369	147	1064	52	75	14	1349	439	1877	5	833	475	3196	1177	5681	23
Psychiatry	105	22	383	84	594	21	61	30	40	12	143	64	19	10	90	24	143	20	185	62	513	120	880	28
Forensic M.	18	1	55	1	75	25	1	-	-	-	1	100	-	-	-	-	-	...	19	1	55	1	76	26
Family medicine	419	264	1347	875	2905	24	340	220	470	249	1279	44	43	11	29	12	95	57	802	495	1846	1136	4279	30
Emergency	224	47	1479	452	2202	12	139	24	444	40	647	25	7	-	69	3	79	9	370	71	1992	495	2928	15
Intensive care	153	41	548	111	853	23	27	4	217	19	267	12	2	-	34	1	37	5	182	45	799	131	1157	20
Nephrology	54	14	434	90	592	11	28	8	88	9	133	27	11	1	34	1	47	26	93	23	556	100	772	15
Pediatric surgery	24	8	131	13	176	18	13	3	24	2	42	38	7	-	9	-	16	44	44	11	164	15	234	24
Blood diseases	15	4	20	13	52	37	33	17	51	13	114	44	3	1	4	2	10	40	51	22	75	28	176	41
Gastroenterology	16	3	56	5	80	24	47	3	39	3	92	54	22	-	53	2	77	29	85	6	148	10	249	37
Endocrinology	54	26	64	25	169	47	20	9	4	5	38	76	7	-	25	7	39	18	81	35	93	37	246	47
Oncology	25	8	119	28	180	18	54	11	86	18	169	38	9	1	12	1	23	43	88	20	217	47	372	29
Vascular surgery	6	1	63	1	71	10	13	1	12	-	26	54	8	-	8	-	16	50	27	2	83	1	113	26
Others	406	135	330	78	949	57	232	130	254	96	712	51	101	15	21	5	142	82	739	280	605	179	1803	57
Total	6051	3068	20264	6458	35841	25	4394	2194	5202	1408	13198	50	1265	304	14557	6353	22479	7	11710	5566	40023	14219	71518	24

[13] Medical cities were established to serve as world-class healthcare centers. Currently, there are six major medical cities in the Kingdom with branches in smaller cities.

The high cost associated with training physicians abroad, which is now an estimated CAD 1.3+ million per physician to be trained in Canada only, created a need to understand why Saudi Arabia as a high-income country still depends heavily on foreign training, and what impact that surgical foreign training programs have on patient outcomes when compared to national surgical training programs. Furthermore, although Saudi Arabia has an experienced Commission for Health Specialties, the number of surgeons available in the Saudi healthcare system to perform surgery is insufficient for the current national surgery demands.

To my knowledge, Saudi Arabia does not have pooled clinical and outcome data that could be used to determine the efficacy of foreign-trained Saudi surgeons in the healthcare workforce. Therefore, this dissertation could potentially start a national database for clinical outcomes where patient surgical outcomes can be traced back to surgeons and thus providing rich insights about training programs.

In summation, this dissertation aims to focus on surgical training by addressing the three following research questions:

1. What is the difference in the quality of health outcomes of patients treated by Saudi surgeons who were trained in Canada and Saudi surgeons who were trained in Saudi Arabia?
2. What is the Comparative incremental cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada?
3. What are the perspectives of program directors and residents on the current Saudi surgical training system, and how can it be improved?

Answering these questions will add to the existing literature on the effects of postgraduate surgical training on patient outcomes and advance current thinking about the importance of such research. Specifically, the dissertation will help:

- To investigate the causal link between Canadian and Saudi postgraduate surgical training programs and patient clinical outcomes.
- To identify critical components of postgraduate surgical training policies currently in Saudi Arabia that may directly affect patient clinical outcomes.
- To develop a performance improvement framework to improve the postgraduate training program in Saudi Arabia to improve the quality of postgraduate surgical and medical training programs.

This dissertation begins by setting the context for evaluating Canadian and Saudi Arabian postgraduate training programs through patient outcomes to demonstrate this dissertation's broader relevance and value including the effect of training environments on training outcomes and their influence on patient outcomes between Saudi Arabia and Canada. I then provide a clear research rationale that acts as an overarching theme for my proposed three-paper dissertation format, in addition to a glimpse of what the existing literature articulates as a foundation for the thesis (theoretical background).

Overview of the Training Environment in Saudi Arabia & Canada

The landscape of postgraduate surgical training outcomes and their effects on patient care depends heavily on many contributing factors. These factors range from structural components such as the type of hospital (primary, secondary, tertiary), process components such as teaching vs. non-teaching and the training environment. The training environment survey has been extensively validated in the Saudi context. Training institutions (Teaching & non-teaching) are using the Postgraduate Hospital Educational Environment measure (PHEEM) as one of the primary sources to understand the effect of the training environment on trainees' ability to acquire the required competencies. In the upcoming paragraphs, I will briefly touch upon some of the studies that addressed the training environment within Saudi Arabia in both teaching and non-teaching hospitals. It was quite difficult to find papers on the

Canadian training environment, as shown below, as that could be because all the training centers are university-based hospitals implementing the competency by design framework. However, the literature that was found is briefly mentioned below.

In Saudi Arabia, the health care system includes the three structural components mentioned above and a good mix of teaching vs. non-teaching (service) hospitals. A teaching hospital is a university-based hospital accredited by the Saudi Commission for Health Specialities to provide postgraduate medical and surgical training for those residents who successfully meet the national matching process that the Saudi Commission administers. A non-teaching hospital is considered a service hospital that mainly serves a specific population; these hospitals, for the most part, are tertiary hospitals such as King Faisal Specialist Hospital, King Fahad Medical City, Military hospital. Non-teaching Hospitals (Service) are also accredited by the Saudi Commission for Health Specialities (SCFHS) in one or more programs to train residents in medical and surgical postgraduate programs.

The evident difference between teaching vs. non-teaching hospitals in Saudi Arabia is the engagement in scholarly activities that residents are encouraged to conduct and publish research papers within the realm of their program. Further, the training process in teaching hospitals relies on strictly following the competency by design model, while non-teaching hospitals are lenient in following that model. However, it is essential to mention that the SCFHS accredits both institutions by showing evidence that they have fulfilled the institutional and program accreditation. Therefore, it is the governance of the training process delivery that differs between them, causing the variation in training outcomes between these two types.

To objectively address the training environment in training centers within Saudi Arabia, a literature review was conducted to understand the broader effect of the postgraduate medical and surgical environment on the variation of competencies of trainees who graduate from the accredited programs. Bin Saleh et al., in their paper titled "Evaluation of the learning environment of urology residency training using the postgraduate hospital educational environment measure inventory[14]." The authors wanted to evaluate the learning environment of the urology program across the regions in Saudi Arabia in a cross-sectional study using the postgraduate hospital educational environment measure (PHEEM) as an instrument of choice to identify the strengths and weaknesses of the training environment. The study concluded that the training environment for Urology residents needed to be improved overall; however, some sectors had better training environments than others. In addition, residents' satisfaction with their training environment improves by having a structured training process governance system; however, within this study, it was not evident if the improved satisfaction with the Urology training environment was better in university-based hospitals (Teaching) or non-teaching hospitals.

Al-Sheikh et al.[15] have also performed a PHEEM survey in a university-based hospital in a cross-sectional study for trainees completing their residency in a university-based training center. This study has shown that trainees in university-based training environments viewed their training environment as “a more positive than the negative environment,” with an overall score of 89.21; the study indicated room for improvement to better the trainees’ training environment within the center.

To understand further the effect of university-based teaching hospitals had better training environments than non-teaching hospitals, a study completed by Al-Murshad and Alotaibi was reviewed[16]. Their study intended to measure (PHEEM) at the King Fahad Hospital of Dammam University and concluded that trainees in this university teaching

[14] (Binsaleh, Babaeer, Alkhayal, & Madbouly, 2015)
[15] (Al-Sheikh, Ismail, & Al-Khater, July 2014)
[16] (Al-Marshad & Alotaibi, 2011)

hospital also perceived the training environment as more positive than negative, with room for improvement.

The conclusion in the last two papers suggests that the teaching standards are inferior in-nonteaching hospitals than it is in teaching hospitals. This assumption, however, was refuted by a study titled "Impact of students in non-teaching hospitals," conducted by AlSuwayri[17] has taken a reverse approach to the training environment by asking the trainers and the clinical supervisors to view the impact of trainees on clinical supervisors, the hospital environment, and patient care. In this study, it was found that trainees positively affected trainers, the hospital environment, and the quality of patient care.

Having briefly examined the two sides of clinical environment perception through the eyes of both trainees and trainers within teaching and non-teaching hospitals, it can be safely concluded that the training environment affects training outcomes. Further, it is also important to mention that accredited teaching hospitals have a more structured approach to train the trainees in their postgraduate medical and surgical training programs. This was evident during the focus groups conducted for this thesis, where trainees in non-teaching hospitals were more service-oriented and participated less in scholarly activities than those in teaching hospitals.

In the Canadian context, postgraduate medical and surgical training is conducted in university-based hospitals (Teaching Hospitals), providing trainees a structured training process through using "Competency by design[18]," which is an outcome-based curriculum that incorporates the core competencies required to train residents in surgical specialties based on the required needs identified. Since all training centers are university-based hospitals (Teaching Hospitals), the outcomes of training programs have less variation than those training programs delivered in the Saudi non-teaching program.

[17] (Suwayri, 2017)
[18] (Pinsk, Karpinski, & Carlisle, 2018)

During the literature research, finding papers that directly dealt with PHEEM in the Canadian context was quite difficult; articles that dealt with clinical learning environment (CLE) captured one area, such as operating room learning environment article written by Kanashiro et al., where " The Operating Room Educational Environment Measure (OREEM) was adapted[19]." In their paper, they have concluded that "The OREEM has potential to be applied further as a quality assessment tool whose results could be used by faculty and program directors to improve the learning experiences of residents in the operating room.[20]"

Pollett and Waxman compared the Canadian and Australian postgraduate surgical education and training programs. In this paper, they concluded that surgical educational and training programs in Australia "could benefit from some of the structure, goals, and objectives as in Canada, and the increased demands on surgeons to perform formative work-based assessments may require competitive financial compensation the states. An accreditation system that assesses overall function would be better to evaluate the educational success of the program[21]."

The next chapter will dive into the current status of the postgraduate surgical and medical training programs within Saudi Arabia. The current Canadian status has not been addressed as this thesis will only focus on the effect of training systems on patient outcomes within Saudi Arabia and understand all the affecting factors that might influence patient outcomes.

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[19] (Kanashiro, McAleer, & Roff, February 2006)
[20] (Kanashiro, McAleer, & Roff, February 2006, p. 150)
[21] (Pollett & Waxman, 2012)

Saudi Arabian postgraduate surgical and medical training: current status

Saudi Commission for Health Specialties (SCFHS) oversees five training streams: Surgical, Medical, Dental, Nursing, Pharmacy, and Allied Health. Training centers and programs are accredited by SCFHS, which represents each specialty and subspecialty. SCFHS[22]is responsible for 140 residency programs in more than 1,000 centers, with a total of 13,000 trainees overall and an annual acceptance of 4,000 trainees in 2019[23]. SCFHS sets accreditation standards for training centers through its Department of Institutional Accreditation; an accredited program must operate under the authority of the SCFHS authority, and it must document its commitment to provide the required educational, financial, and human resources to support the training journey. To approve a new program, scientific councils, and committees within the SCFHS[24] are responsible for setting the standards and requirements for accreditation of specific training programs, including curricula development and professional examination questions tied to the curriculum. SCFHS has adopted the CanMEDS framework, created in the 1990s by the Royal College of Physicians and Surgeons of Canada (the College of Physicians) for training processes to improve patient care. "All medical, surgical, dental, and nursing standards [in Saudi Arabia] are tied to the Canadian Medical Educational Directives for Specialties (CanMEDS)[25]". CanMEDS "forms the basis for all royal college educational standards for specialty education[26]". It is an evidence-based framework that has proven its effectiveness in Canada. This framework is composed of medical abilities that physicians require to meet the healthcare needs in the communities they serve. Competencies are organized under seven

[22] See Appendix 1, SCFHS Accredited Programs 2014–2015.
[23] (ACGME, 2019, p. 2)
[24] The Saudi Commission appoints scientific councils and committees for health specialties. They have regular meetings. Their primary mandate is to review proposed new training programs and set requirements and educational standards that need to be followed by institutions. These standards are then sent to the Program accreditation department to ensure compliance with the requirements.
[25] (ACGME, 2019, p. 7)
[26] (Royal College of Physicians and Surgeons of Canada, 2014, p. 3)

major roles of physicians[27]: medical expert, communicator, collaborator, manager, health advocate, scholar, and professional.

According to the College of Physicians[28], a medical expert is a physician who integrates all CanMEDS Roles, applying medical knowledge, clinical skills, and professional values in their profession. As communicators, physicians establish a relationship with their patients and their families by sharing and gathering essential information for effective treatment. In the collaborator role, the physician creates professional communication and effective teamwork with other healthcare professionals to provide patient-centered health treatment. As leaders, physicians connect with other healthcare professionals to contribute to a vision of high-quality healthcare services provided through their activities as clinicians, administrators, scholars, or teachers. As advocates, physicians utilize their experiences and expertise to influence their communities or patient clusters[29] to improve health by assessing the community needs and supporting the mobilization of resources to contribute to change. Physicians' role as scholars relies on their life-long commitment to learning and teaching others, evaluating evidence, and contributing to scholarship. Finally, as professionals, physicians in this framework are committed to the wellbeing of their patients and society by practicing ethically and upholding a high personal standard of behavior.

Research examining the descriptive validity of the CanMEDS roles in international contexts has shown that the seven roles were not valued equally. Alternatively, in the Saudi context, Amin and Alshammary (2015) stated that advantages include the ability to benchmark and compare with international programs, expediting the process of developing postgraduate training curriculum, facilitation of cross-border training of physicians, and ease of sharing resources such as faculty training and assessment materials.

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[27] (University of Toronto, 2019).
[28] (Royal College of Physicians and Surgeons of Canada, 2014).
[29] Patient clusters is "an aggregation of cases or diseases or another health-related condition, that is closely grouped in time and place." (Shiel, 2020).

Deploying CanMEDS in postgraduate training in Saudi Arabia required several innovations to adjust the framework to the local context[30]. One of these innovations is a list of the most common conditions and procedures for each specialty: top causes of morbidity, mortality, admissions, outpatient visits, and emergency department visits. The benefit of creating such a list, according to the authors, is to highlight essential areas in postgraduate training and the skills and knowledge associated with them within the local context. Second, the inclusion of a list of 36 universal topics[31] that are adequate to required practice is supplemented by core specialty topics, which are in addition to ensuring practitioners are competent in accordance with the six-pronged framework model comprising: professionalism, communicator, scholar, health advocate, manager, and collaborator[32]. In terms of the universal topics necessary to optimize competence of knowledge, these comprise fundamentals of safe drug prescribing, sepsis, nosocomial infections, antibiotic stewardship, and blood transfusion, plus specialist knowledge within health ethics and various fields of medicine, including cancer, diabetes, and metabolic disease, medical and surgical emergencies, acute pre-, peri- and postoperative care and elderly medicine[33]. These universal topics are key prerequisites for trainees engaging in specialist training as knowledge across the former areas is critical to advancing knowledge into core specialty topics and, in turn, knowledge and skills within sub-specialty topics[34].

The dissertation looked at the specific empirical link between surgeons' technical skills acquired through training, whether domestically or in Canada, and patient outcomes, specifically in Saudi Arabia. It considered the following patient outcomes: 30-day readmission rates and postoperative surgical complications of a specific surgery in a 12-month follow-up period, including clinical visits, 30-day mortality rates, postoperative length

[30] (Amin & Alshammary, 2015, p. 208)
[31] Please see Appendix 1.
[32] (Amin & Alshammary, 2015)
[33] (Amin & Alshammary, 2015)
[34] (Amin & Alshammary, 2015)

of stay. Postoperative complications are defined as “any undesirable, unintended and direct result of an operation affecting the patient, which would not have occurred, had the operation gone as well as could reasonably be hoped[35].” Dindo et al. defined postoperative complications as “any deviation from the normal postoperative course[36].”

The above focus on patient outcomes derives from the theoretical framework of this thesis. A literature review conducted indicates that the roots of the healthcare outcomes quality movement in the United States of America can be traced back to the 19th century. Since then, particularly over the last half-century, there have been several quality improvement efforts/movements.[37] One of the most influential movements in evaluating the quality of medical care was led by Avedis Donabedian (1966); his model relied on elements of structure, process, and outcome to assess the quality of care delivered to suggest that care structure and process of delivery can contribute to patient outcomes[38]. Since then, various quality outcome movements that focused on different elements of patient care were carefully examined. During the purposeful attempts to measure and improve patient quality outcomes, another movement emerged. It refers to the patient experience as a quality domain. It aims to support patients, payers, and providers to make rational decisions based on a better understanding of how decisions impact a patient's life. According to the American College of Emergency Physicians[39], the quality outcome movement is based on four techniques:

- “Greater reliance on standards and guidelines;
- Routine and systematic interval measures of patient functions and wellbeing, with disease-specific clinical outcomes;
- Pooled clinical and outcome data, and Appropriate results from the database analyzed and disseminated to meet the concerns of each decision-maker.”

[35] (Sokol & Wilson, 2008, p. 943).
[36] (Classification of surgical complications, p. 206).
[37] (Marjoua & Bozic, 2012, p. 263)
[38] (Marjoua & Bozic, 2012, p. 276)
[39] (ACEP, 2014, p. 1)

The specific surgical outcome in this three-paper thesis focused on both the second & third points, using postoperative medical records to examine surgical specific patient outcomes. To support this point, a study conducted to measure the quality of surgical care done by Birkmeyer et al. showed an association between surgical specific processes and outcomes such as lower mortality rates post-operatively[40]. However, the study showed a couple of disadvantages associated with using process measures such as "many processes known to be effective in general may not be appropriate for all patients[41]." The second limitation is "the relative lack of evidence about which processes are important for specific procedures[42]."

Many would argue that postoperative compilations directly result from the multidisciplinary healthcare system, such as surgeons' technical skills and knowledge, institutional factors, prior health conditions, etc. Plerhoples & Morton (2012) stated, "Complications from operative care resulted in 11% of total disease burden, of which half is estimated to be preventable.[43]" For this reason, it was essential to control for numerous confounding variables in the analyses performed, particularly in hospital centers, which was attained by designing a multi-center study as opposed to a single-centered study. Thus, the three governmental teaching hospitals chosen by this study are accredited by the Joint Commission Accreditation International (JCIA) as well as the Central Board for Accreditation of Health Institutions (CBAHI), where studies have shown that "there is consistent evidence that shows that accreditation programs improve the process of care provided by healthcare services. There is considerable evidence to show that accreditation programs improve clinical outcomes of a broad spectrum of clinical conditions. Accreditation programs should be supported as a tool to improve the quality of healthcare services.[44]"

[40] (Birkmeyer, Dimik, & Birkmeyer, 2004, p. 628).
[41] (Birkmeyer et al, p. 629).
[42] (Birkmeyer et al, p. 629).
[43] (Plerhoples & Morton, 2012, p. 25).
[44] (Alkhenizan & Shaw, 2011, p. 407)

The accreditation programs ensure that there are comparable staff credentials, infection rates, type of equipment used, hospital size, and funding sources. A systematic review conducted by Alkhenizan & Shaw stated, “There is consistent evidence that shows that accreditation programs improve the process of care provided by healthcare service. There is considerable evidence to show that accreditation programs improve clinical outcomes of a wide spectrum of clinical conditions[45]”. The variation between hospitals' characteristics was examined by analyzing selected key performance indicators (KPIs)[46] that were considered confounding variables. For each KPI, it was deemed arbitrary that a (±) difference of (≤5%) between the hospital's KPI and the average of that KPI for the three hospitals would be considered no significant impressing variation.

Table (2) below illustrates the hospitals' selected KPIs outcomes. It displays the average of the KPIs for the three hospitals, the value of 5%, the range of [KPI±5%], and the decision of whether it falls within the range. Remarkably, all the KPIs across the three hospitals were within range of [average of KPI±5%], which indicates the KPIs are similar with no significant impressing variation between them. With this approach, it may be assumed that each hospitals' characteristics and its quality performance indicators would not account for much of the variance in surgical outcomes related to the origin of surgeons' training and education. However, as with any multi-center study, it is impossible to control for organizational factors that may influence the relationship between a defined exposure and specific outcomes, such as culture and operational processes; such factors are likely to remain as residual confounders within this thesis.

[45] (Alkhenizan & Shaw, 2011, p. 407)
[46] I am sure that other KPIs could be examined, but due to the lack of valid, reliable data, these were the only indicators that all three hospitals had collected.

Table 2: Hospital selected KPIs outcomes

	KFMC	KSMC	KSUH	Average of KPI	Value of 5%	Range of [Average of KPI±5%]	Fall within range
Type of institution	Governmental	Governmental	Governmental	-	-	-	-
Level of care	Tertiary	Tertiary	Tertiary	-	-	-	-
Cost of care	Free	Free	Free	-	-	-	-
Accreditation entities	JCIA, CBAHI*	JCIA, CBAHI*	JCIA, CBAHI*	-	-	-	-
KPIs							
Mortality rate	3%	3.2%	2.98%	3.06 %	0.153	[2.91-3.21]	Yes
OR Utilization	73%	74.2%	78.6%	75.26%	3.760	[71.50-79.02]	Yes
Average of Near misses	18.1	16.75	16.90	17.25	0.863	[16.39-18.11]	Yes
Readmission (surgical)	6.1%	6.5%	6.2%	6.27%	0.313	[5.96-6.58]	Yes
Medication Errors (per 1000 dispensed doses)	0.017	0.018	0.017	0.017	0.009	[0.016-0.018]	Yes
CLABSI rate	3.17%	3.30%	3.25%	3.24%	0.162	[3.08-3.40]	Yes
Fall (per 1000 patients care days)	0.37	0.35	0.36	0.36	0.018	[0.34-0.37]	Yes

Throughout this thesis and especially in paper #1, I have set controls for patient's diagnosis by selecting three specific surgeries (neurosurgery, cardiac surgery, and surgical oncology) and assessing outcomes and the differences in such outcomes across the three hospitals centers). I have also within the regression analysis conducted separate multivariant regression based on the specific surgery and have completed two types of analysis. One excludes the organization factors under the assumption that the centers are identical as mentioned three teaching hospitals. The other analysis shown in later tables 27-34 in paper one has included the organization as one of the confounding factors, shown in tables 24-30 that when using a general linear model analysis, it excluded the board and the centers (KSU-MC, KFMC) due to no relationship between the outcomes and the organization in the three specialties selected (Neurosurgery, Surgical Oncology, Cardiology).

However, when conducting a logistical regression analysis that included the board type and organization Tables (31- 34), it was found that when accounting for the organization as a confounding variable in post-operative complication, mortality rate, and readmission to the operating room or the General ward within 30 days), the hospital as a confounding variable did not affect patient outcomes.

By attempting to control these confounding factors to the best of my ability and the availability of sound, reliable, and valid data, I was able to examine the empirical association between postgraduate surgical training and patient outcomes.

Research Rationale

This dissertation will aim to answer the following research questions through a three-paper dissertation format:

1. What is the difference in the quality of health outcomes of patients treated by surgeons trained in Canada and those trained in Saudi Arabia?
2. What is the Comparative incremental cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada?
3. What are the perspectives of program directors and residents on the current Saudi surgical training system, and how can it be improved?

The answers to these questions will help examine the impact of various domestic and Canadian postgraduate medical training programs for Saudi Arabian surgeons on the quality of care they offer to patients upon completing these programs. Table 3 summarizes the key variables pertaining to the national surgical quality improvement program that helped frame the research questions.

The provision of quality postgraduate surgical training programs in Saudi Arabia is essential for reducing the cost of training Saudi surgeons overseas. Improving the quality of surgical training may eventually lead to improving the quality of surgical care. In addition, because surgeons trained in Canada often master their practical skills in surgery and undertake various health-related research projects, it is expected that they will be able to contribute to establishing health research centers. These centers will further increase the quality of health care in the country.

Table 3: National Surgical Quality Improvement Program thesis related Variables (Khuri, et al., 2007, p. 1092)

Category	Variable
Preoperative variables	Demographic Gender Race Age General health status Height Weight Current smoker
Operative variables	Current procedural terminology code of primary operation Current procedural terminology codes of secondary operations Postgraduate year level of surgeon Emergency Wound class Anesthesia type Operation time Anesthesia time Work relative value units Red blood cells transfused Transfer status Operative date Inpatient/outpatient operation Postoperative diagnosis Specialty code of surgeon
Postoperative variables	30-day mortality 30-day overall morbidity Return to operating room Hospital length of stay Postoperative length of hospital stay
Cardiac events	Cardiac arrest Myocardial infarction Central nervous system events Cerebrovascular accident Coma Peripheral nerve injury Respiratory events Pneumonia Unplanned intubation Pulmonary embolism Failure to wean
Other events	Graft Failure Deep vein thrombosis Systematic sepsis Bleeding

Theoretical Background

To develop the theoretical background section, a total number of 2,400 studies linked training to patient outcomes, three Ph.D. student dissertations, and two reports associated with the topic in hand were selected. The search databases used in this thesis included PubMed Central (PMC), SAGE publications, NHS England, Elsevier, ScienceDirect, MEDLINE, and BMJ Quality & Safety. These databases were selected as they are the most reliable source of biomedical and healthcare literature. Further, these databases are the most accessible resources available for a new scholar; they also provided me with the most relevant scholarly articles required for this thesis.

The search parameters included key terms such as postgraduate training, residency, surgical training, and patient outcome, effects of training on patient outcomes, surgical specific outcomes, quality of training and patient outcomes, and related nomenclatures. The inclusion criteria for the literature review also included English-only research, free full-text, subject relevancy; all other studies that did not meet the criteria were excluded in the literature review.

Out of the 2,400 studies[47], Forteen were considered most relevant studies that specifically linked the location of training with patient outcomes. Four systematic reviews that addressed the effects of postgraduate training on patient outcomes were also identified. As opposed to primary studies, the latter research was given greater weight in informing the research question and selecting variables for analysis in this research. The second component of the literature review considered how these articles presented the effects of postgraduate surgical training on patient outcomes. Further, the research gaps of these studies and the proposed ways to address these gaps were outlined. Table 4 summarizes the 14 key studies examining the effect of surgeon training on patient outcomes.

[47] Only the relevant studies are cited in this thesis.

Table 4: Studies examining the effect of surgeon training on patient outcome

Study #	Author, Year	Site	Comparison	Data source	Analysis method	Setting (#of Hospitals)	# Of Patients	Morbidity	Post-Op Mortality	Recurrence	Long Term Survival
1	McArdle 1991 (UK) Volume	Colorectal	Gen surgeon & Surgeons with high volume of surgeries	Prospective	Multivariate analysis	Single setting Royal Infirmary	645			Lower for surgeons with larger number of procedures	
2	Holm 1997 (Sweden) Training & experience	Colorectal	Specialist w/10 years vs. non-specialist University hospital vs. community hospital	Prospective	Randomized trials mixed methods Logistic regression & Multivariate	(14) Multi-centers (3) university +(11) community hospitals	1399		Improved with surgeon with 10 years Improved in university hospitals	Improved with surgeon with 10 years Improved in university hospitals	
3	Porter 1998 (Canada) Training & volume	Colorectal	Colorectal Vs. Gen surgeon	Prospective Patient Records	Univariate & Multivariate analysis	(5) Multi-centers	683			Improved with specialized training & volume of surgeries	Improved
4	Pearce 1999 (USA) Training &Volume	Vascular	Vascular surgeon certifications vs none certified & volume	Retrospective chart review of computerized pathology record	Multiple logistic variable regression	Multi-centers all non-federal hospital admissions	31,172 LEAB 45,744 CEA 13,415 AAA	Improved with higher volume Certification: Improved CEA, AAA	Improved with higher volume Certification: Improved CEA, AAA		
5	Dorrance 2000 (UK) Training	Colorectal	Colorectal vs. vascular Transplant vs. Gen-surgery	Retrospective University teaching hospital pathology record	Univariate & multivariate analysis (Early-stage disease, advance vascular invasion,	Single Center university teaching hospital	378			Improved for colorectal surgeons	

					colorectal specialty							
6	Coates 2001 (USA) Training	Pelvic reconstruction Gynecology	Experienced surgeon vs. resident physicians w/senior surgeon supervision	Retrospective Patient charts	Univariate & multivariate regression	Single site Tertiary referral center	310	No Significant difference	No Significant difference			
7	Tu 2001 (Canada) Training & volume	Abdominal aortic aneurysm	Vascular vs. Cardiac Vs. General surgery specialties	Retrospective Linked 3 administrative database OHIP physician billing codes, CIHI discharge database, Ontario registered persons database	Univariate &multivariate	Not mentioned	5878		Improved for elective AAA performed by vascular or Cardiac surgeon			
8	Prystowsky 2002 (US) Training & experience	Colorectal	Colorectal vs. Gen-surgery, ABS-certified vs noncertified, University vs. non-university trained	Retrospective Illinois Hospitals and health systems association comp data	Mixed effects logistic regression analysis Mixed effects liner regression analysis	(76) – Multi center	15,427	Improved for ABS certification	Improved for ABS-certification			
9	McKay 2008 (Canada) Training	Hepatic	Surgical Oncology vs. HPB vs. Other specialties vs. Gen-surgery	Retrospective Patient Records	Univariate & multivariate analysis	(9)-Multicenter	1,107	Improved for HPB	No Significant difference			
10	Asch et.al., 2009)USA)	Obstetric deliveries	Obstetrics & gynecology deliveries	Retrospective study	Hierarchical generalized linear Model (HGLMs)	107 residency programs delivered in multi center	4906169		Obstetrics and gynecology training programs can be ranked by the maternal	N/A		

									complication rates of their graduates' patients.		
11	van der Leeuw et.al (2012)			Systematic review		Ninety-seven articles were included					
12	Thomas 2013 (Germany) Training & experience	Kidney Transplant	High experience vs. Senior resident vs. mid-experience vs. low experience	Retrospective Patient records	Univariate analysis using Kruskal Wallis test	Not mentioned	184 deceased	N/A	N/A		
13	Bansal et.al., 2016 (USA)	General surgery	Effect of training in patient outcomes	Retrospective patient records	Hierarchical generalized linear Model (HGLMs)	349 New York and Florida hospitals	230,769 patients operated on by 454	Patients who were operated on by residents who were trained in top tertial residency programs were less likely to experience adverse events.	The magnitude of the effect of the residency program on the outcomes achieved by the graduates decreased with increasing years of practice.	N/A	
14	Loiero et.al., 2017 (Zurich, Switzerland)	General Surgery	Impact of Residency Training Level on the Surgical Quality Following General Surgery Procedures	Patient Files	A multivariable linear regression analysis was used to analyze differences between groups.	University Hospital of Zurich, Switzerland	2715 patient		No difference between groups concerning the postoperative complications was detected.		

Overview of Existing Theory

The timeline in Figure 3 shows that the majority of studies associated with surgical training with patient outcomes were conducted after the late 1990s. These studies were mainly published in North American and European countries, assessing the impact of surgeons' training on patient outcomes. The discourse on evaluating the association between the postgraduate surgical training program and patient outcomes is to examine discrete, patient-focused endpoint process indicators. These process indicators have been identified and defined by quality management standards, such as morbidity and mortality rates, infection rates, readmission rates, return to the operating room, the volume of surgeries, physician technical skills, etc.

Since the mid-1990s, studies have retrospectively analyzed the association between surgeons' technical skills and improved patient outcomes. Methods such as univariate and multivariate analysis were primarily used to analyze data. The association between training and quality of patient outcomes has gained traction in particular due to increased demand for accountability fueled by the quality movement that was initiated in 1999[48]. This movement aimed to improve patients' quality of care and develop and transform "a science of health care quality" into a national movement[49].

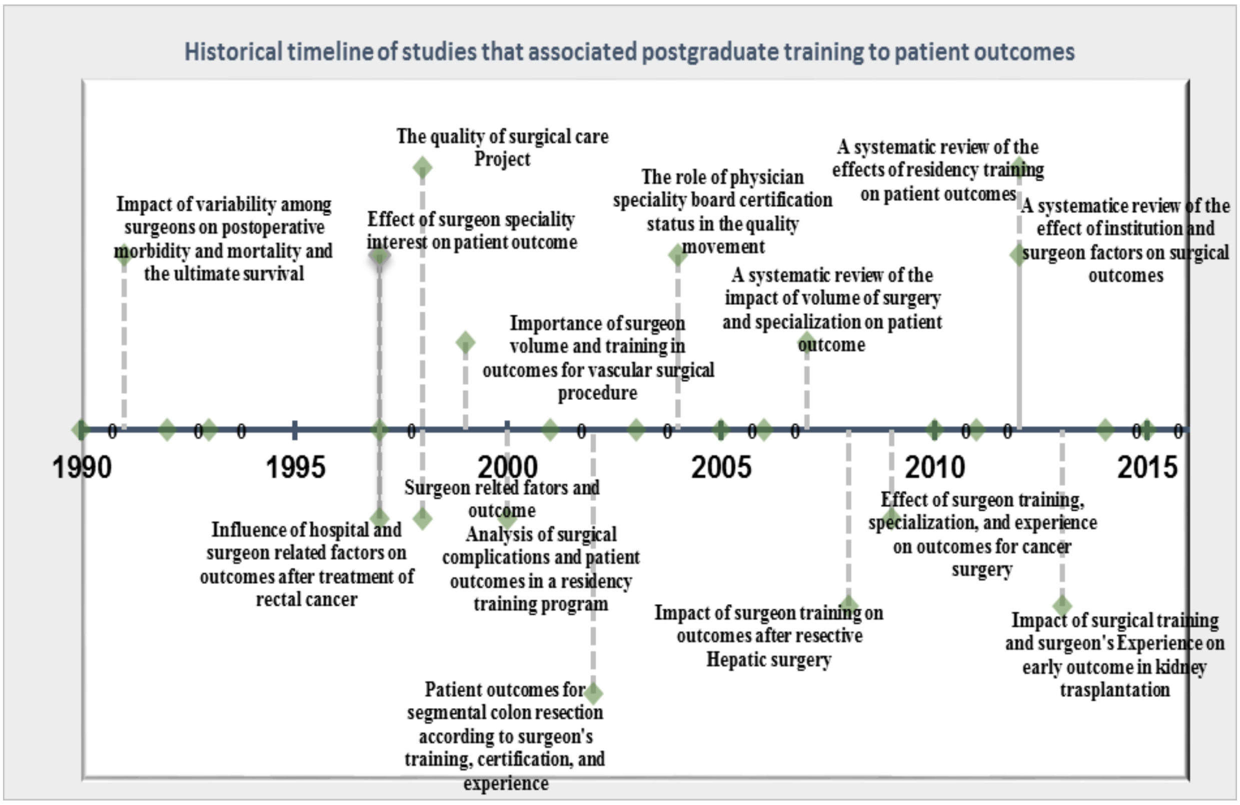
Other factors include training center ranking, Accreditation effect, curriculum effect, training autonomy, training environment, teaching Vs. Non-teaching effects were also examined during the literature review. The training environment in teaching vs. non-teaching hospitals was elaborated on in the preceding paragraph, "overview of the training environment in Saudi Arabia & Canada[50]."

[48] (Bodenheimer, 1999, p. 489).
[49] (Bodenheimer, 1999, p. 488).
[50] Page 10

Elements such as surgical specialization, surgical experience, and surgical volume will be explained in detail using the relevant studies mentioned in table 4. In addition, other factors such as hospital ranking, Training level were also included in table 4 to show that other factors should be considered when looking at the impact of training outcomes on patient outcomes.

The following paragraphs will elaborate on the studies that focused on surgical specialization, volume, and experience. In addition, there will be a slight inclusion of aspects such as training center ranking and training level as they also affect patient outcomes.

Figure 3: Historical timeline of studies that associated postgraduate training to patient outcome



Surgical Specialization

Surgical specialization was defined as "residency, fellowship or self-declared specialty interest[51]." Nine studies examined the effects of surgical specialization on patient outcomes. In nine studies that examined the impact of surgical specialization on patient outcomes, five focused on colorectal surgery specialization. In contrast, hepatic surgery, vascular surgery, gynecological surgery, and kidney transplantation were the subjects of the remaining four studies. I will hold the specializations constant, which will help focus on the effects of training locations on patients' outcomes for each specialization.

Three authors[52], in their research, demonstrated that surgeons' specialty interest has a direct effect on patient outcomes. For example, Dorrance (2000) et al. showed that after 45 months of follow-up, colorectal surgeons achieved lower local and overall recurrence rates (p=0.04) compared with a vascular, transplant, or general surgeon, who were 3.42 times more likely to develop local recurrence. In addition, colorectal surgeons were able to achieve higher disease-specific survival rates. These studies showed that healthcare quality and variation in patient outcomes were highly associated with surgical specialization. Some conditions may be more challenging to treat than others, but it was not evident within these studies that this is the case. To show the effect of the specialization, the authors stated, "This study demonstrates that the surgeon's specialty interest has a direct effect on patients' outcomes[53]."

Holm (1997) et al. found that patients that were operated on by certified surgeons with ten years of experience or more had a lower risk of local reoccurrence of rectal cancer and lower mortality rates; he states, "There was a significant surgeon

[51] (Bilimoria et al., 2009, p.1800).
[52] Dorrance (2000) et al., Holm (1997) et al., Prystowsky et al. (2002)).
[53] (Dorrance, Docherty, & O'Dwyer, 2000, p. 495).

related variation in patient outcomes, which is probably related to the surgical technique[54].”

Prystowsky et al. (2002), through their study of patient outcomes for colon resection, examined if the outcomes varied according to surgeon-specific factors, such as board certification, subspecialty certification, site of residency training, and years of experience. The authors used regression analysis with mixed effects to “assess the significance of surgeon specific variables as a predictor of outcomes after risk-adjusted for patient age, gender emergency of admission, surgeon volume, hospital site, comorbid illnesses” (p. 663). This study showed improved morbidity and postoperative complications for surgeons who had the American Board certification compared with general surgeons. It is worth mentioning that this study is the most relevant to the type of research this dissertation is focusing on.

Pearce et al. (1999) found that surgeons with subspecialties have improved mortality rates in undergoing abdominal aortic aneurysm repair (AAA). Tu et al. (2001) also found that patients who underwent elective AAA, performed by vascular or cardiac surgeons, had a significantly lower mortality rate than patients who had their AAA repaired by general surgeons.

Contrary to the above, there were two studies led by McKay et al. (2008) and Cotes et al. (2001), who found no significant differences in mortality rates or morbidity rates when comparing surgical specialty effects on patient outcomes. The first study included oncological surgeons, Hepatopancreaticobiliary (HPB) surgeons, and other specialty surgeons training; The second included comparing patient outcomes that underwent pelvic reconstruction surgery performed by experienced surgeons vs. resident physicians with the assistance of senior surgeons. The only observed disadvantage associated with the latter was prolonged operation time.

[54] (Holm et al., 1997, p.657).

The final study that examined the impact of surgeon specialty on patient outcomes was conducted by Thomas et al. (2013). This study was quite interesting as the authors analyzed 184 kidney transplant procedures retrospectively, during which the donor passed away. They found that only 20% of the surgeons had undergone this specific transplant training. This is significant because there is no formal training in transplant surgery in Germany. Therefore, the study was designed to determine whether the training is feasible and if there is an association between the training of surgeons and lower warm ischemic time[55] and lower operation time.

Surgical Experience

Experience refers to the number of years that the resident has had during training and the number of years practicing after certification. Four studies found that experience had a positive effect on patient outcomes. For example, Prystowsky et al. (2002), Holm et al. (1997), and Thomas et al. (2013 found that surgeons with 5-20 or more than 20 years of experience lower complexity rates, lower chances of disease reoccurrence rates, significantly lower ischemic time.The final study used the surgical experience as a factor for improved patient outcomes during residency training.

In addition, Loiero et al[56]. (2017) investigated the effect of experience when supervising residents in the operating room, where patient safety is ensured when junior residents are managed and coached by Senior residents who can adopt the role of the teaching surgeon in charge.

Surgical Case Volume

Surgical case volume was addressed in five studies and found that it is positively associated with patient outcomes. However, these five studies varied in how to define case volume. For example, some studies defined case volume regarding

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[55] Ischemic time is the time between traumatic amputation of a limb or portion of a limb and its surgical re-implantation.
[56] (Loiero, Slankamenac, Clavien, & Slankamenac, 16 June 2017)

surgeons performing a certain number of surgeries per year. In contrast, other studies defined case volume in hospital volume, measuring the total number of specific types of surgeries conducted per year.

Authors such as Tu et al. (2001), Porter (1998) et al., and Pearce et al. (1999) all found that there is a strong association between surgical case volume and improved patient outcomes. In addition, these studies have identified the improved patient outcomes associated with surgical volume as improved 30-day mortality rate and oncological lower recurrence rate.

Summary of Key Studies

In the literature review studies, three main themes were discussed: surgical specialization, surgical volume, and surgical experience. Each of these elements showed their apparent association with improved patient outcomes. Further, additional studies included the institutional ranking as one of the variables that directly impact the quality of training and, as a result, on patient outcomes. Residency training level was also studied to understand the impact on patient outcomes. The last two studies were just a few articles that addressed other variables that could affect the quality of training and, therefore, on patient outcomes.

This thesis has accounted for the difference in training environment between the Canadian training system and the Saudi training system. This thesis previously examined the training environment in both countries, and since this thesis is focused on improving the Saudi training context, it also accounted for the organizational effect that would influence the patient outcome and isolated it using regression analysis as shown in paper one titled "Saudi Arabia vs. Canada — Is there a difference in the quality of patient surgical products based on postgraduate surgical training location? Paper #1 found that there is, in fact, a strong association between organizational impact and patient outcome, which dilutes the training system effect.

Theoretical Framework

As an overarching theoretical and conceptual framework, this thesis draws on competing patient care quality movements that occurred as early as the 19th century, as mentioned earlier, as the basis for health systems performance measurement. Since then and over the last half of a century, there have been several quality movements[57]. One of the most influential movements in evaluating the Quality of medical care was led by Avedis Donabedian (1966); his model relied on elements of structure, process, and outcome to assess the Quality of care delivered[58]; where his study suggests that care structure and process of delivery can contribute to patient outcomes. Since then, various outcome movements that focused on different elements of patient care were carefully examined.

Other Quality frameworks that would build on the Donabedian structure are quality improvement frameworks, particularly in relation to national surgical quality improvement programs. The fundamentals of quality improvement start by providing insight into the underlying theoretical frameworks[59].

Quality improvement initiatives in the surgical context emphasize the Quality of surgical care and the importance of surgical conditions addressing global public health problems. There are many competing theoretical models for Quality Improvement (QI) in surgery in which various studies have been conducted using QI models in surgery[60]. Despite the plethora of theoretical models, for the sake of sticking to the scope of this thesis, three specific models designed for surgical quality improvement have been identified and proposed: Proven Care, C.K Hart framework, and Collaborative Quality Improvement. The Proven Care model by Berry et al[61]. has three components:

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[57] (Marjoua & Bozic, 2012, p. 263
[58] (Marjoua & Bozic, 2012, p. 276)
[59] (Donabedian, 1966).
[60] (Berry et al., 2009; Hart et al., 2016; Luckenbaugh et al., 2017).
[61] (Berry et al., 2009)

establishing best practices for CABG patients, assembling a multidisciplinary group to inject these best practices into the daily workflow, and implementing the program with real-time data to redesign the program for higher reliability. This model provides a quality improvement model for specific types of surgery, such as heart surgery, though it can be used in all surgical fields and interventions. However, a criticism of the model is that it is not appropriate for high-volume surgical departments. In addition, since it is often deployed in a small community, generalization problems could arise. For that reason, this model is not suitable for this research.

Hart et al[62]. Argues that the C.K Hart framework provides a more detailed and generalized surgical measurement framework that helps to identify and assess critical surgical outcomes, key steps, and processes to improve patients' outcomes. The model facilitates improvement based on three primary areas: 1) measurement of outcomes throughout each care phase; 2) reliable care processes are identified; and 3) mitigation of complications. Consequently, these three areas could be ideal for building a practical surgical quality improvement framework given its generalizability and ability to mitigate quality improvement issues.

Luckenbaugh et al[63]. contends that the collaborative quality improvement model provides a better surgical quality improvement solution through cooperation. Similar to the C.K Hart framework, the model adopts a 'measuring to improve' philosophy comprising of core principles. These principles include quality data collection, feedback to physicians and practices, dissemination, and implementation of strategies amongst collaborative members, aiming to improve the provision of care, treatment outcomes, and costs. The surgical quality improvement collaborative is a voluntary consortium of medical or surgical physicians collaborating on interventions that include feedback of outcome data and training in continuous quality improvement

[62] (Hart et al., 2016)
[63] (Luckenbaugh et al., 2017)

techniques. However, the model's significance is drawn from two key dimensions: surgical quality improvement framework and collaborative support. Hence, the model includes the need to conduct quality improvement assessments, ultimately leading to improved systems and processes for better outcome improvements. This shows that both the quality improvement framework and collaborative support complement each other.

After reviewing the above theoretical models and considering the proposed research questions, the collaborative quality improvement model is more suited to this research. Although the C.K Hart framework is a comprehensive and generalized surgical measurement framework to improve patients' outcomes, the collaborative quality improvement model provides these benefits and more. In addition, the collaborative quality improvement model offers a framework for surgical Quality improvement and collaborative support, which is a vital component to identifying the improvements required for current Saudi training systems to drive surgical quality improvement for national surgical quality improvement programs.

Research Design & Methods

This dissertation intends to examine the empirical relationship between the training processes in two different locations and patient outcomes by assessing the training process residents undergo during their residency years[64]. In paper one, a multivariant regression analysis was used to examine the empirical link between two training systems (Canada & Saudi Arabia). To test the sustainability of the National scholarship programs that Saudi Arabia provides its qualified postgraduate surgeons, paper two used a cost-effectiveness analysis to determine the effectiveness of the training systems using patient outcomes. Finally, paper three used a mixed-methods

[64] Paper #3 of this thesis.

approach (focus groups, resident and program directors' surveys, and Delphi survey) to develop a quality improvement framework that is culturally appropriate.

The aim is to find practical implications for further research in the field to test the theory "that training does impact patient outcomes" using the previously mentioned specific statistical and non-statistical methodologies to understand the impact of factors such as training locations on patient outcomes. The studies included in the literature review found that the respective authors/researchers used a single method (quantitative or qualitative) to address the topic. Therefore, this dissertation used quantitative and qualitative methodologies to understand the life cycle for creating postgraduate medical training policies before they are accepted; this added richness to the final recommendations in paper #3. Finding research that affirms the existing and consequential relationship between surgical training and patient outcome was the first step in understanding the methodological concepts presented and the limitations of these studies. This dissertation is not intended to develop new methodologies; it aims, however, to address some of the essential questions in the field. These questions include the following:

1. What are the effects of training on patient outcomes, and what are the crucial variables that affect outcomes?
2. What are the incremental costs associated with training?
3. How do certified surgeons view their past training, and what contribution about their experiences can they offer?
4. What aspects of post-surgical training should be addressed and reformed?

This research has drawn a general list of independent and dependent variables from these questions and the review of key studies on the existing and consequential relationship between surgical training and patient outcome (see Table 5). Therefore, the variables presented in this thesis were conceptualized and operationalized based on the idea of surgical training and patient outcome, which involves quality improvement interventions.

Table 5: A general list of confounding variables for all forms of surgery assessed categorised into trainee, centre and patient factors.

Surgical Trainee Factors	Hospital Centre Factors	Patient Factors
Location of training Post graduate surgeons qualifications Duration of surgical training/experience in specialist fields	Structure of care (hospital, equipment, supplies) Costs Resources Culture Operational processes Management Staffing levels	Gender Age Pre-operative health status and diagnosis Post-operative length of stay Post-operative morbidity Return to operating room Readmission within 30 days Complications (wound infections, bleeding)

The independent variables, among those listed in table 5, refer to the variables that change, and in this thesis, they are held constant for analytical purposes. In the context of this research, these refer to the variables pertaining to surgical training and patient outcome characteristics that can continuously change, such as the location of the surgeon training system and patient age. These were conceptualized as the location of training given that there are many locations people can train and gender, age, and health status that vary across all patients. The same goes for qualifications, as surgeons will have varying post-graduate degrees depending on where they studied.

The dependent variables refer to the issues being studied or measured against the independent variables. These include the postoperative length of stay, postoperative morbidity, return to the operating room, readmission within 30 days, cost wound infection, and bleeding. For example, operationally defining cost can be achieved by measuring cost against training location since different training facilities offer different degrees of training at varying prices. Another example is that wound infections can be measured against the structure of care as an exemplary care structure; having the right equipment and resources to treat the wound would help patients recover faster and have a better health care experience. Other conceptualizations and operationalizations of the variables are defined in the papers. From these conceptualizations and operationalizations, in addition to a review of the literature and subsequent empirical work, this research draws contributions to theory and practice.

Contribution

As stated in the introduction, many medical education experts have highlighted the need to examine the relationship between medical training and patient clinical outcomes. This dissertation aims to address this need and generate a better understanding of the effects of the location of postgraduate surgical training processes on post-surgical patients' outcomes. Furthermore, by addressing the research questions stated previously, health-policy recommendations will be formulated in respective papers to address two different paradigms, such as how to make important decisions regarding the allocation of resources:

- The professional paradigm assesses the current postgraduate national surgical training program and determines the quality of patient outcomes variation and elements that contribute to this variation.
- In the political paradigm, by addressing current policy needs regarding postgraduate health training governance in the Kingdom of Saudi Arabia and formulating future recommendations in the form of a performance improvement framework.

In addition, to enhance the understanding of the training vs. patient outcome relationship, Saudi Arabia could offer insight into how the training infrastructure process and delivery in two different countries (Canada & Saudi Arabia) affect patient outcomes. Since Saudi Arabia depends heavily on foreign training for their qualified surgeons and other medical specialists while also depending on expatriates with different training backgrounds to participate in its healthcare system; it means that most of the country's participating physicians have acquired their skills in different countries with distinctive medical training infrastructures, rules, and regulations, and technologies. In other words, Saudi has become a melting pot for various training experiences that directly affect patient outcomes.

This dissertation will also help inform relevant decision-makers in Saudi Arabia and encourage them to move forward and create the policy reform required to improve the quality of medical training.

Furthermore, this dissertation will enable policymakers to consciously allocate financial resources that would help in ensuring that the current training will provide a high standard of training to all those who qualify. This, in turn, will ensure that patients are receiving the same standard of care and increase their chances for better health outcomes.

Given the fact that this dissertation focused on the Canadian postgraduate surgical training program that is provided through the Royal College of Surgeons Canada and the Saudi postgraduate surgical training program that is provided through the Saudi Commission for Health Specialties, insights from those participating in the workforce enhanced the richness of this dissertation by examining how foreign postgraduate surgical training program location can influence the patient outcome through the process of care delivery.

By examining the Canadian experience in postgraduate surgical training programs, recommendations for improving surgical practices in this area will be provided to bridge the knowledge between the two countries and develop a cross-check for essential elements that are culturally and socially acceptable to the Saudi Arabian healthcare system and health providers. The performance improvement model, "Excellence by Design[65]," is introduced in paper three of this dissertation and aims to create a systematic process to monitor the training process and measure their outcomes to minimize training variation outcomes between centers. The broader impact of this thesis on the current Saudi postgraduate health training system would be threefold two would be considered the direct impact, and the third would be an indirect result of systemized and quality training process:

1. It would focus on the main training processes to provide trainees with the highest quality training process unified throughout the Kingdom and provide equity of training opportunities throughout Saudi Arabia.
2. Having a performance improvement system that is flexible enough to start at any point of the training process would ensure that trainees would have comparable competencies based on their programs, impacting increased patient safety that could be easily measured and reported.
3. Improving the training system would have an indirect impact on improving the quality of life within Saudi Arabia as trainees would master roles such as scholars and leaders, which would allow them to invest more time in patient education proactively, and hopefully be encouraged to increase their participation in the community and research.

In addition, This thesis would positively impact patient safety as the quality of training program outcomes would improve. On a larger scale, Saudi Arabia would become a reference point in replicating this system anywhere within the Gulf countries.

A final additional direct contribution would be the possibility of replicating this study in different contexts with different specialties to evaluate the efficacy of various training programs, using the patient outcome as one of the key indicators that could influence the benefit-cost relationship.

[65] Introduction & explanation of this proposed framework in paper #3

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Paper #1: Saudi Arabia vs. Canada —
Is there a difference in the quality of patient surgical outcomes based on postgraduate surgical training location?

Abstract

Background

Residency training is crucial for building clinical, academic, and professional skills to practice safe and reliable medicine; however, examining the outcome of various training programs has received minimal attention from leading postgraduate medical education journals. Thus, linking the quality of training based on the location and type of surgical training they received with the quality of postoperative patient outcomes is nearly non-existent.

Objective

This paper attempts to determine if there is a difference in the quality of health outcomes of patients treated by Saudi Arabian surgeons trained in Canada and Saudi surgeons trained in Saudi Arabia.

Methods

A cross-sectional analysis of patients who underwent invasive surgical operations between January 2012 and December 2017 in three medical cities. The study included patients who underwent surgical operations selected and stratified by a surgeon residency board, either the Saudi Commission for Health Specialties, a.k.a. the Saudi board, or the Royal College of Physicians and Surgeons of Canada, a.k.a. the Canadian board. Three types of specialty surgeries —neurosurgeries, cardiac surgeries, and surgical oncology across three hospital centers of KFMC, KSMS, and KSUH, were selected. The samples selected were conveniently based on the availability of a comparable volume of surgeons certified by the Saudi and Canadian boards. The primary outcomes were a composite of surgical complications, death, readmission, and length of hospitalization. A multivariate regression analysis was employed to estimate

the association between surgeons' characteristics and the study outcomes[66]. A P-value of < 0.05 was considered significant.

Results

A total of 1069 patient medical records were included in the study, of whom 495 (46.3%) were cardiac patients, 405 (37.9%) were oncology patients, and 169 (15.8%) were neurosurgery patients. The mean age of the patients was 48.15±21.49. Males represented 601 (57.5%) of the participants. The linear regression, that when considering the Board certification and training process location as an independent variable and the length of hospital stay, morbidity grade, morbidity onset, duration of surgery, and postoperative complications, the Canadian-trained surgeons have demonstrated better patient outcomes based on their statistical lower P-values, in all the dependent variables mentioned above. However, the Canadian-board-trained surgeons showed different performance that pertains to longer duration of surgery and higher number of clinical visits in neurosurgery (shunt and shunt revision) and cardiac surgery (CABG) with a statistical P-value of .005, .000, and 0.00, respectively[67].

In the logistic regression tables[68], it also became evident that, when using the location of training and type of board as an independent variable and mortality, readmission to the operating room (O.R.) within 30 days and readmission to the General Ward (G.W.) within 30 days, surgery performed by Canadian-trained Saudi surgeons was associated with significantly lower mortality, readmission to O.R. and readmission to the G.W with P-values of .012, < .001 and .196, respectively.
Finally, hospital center characteristics observed variables' effects upon outcome measures. For all surgical specialties, the center of KSU-MC was associated with a significantly longer duration of surgery (B=65.4, p<0.001) and a more significant

[66] Surgeon board mainly an independent variable and patient outcomes based on the dependent variable listed in Table 5 within the introduction.
[67] Tables 7 & 8
[68] Tables 11 to 13.

number of clinical visits (B=11.7, p<0.001) but no significant associations with the length of stay (B=-0.076, p=0.405), morbidity grade (B=0.018, p=0.887), or morbidity onset (B=-0.065, p=0.482) were recognized. Similarly, the center of KSMC observed a significantly higher number of clinic visits (B=6.7, p<0.001) but there were no significant associations with surgery duration, length of stay, morbidity grade, or morbidity onset (all p>0.05). For neurosurgery, KSMC was associated with a significantly shorter duration of surgery (B=-36.6, p<0.001), a lower number of clinical visits (B=-3.9, p<0.001), and a shorter length of stay (B=-38.9, p<0.001) but no significant associations with morbidity grade or morbidity onset were observed. Despite some significant effects, logistic regression showed that the hospital center as a general confounder was not associated with any defined postoperative patient outcomes (p>0.05).

Conclusion

Having controlled for the confounding variables such as structure and process of healthcare delivery within the three chosen hospitals to the best of my ability with the available valid and reliable data. It could be concluded that Saudi-board-certified surgeons are more likely than Canadian-board-certified surgeons to attain adverse surgical outcomes based on the three selected specialties'. However, considering organizational effects such as the three governmental teaching hospitals included in this study showed that the board certification as an independent variable had no impact on patient outcomes. A prospective-matched cohort study is warranted to understand better and inform policymakers to make more rigorous evidence-based decisions.

Keywords: Surgeons, complication, Saudi Arabian, Saudi, Canadian, board, outcomes, quality of care, the structure of care, process of care, surgical care, postoperative complications.

Chapter 1. Introduction

1.1 Overview

Health-quality outcome research was the highlight of the 1990s. For the most part, the outcome was associated, according to Mitchell et al., 1998, with the five Ds: "Death, Disease, Disability, Discomfort and Dissatisfaction[69]". The shift to focus on patient outcomes was guided by Donabedian's (1966) work to evaluate and compare healthcare quality[70], which created a "framework for outcome research and outcome management[71]".

Prystowsky & Bordage (2001) added that the attention that outcome research gained in the 1990s is due to the high costs associated with the use of medical resources and the limited effectiveness of certain medical practices that contribute to the overall improvement of the health of populations. Therefore, researchers typically consider three general parameters: clinical outcome, patient satisfaction, and cost[72].

Donabedian (1966), in his paper, "Evaluating the Quality of Medical Care," assessed the medical-care process at the physician-patient interaction level. He stated that the use of outcomes as a measurement of quality had been limited due to many factors: Relevancy of outcome measurement is one of the limiting factors, as some outcomes are irrelevant to the context measured in — "measuring the wrong thing[73]". In addition, the confounding variables that are associated with measuring outcome are another limitation; controlling these confounding variables may, at times, become unattainable. Finally, according to Donabedian[74], medical technology is not fully effective, and the measures of success are not known.

[69] (Mitchell, Ferketich, & Jennings, 1998, p. 43)
[70] (Mitchell, Ferketich, & Jennings, 1998, p. 43)
[71] (Mitchell, Ferketich, & Jennings, 1998, p. 44)
[72] (Prystowsky & Bordage, 2001)
[73] (Donabedian, 1966, p. 69).
[74] (Donabedian, Evaluating the quality of medical care, 1966, p. 693)

Nonetheless, patient outcome measurements as a way to assess performance of surgeons based on specified indicators and outcomes measures, have proven their validity due to the advantages that they evoke, such as the validity of the outcome evidence that is seldom questioned, and the results are concrete and can provide a precise measurement[75]. Birkmeyer et al. (2004) stated that there are at least two additional advantages of direct-measure outcomes: "First, because most consider patient outcomes the 'bottom line' of surgical practice. Second, measurement alone may improve outcomes[76]". Further, there has been a strong shift over the past two decades toward quality improvement that has led to increased interest in determining the ideal methods of assessing the quality of surgery[77].

This paper will consider clinical outcomes of surgical care in three specialties: neurosurgery, cardiac surgery, and surgical oncology to capitalize on the strengths of outcome measurement. Neurosurgery provides both an elective and urgent service for patients sustaining a range of problems, such as traumatic brain injury, hydrocephalus, and spinal cord compression. At the same time, cardiac and oncological surgery also provides interventions for patients with both acute and chronic disease states. Within these three specialties, the following surgeries will be the main focus of this dissertation. In neurosurgery, data was collected for Pediatric patients undergoing shunt and shunt-revision interventions, which included ventriculoperitoneal, ventriculoarterial, and lumboperitoneal shunts; in cardiac surgery, all available data for coronary artery bypass graft (CABG) surgeries were collected, and finally, in surgical oncology, data was sought from patients who underwent excision of colonic and breast tumors. These specific surgeries were chosen due to the availability of valid and reliable information within patient medical record files that could be reviewed for both

[75] (Donabedian, 1966, p. 693)
[76] (Birkmeyer, Dimick, & Birkmeyer, 2004, p. 629)
[77] (Leake & Urbach, 2010, p. 332)

the Canadian- and Saudi-trained surgeons. In addition, Birkmeyer et al. (2004) stated, "the procedure itself may be the most effective approach to quality measurement[78]".

Before attempting to assess the quality of patient surgical outcomes, it is necessary to agree on what is meant by Quality of Outcome. According to Donabedian, "We must begin with the performance of the physicians … there are two elements in the performance of practitioners: one technical performance and the other is interpersonal[79]." Therefore, this paper will focus on the technical performance of the surgeons and their ability to achieve improvements in the overall health status of their patients, as the quality of outcome stems from the performance of the surgeons. This leads us to focus on the technical quality, which is "judged by the degree to which achievable improvements in health can be expected to be attained"[80].

The definitions of the terms, such as structure, care, outcome, quality, mortality rate, morbidity rate, readmission rate, and postoperative complications, are as follows:
The structure is defined as "the attributes of the setting in which care occurs." This includes the attributes of material resources such as (facilities, equipment, and money, of human resources, such as the number and qualifications of personnel), and of organizational structure "such as medical staff organization, methods of peer review.[81]"

Surgical care is "any measure that reduces the rates of physical disability or premature death associated with a surgical condition.[82]"

The outcome, in this context, is regarded as a "consequence of care, rather than a component of it.[83]" This can be measured using specific indicators, including

[78] (Birkmeyer, Dimick, & Birkmeyer, 2004, p. 630)
[79] (Donabedian, 1988, p. 1743)
[80] (Donabedian, 1988, p. 1745)
[81] (Donabedian, 1988, p. 1745)
[82] (Bickler et al., 2009, p. 374)
[83] (Campbell, Roland, & Buetow, 2001, p. 1612)

readmission rates and postoperative complications, during the first year after the surgery within a particular subspecialty.

Quality is defined by the Institute of Medicine "as the degree to which health services for individuals and populations increase the likelihood of the desired outcome and are consistent with current professional knowledge.[84]"

Postoperative Complications are defined as "any undesirable, unintended and direct result of an operation affecting the patient, which would not have occurred had the operation gone as well as could reasonably be hoped.[85]"

Mortality Rate is defined as the number of patient deaths within 30 days of a completed surgical procedure.

Morbidity Rate is defined as the number of relative reoccurrences of a specific disease within 30 days of surgery.

Readmission rate is defined as the number of readmissions for the same illness within 30 days of discharge from the hospital after the surgical procedure. "Readmissions cause a high burden to healthcare systems and patients.[86]"

1.2 Surgical Training

1.2.1 Saudi Arabian Context

To understand the quality of postgraduate surgical training and its ultimate effect on the quality of healthcare provided to patients and its influence on the outcome of their postoperative conditions, it is essential to shed some light on the training process that residents undergo to achieve their Saudi board certificates.

The first medical school in Saudi Arabia was established in 1969. "It accepted 35 students in its charter class …. Undergraduate medical education is a 6-year course and 2½ years of clinical rotations, a 12-month rotating internship is required before starting postgraduate training.[87]"

[84] (Campbell et al., 2001, p. 1614).
[85] (Sokol & Wilson, 2008, p. 943).
[86] (Fischer et al., 2014, p. 1)
[87] (AlAwami, 2000, p. 355)

Postgraduate surgical training in Saudi Arabia consists of residents, trainers, and the trainer of trainers, with a well-defined objective-structured multidisciplinary curriculum "that addresses the general and specific objectives of disease as well as contents, instructional techniques, and the teaching and training methods and plans. The training program's scientific, academic and training activities consist of daily morning meetings that discuss emergency admissions, as well as interdepartmental consultations, including ICU and inpatient.[88]" In addition, an academic half-day is mandatory for all training programs; this includes lectures given to residents or prepared by residents. If an interesting subject arises, then the topic is discussed either in journal clubs or educational meetings, where topics are critically analyzed to prepare residents to write their papers in the future.

Their residency journey starts in general surgery. However, depending on their specialization, they spend 3-7 years completing their training requirements and preparing for the Saudi Commission exam. The exam consists of two parts. The first part is called an OSCE, an objective structured clinical examination. The second part is a written exam that consists of multiple-choice questions, as well as short answers. Once the resident passes the exam, they are considered a Saudi-board-certified consultant and can practice, according to the privileges that they are given.

In Saudi Arabia, the Saudi commission has over 1000 accredited centers to deliver the various postgraduate health training programs. These centers vary from teaching tertiary hospitals to secondary hospitals to primary hospitals. The three chosen hospitals for this thesis are all tertiary teaching hospitals that report directly to the ministry of health with similar budgets and bed counts[89]. These three hospitals were chosen because the surgeons can freely complete a locum in any one of them at a

[88] (Hamour, AlShareef, & Abdalla, 2016, p. 2)
[89] King Khalid university hospital has 1200 beds, and King Saud Medical City has 1500 beds, and King Fahad Medical City has 1200 beds.

certain point in time, which supports the assumption that the overhead, qualifications, and support staff and equipment are identical.

1.2.2 Canadian Context

The Canadian system is identical to the Saudi process; in fact, Saudi Arabia has adopted the Canadian training system, which has been proven, for many years, that its ability to train foreign residents results in them graduating with the highest qualifications. When a Saudi resident decides to train in Canada, he/she would have to take the Medical Council of Canada Evaluating Exam (MCCEE), which qualifies them to train in Canada. Once the resident passes this exam, he/she would have to attend a formal interview with the selected program director. The program director would then give the final approval on the adequacy of the resident to join the team. Once the resident completes his/her 2-6 years of residency, depending on their specialization, they are required to sit for the Royal College's board exam; this exam consists of the same two parts as in the Saudi board exam. Once the resident successfully passes the exam, he/she then becomes a Canadian-board-certified surgeon. See Table 1, below, which compares the postgraduate medical training available in the United States, Canada and Saudi Arabia.

Table 1: Overview of Medical Specialist Training and Terminology[1]

	United States	Canada	Saudi Arabia
Pre-Specialist Training Phase	4 years (entry after bachelor)	4 years (entry after bachelor, except for Quebec[1])	7 years (entry after bachelor}
Initial Training Phase	Intern or transitional year doctor (1 year optional)	Resident PGY1 (1 year required)	Resident PGY1
Specialist Training Phase	Resident	Resident (PGT2 and up)	Resident
Typical Length of Training	3-7 years	2-6 years	3-7
Position after certification	Attending physician, faculty	Attending physician, faculty	Associate consultant for 3 years, then full consultant

1.3 Research Plan

Residency training is crucial for building clinical, academic, and professional skills to practice safe and reliable medicine; however, examining the outcome of various training programs has received minimal attention from leading postgraduate medical education journals. Furthermore, linking the location of surgical training with the quality of postoperative patient outcomes is nearly non-existent. I emphasize nearly, as most of the literature reviewed, links the training location in a specific setting, such as medical universities, to the quality of student skills they have when they graduate.

However, some studies have explored the variance in surgical outcomes among patients who received surgery within teaching hospitals versus non-teaching hospitals, providing insight into the factors influencing geographical or regional variances in outcomes. For example, Vinden et al. (2016) conducted a retrospective evaluation of patients who underwent various forms of surgery over ten years between 2002 and 2012 to explore the variances in operation duration between teaching and non-teaching hospitals in Canada. A total of 713,573 surgical cases were eligible for analysis, and the results revealed that operation time was significantly longer in teaching hospitals by 22% than in non-teaching hospitals ($p<0.001$). While no patient outcomes were directly explored in the study, prolonged operating times can have implications for postoperative morbidity. However, cases managed in teaching hospitals tended to be greater in acuity and complexity. However, the study was unable to account for various patient and surgeon confounders. Thus, inferences about surgical training between the hospital types could not be assumed to impact operating time.

Other studies have revealed variances in both surgical performance and patient outcomes related to resident training despite the former methodological issues. Still, few have explored outcome differences across teaching and non-teaching hospital settings[90]. McGee et al. (2020) explored the differences in surgical duration between teaching and non-teaching hospitals in a recent population-based cohort of resident surgeons working with obstetric and gynecological surgery. The total cohort comprised more than 330,000 procedures, with 30% being conducted in teaching hospitals and the remaining majority in the community. The results showed that the surgical time was significantly longer in teaching hospitals than in non-teaching hospitals, which varied between 6-20% depending upon the procedure performed. Although teaching residents were linked to increased operative times in teaching hospitals and was associated with an additional $16 million in costs, training residents cannot be undermined as they represent future surgeons and consultants. Similar observations have been observed in other studies, but the impact of residents operating in teaching hospitals upon patient outcomes cannot be reliably compared to those operating in non-teaching hospitals, given the range of confounders that persist[91]. The confounding effect of older age patients and multiple comorbidities upon surgical performance between teaching and non-teaching hospitals has been reflected in few studies. One study based on over 212,000 cervical spine procedures showed that operative complications and in-hospital mortality were significantly greater in teaching hospitals than non-teaching hospitals, but this was attributed to significant predictors of operative complexity and patient's morbid status ($p<0.05$) and not the teaching status of operating surgeons ($p>0.05$)[92]. Another study showed that patients receiving general emergency surgery in teaching hospitals observed slightly higher mortality but lower rate of complications and length of stay than those treated in non-teaching hospitals, but the differences were not statistically significant (all $p>0.05$)[93]. Thus, while some studies have sought to ascertain variances in inpatient and service outcomes related to surgical resident training and

[90] (Pollei et al., 2013, Kiran et al., 2012, Babineau et al., 2004).
[91] (Welk et al., 2016, Khuri et al., 2001)
[92] (Fineberg et al., 2013)
[93] (Zafar et al., 2015)

operative setting, there is a complete scarcity of such research specific to surgeons trained under the Saudi program.

To overcome the dilemma of linking the location of training in two different countries with extremely similar training processes, it was imperative to specify the specialties examined with well-defined inclusion and exclusion criteria.

This will simplify the process of answering the **main research question**:

"What is the difference in the quality of health outcomes of patients treated by Saudi surgeons who were trained in Canada versus Saudi surgeons who were trained in Saudi Arabia?"

1.4 Objectives

To investigate the relationship between the effect of the board certification that was obtained through a predefined training process in two different locations (independent variable) and the quality of surgical care, in terms of postoperative complications (dependent variable[94]), such as these nine common outcomes: postoperative length of stay, postoperative morbidity, readmission rates within 30 days, unplanned readmission to the O.R. within 30 days, the volume of surgeries per physician, years of experience and origin of the board, as well as clinical visits. The link between postoperative complications and the quality of care may not be direct. Researchers have used postoperative complications, such as vitals' status at 30 days and length of stay[95], to examine the association between postoperative complications and quality of care.

In this paper, clinical outcomes of surgical care in three specialties were considered: neurosurgery, cardiac surgery, and surgical oncology. Within these three specialties, the following surgeries will be the focus of this dissertation: In neurosurgery, data was collected for shunt and shunt-revision cases; in cardiac surgery,

[94] A general list of independent and dependent common variables is presented in **Table 5**, on page 32
[95] (Henderson & Daly, 2009, p. 21)

all available data were collected for coronary artery bypass graft (CABG) surgeries; and finally, in surgical oncology, we will be looking at colon and breast cancer cases. These specific surgeries have been chosen due to the relatively higher availability of reliable medical record files, which could be reviewed for Canadian and Saudi-trained surgeons. The literature has highlighted some of the factors influencing outcomes for the former types of surgery, which are pertinent to note as they may require consideration and accounting for this study. For any form of surgery requiring general anesthesia, patients' clinical status, such as age, comorbid conditions, and cardiorespiratory fitness, is a significant predictor of outcomes[96]. Specifically, for neurosurgical shunt surgery, evidence has shown that the cause of raised intracranial pressure, as well as age, a reduced conscious level at presentation, prior excision of a brain tumor, and the need to place extra-ventricular drains, are associated with postoperative complications and morbidity[97]. For coronary artery bypass grafting, age >60 years, obesity, prior myocardial infarction, pre-existing severe impairment to left ventricular ejection fraction, and a history of primary coronary intervention have been linked to poor outcomes in the postoperative period. At the same time, older age and a poor pre-operative comorbid status have also been associated with adverse outcomes following oncological surgery[98].

1.5 Hypothesis

Surgeons trained in Canada have fewer adverse postoperative events than those who have been trained in Saudi Arabia. The primary impact of surgical-training programs on patient outcomes would be the result of: The location of the training system they had received; in this case, the training in Saudi Arabia was through the Saudi commission, and the training in Canada was through The Royal College of Physicians

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[96] (Doglietto et al., 2020)
[97] (Khan et al., 2015, Reddy et al., 2014)
[98] (Nicolini et al., 2017, Nalysnyk et al., 2003, Martin et al., 2006, Tevis and Kennedy, 2016)

and Surgeons; the amount of experience the surgeons had gained after they have been certified by the board; and the volume of operations they had conducted upon completion of their postgraduate surgical-training program.

Chapter 2. Methods

2.1 Overview and Design

This research is primarily a quantitative study using bivariate and multivariate analysis. These two techniques will allow me to examine the relationships between the variables chosen and control the association among variables using the multiple regression techniques. For example, the bivariate analysis will directly link the type of board certification obtained in a specific location to patient outcomes indicated in the data collection form (See Appendix 2). The multivariate will consider other factors, such as volume of cases done by surgeons, the multicenter included in this research, comorbidities, etc.

In this paper, four quality indicators are used: postoperative complications within 30 days, readmission to the O.R. within 30 days, readmission to the general ward within 30 days, and mortality rates. Readmission rates are related to substandard medical care and, therefore, are "widely used as an indicator of the quality of hospital care in surgical patients.[99]" Postoperative complications are considered the most commonly used indicator when linking patient outcomes to the competency of the surgeons.

Readmission rates and postoperative complications are typically a result of numerous variables, including the surgeon's background (location of training and years of experience), the patient's age, gender, diagnosis, or prior health condition[100], and health center characteristics, such as geographic setting, patient capacity, health

[99] (Ashton & Wray, 1996, p. 1533)
[100] (Ashton & Wray, 1996, p. 1533)

professional staffing levels, access to resources and culture[101]. To constrain these variables, the two groups of patients (Canadian-trained surgeons treated one group, and Saudi Arabian-trained surgeons treated the other group.) will share similar variables, such as the same hospital, diagnosis, and completeness medical records. It became evident that there was a shortage of files and medical records for all the patients who underwent the specified surgeries with Canadian-trained surgeons and Saudi-trained surgeons. Therefore, only the available patient files and records were included in this study.

The sampling selection criteria considered Donabedian's three objects that were described as being favorable upon study quality as follows: 1) the actual care provider by a specified category of providers, 2) the actual care received by a specified group of people, and 3) the capacity of a specified group of providers to provide care[102]. Therefore, this paper had to manage the three objects by being very specific, where the case study criteria were concerned: Specifically, the healthcare institution[103] and the board certification of the surgeons that are considered in this study.
Another criterion was the actual care received by identifying the type of surgery examined; and lastly, containing the capacity of a specified group to provide care, including all patients in the five years of 2012-2017.

The data on readmission and postoperative complications rates are collected from patients' hospital charts in three hospitals. All charts are reviewed for surgeries in the past five years as it was considered essential to include patients who had recently undergone surgery and, thus, those treated by residents exposed to the most current version of the Saudi training program. The number of charts reviewed is 1069; Table

[101] (Donabedian, 1966)
[102] (Donabedian, 1966, p. 699)
[103] All three healthcare institutions are CBAHI accredited, and JCIA accredited. This controls for confounding variables, such as staff and medical qualifications, medical and surgical practice protocols, guidelines, and bylaws, as well as overhead requirements to conduct the three specified institutions. A letter from CBAHI is Appendix 6.

3[104] shows the distribution of the reviewed files in each subspecialty chosen, plus the demographic characteristics of patients who had operations. All study participants will be required to work in one of the three-tier not-for-profit teaching healthcare organizations (e.g., King Khalid University Hospital, a King Saud Medical Complex, or King Fahd Medical City). Surgeons who have not completed their residency training will be excluded from this analysis.

A cross-sectional study was conducted on patients who received invasive surgical operations between January 2012 and December 2017 in three medical cities (e.g., King Fahad Medical City, King Saud Medical City, and King Khaled University Hospital) in central Riyadh, Saudi Arabia. The medical cities were considered as one model of the Saudi healthcare system due to the similarities and distribution of study samples between these medical cities. The involved medical cities are major governmental medical cities that serve the public, and they are accredited by the Joint Commission International and follow the same applicable quality standards of practice. The three cities were considered to match the surgical specialties included in the study.

Although we have controlled for all confounding variables in this paper, there remains the likelihood that these findings may be influenced by residual confounding variables such as operative time of day and day of the week and patients' cardiorespiratory fitness. Therefore, we have compared the hospitals to eliminate the variation between hospitals' characteristics and key performance indicators (KPIs) as confounding variables. For each KPI, we have considered it arbitrary that a (±) difference of (≤5%) between the hospital's KPI and the average of that KPI for the three hospitals would be considered "no significant impressing variation." For other hospital center factors that could have influenced the pertinent outcomes of

[104] (on page 66 of this paper)

postoperative complications, readmission to the O.R., readmission to the G.W., and mortality, each institution was integrated as a confounding variable within the general linear and logistic regression models.

Table 2 below illustrates the hospitals' KPIs outcome measurements[105]. Besides, it displays the average of the KPIs for the three hospitals, the value of 5%, the range of [KPI±5%], and the decision of whether it falls within the range. Remarkably, all the KPIs across the three hospitals were within the range of [an average of KPI±5%], which indicates the KPIs are similar, with no significant impressing variation between them. Thus, we can assume that hospitals' characteristics and quality performance culture will not confound the study outcomes with this approach. As for the hospital characteristics, King Khalid university hospital is the only hospital out of the three chosen institutions that is a university-based teaching training center.
On the other hand, King Fahad Medical City and King Saudi medical city are considered service-based training centers. The apparent difference between university-based training centers is their structural approach to training; they ensure that they have secured time for teaching and teaching half days as part of the trainees' curriculum is strictly adhered to. Ayanian and Weissman (2002) stated, "teaching hospitals are widely reputed to provide a high quality of care. Other distinctive missions of teaching hospitals include medical education and training, innovation in clinical care[106]." further, Ayanian et al.1998[107] indicated that teaching hospitals have an overall better quality of care than in non-teaching hospitals when considering process measures. Keeler et al. 1992[108] showed that major teaching hospitals had a lower 30-day mortality rate than non-teaching hospitals. Tomos, Orav, and Brennan 2000[109], also indicated that teaching

[105] These KPIs were selected based on the availability of valid, reliable data. All three hospitals had these KPIs in common and reported on them regularly.
[106](Ayanian & Weissman, 2002, p. 569)
[107] (Ayanian J. Z., Weissman, Chasan-Taber, & Epstein, 1998)
[108] (Keeler et al., 1992)
[109] (Thomas, Orav, & Brennan, 2000)

hospitals have lower rates of preventable adverse drug events than non-teaching hospitals.

The few articles cited above show a difference in the quality of care between teaching and non-teaching hospitals. Therefore, there is a difference in the type of quality of training provided in teaching hospitals vs. service or non-teaching hospitals. This could explain the variation of patient outcomes within this paper between Saudi residents who have completed their training in Canada. The Canadian hospitals are all; university-based teaching hospitals, while in Saudi Arabia, it is a mix between teaching and non-teaching hospitals. In this paper, aspects such as accreditation, adherence to surgical safety checklist, and specific hospital outcomes were considered in the first part of the analysis; we will assume that there is no difference between teaching and non-teaching hospitals. However, later on, as shown, the organizational effect plays a major role in diluting the impact of the training center. The following paragraphs briefly address aspects of accreditation, surgical checklist, and hospitals outcomes.

It was mentioned in the introductory paper of this thesis that accreditation plays a significant role in "improving the process of care provided by healthcare services. There is considerable evidence to show that accreditation programs improve the clinical outcomes of a wide spectrum of clinical conditions.[110]"

In addition to the KPIs mentioned above, the three chosen healthcare organizations strictly follow the WHO surgical safety checklist[111] that they regularly report to the health ministry. This checklist "was associated with a reduction in the rates of deaths and complications among patients[112]".

Although I have attempted to control for most of the factors within the three organizations by choosing three accredited teaching hospitals, Tertiary MOH funded

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[110] (Alkhenizan & Shaw, 2011)
[111] A checklist designed by the WHO to reduce perioperative morbidity and mortality.
[112] (Hayne et al., 2009)

and collecting specific organizational KPIs that were common and shared between the three organizations; it was also necessary to control for the center as a general confounder to help account for variances in culture and other characteristics (Tables 31-34).

Figure 1: WHO surgical safety checklist used by the three organizations

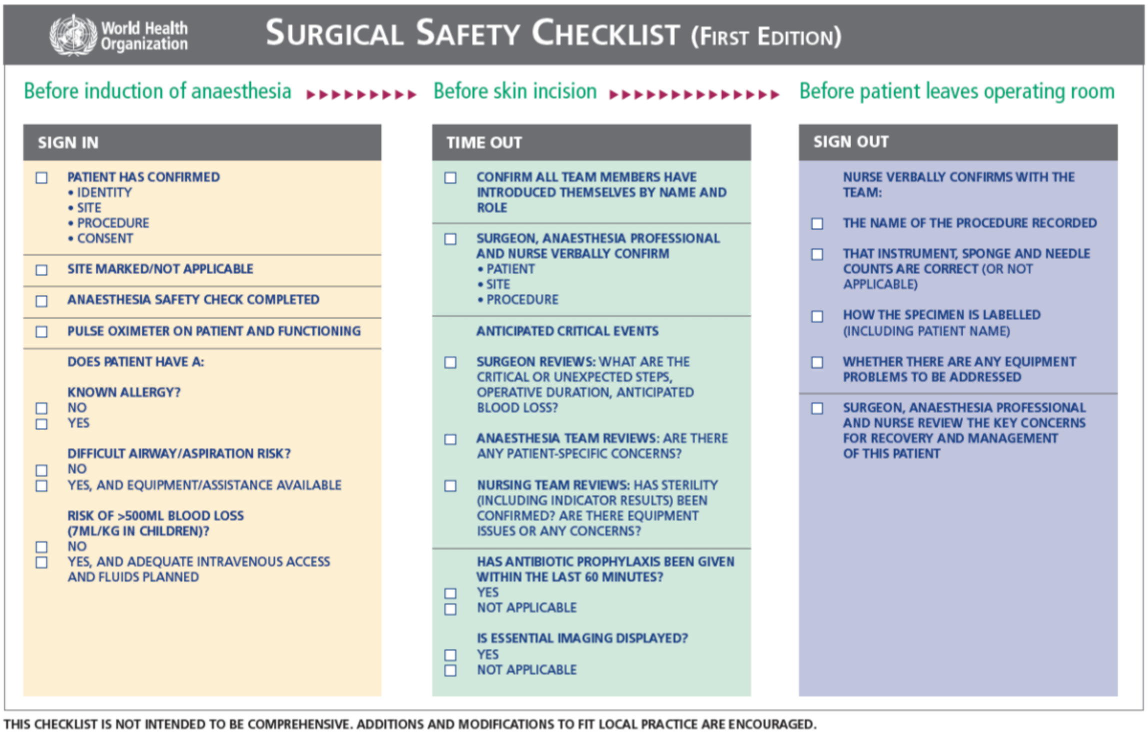

Table2: Hospital Selected KPIs outcomes comparisons

	KFMC	KSMC	KSUH	Average of KPI	Value of 5%	Range of [Average of KPI±5%]	Fall within range
- **Type of institution**	Governmental	Governmental	Governmental	-	-	-	-
- **Level of care**	Tertiary	Tertiary	Tertiary	-	-	-	-
- **Cost of care**	Free	Free	Free	-	-	-	-
- **Accreditation entities**	JCIA, CBAHI*	JCIA, CBAHI*	JCIA, CBAHI*	-	-	-	-
- **KPIs**							
- Mortality rate	3%	3.2%	2.98%	3.06 %	0.153	[2.91-3.21]	Yes
- OR Utilization	73%	74.2%	78.6%	75.26%	3.760	[71.50-79.02]	Yes
- Average of Near misses	18.1	16.75	16.90	17.25	0.863	[16.39-18.11]	Yes
- Readmission (surgical)	6.1%	6.5%	6.2%	6.27%	0.313	[5.96-6.58]	Yes

- Medication Errors (per 1000 dispensed doses)	0.017	0.018	0.017	0.017	0.009	[0.016-0.018]	Yes
- CLABSI rate	3.17%	3.30%	3.25%	3.24%	0.162	[3.08-3.40]	Yes
- Fall (per 1000 patients care day)	0.37	0.35	0.36	0.36	0.018	[0.34-0.37]	Yes

2.2 Subjects and Sampling

The study included patients who underwent surgical operations selected and stratified by each surgeon-residency board, the Saudi Arabian board or the Canadian board. Three types of surgery specialties were selected: neurosurgeries, cardiac surgeries and surgical oncology. We included ventriculoperitoneal (VP) shunts[113] insertion and revision from neurosurgery specialty, coronary artery bypass grafting (CABG) from cardiac surgery, and mastectomy and colectomy from surgical oncology specialty. The sample that was selected was based on the availability of a comparable volume of surgeons certified by the Saudi and Canadian boards.

Below, Table 3 describes the distribution of samples based on the availability of retrieving valid data from the medical cities:

Table 3: Distribution of Samples, based on the Availability of Retrieving Valid Data from the Medical Cities

King Fahad Medical City	Saudi Board	Surgical oncology patients
	Canadian Board	Cardiac surgery patients
	Canadian Board	Neurosurgery patients
King Khaled University Hospital	Canadian Board	Surgical oncology patients
	Saudi Board	Cardiac surgery patients
King Saud Medical City	Saudi Board	Neurosurgery patients

[113] It is worth mentioning that VP-shunt and shunt revision were chosen, although their sample size was small, mainly due to the clarity and validity of file documentation.

2.3 Data Measures

Data Sources: Patients' data were collected from their respected medical records. Data from King Fahad Medical City and King Khaled University Hospital were retrieved from electronic medical records, and data from King Saud Medical City came from hard medical records. Physicians' characteristics were obtained from the healthcare credentialing committees from the respective study sites.

Data Collection Tool: The data collection tool consists of three parts. Part One includes patients' demographics and clinical characteristics (age, gender, medical and surgical history). Part Two includes the physicians' demographics (age, specialty, gender, years of experience after board certification, surgery volume, and source of board). Part Three includes main study outcomes (type of surgery [urgent versus elective]), type of surgery, morbidities [hemorrhage, uncontrolled pain, deep venous thrombosis, damage to adjacent structure, infection and organ-specific complications], morbidity onset [intraoperative versus postoperative], morbidity grade [grades 1-5][114], readmission within 30 days [operation room versus general ward], death, length of hospitalization, duration of surgery, number of follow-up clinics visited after discharge, and mortality and morbidity rates). These outcomes best describe the overall burden of short-term postoperative complications. The definition of surgical complications that has previously been used and represents major morbidity is included in this study.

2.4 Data analysis

Multivariate analysis, according to Rencher (2002), "consists of a collection of methods that can be used when several measurements are made on each individual or object in one or more sample"[115]. One of its main strengths is its ability to analyze large sets of data with many variables compared to a specific sample[116]. Arppe (2008), in his

[114] Morbidity grades are explained in Appendix 4.
[115] (Rencher, 2002, p. 1)
[116] (Pripp, 2013, p. 63)

dissertation, stated that the purpose of a multivariate analysis "is to study the joint and simultaneous relationship of all the selected variables with respect to the studied phenomena"[117]. In this study, we had three healthcare facilities, with a variable number of patient records reviewed and data required, abstracted. It was evident that a multivariate regression analysis would be the most suitable statistical tool to use to obtain the required information for the certifying board, years of experience after certification and, finally, the number of patients who had operations performed by each specific surgeon. The main strength of utilizing multivariate analysis is the ability to control for known confounders and to also ascertain how much of the variance each confounding, and predictor variable has upon defined outcomes[118].

Multivariate analysis, like other statistical tools, has its downfalls. It is a complex research tool that requires a large amount of data that needs to be statistically analyzed. Regarding the selection of cases, purposeful sampling may have caused bias, but the limit on the small number of files was a factor that affected some of the results, especially in surgeries, such as surgical oncology. Further, my own preconceived notions may influence discussion of the results but I adopted an objective and reflective position in order to overcome this potential issue. To overcome this researcher's bias, a professional medical-record analyst will verify the findings from patient records.

This paper uses both multiple linear regression and logistic regression to give a more comprehensive and objective analysis, as well as, determining the strength of the relationship between the dependent variable and the independent variable.

In the linear regression we wanted to answer a causal question and to explain the association between location of training and all the dependent variables such as Duration of Surgery, Number of Clinic Visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset. We have also used other independent variables to understand the causal

[117] (Arppe, 2008, p. 113)
[118] (Campbell et al., 2007)

relationship of years of experience, surgery volume, surgery type (urgent vs. elective surgery) with all the dependent variables above.

Complementing the linear regression with the logistic regression, gave this study a more robust analysis. In the logistic regression outcomes involving readmission rates within 30 days to OR and readmission rates to the general ward within 30 days, mortality rates, and complications do not meet the linear regression for an interval or ratio scale, therefore, the use of a logistic regression was warranted. Here, we wanted to predict the dependent variable using multiple independent variables and estimate through the odds-ration the likelihood or unlikelihood for the outcome to be present.

Statistical analysis was performed using SPSS version 24.0[119]. Descriptive analysis was used to describe patients' and physicians' characteristics, as well as to describe the study outcomes (mean, frequency, percentages and rates). Chi-square was used to compare categorical variables and independent T-tests. ANOVA was used to compare continuous variables where appropriate. A regression analysis was employed to estimate the association between surgeons' characteristics and the study outcomes.

2.5 Ethical Considerations

Prior to study conduct, institutional review board approvals were obtained from the study sites (King Fahad Medical City, King Saud Medical City and King Khaled University Hospital). Patients' and physicians' identities were kept confidential, anonymized and coded. No identifiers were used during data analysis. No contact has been made with any patient or physician. Study data-collection sheets were stored in a double-closed cabinet under the supervision of the primary investigator. Written informed consents were not sought from the patients nor the physicians, given that the data was anonymized, and institutional review boards approvals were under the exempt

[119] (IBM Corporation, Armonk, NY, US)

category. Further, Carleton University ethics clearance was obtained in addition to the mentioned above IRBs.

Chapter 3. Results

3.1 Descriptives

A total of 1069 patient medical records were included in the study. Out of 1069, 495 (46.3%) were adultcardiac patients, 405 (37%) were adult oncology patients, and 169 (15.8%) were **pediatric** neurosurgery patients . The mean age of study participants was 48.15±21.49. Males represented 57.5% of the participants. This is shown in Table 4, shown below.

Table 4: Patients' demographic characteristics (n = 1069)

	n (%)
Patients' Classification (Disease) Neurology Oncology Cardiology	 169 (15.8%) 405 (37%) 495 (46.3%)
Age of all Patients (Mean±SD) Age of Neurology patients Age of Oncology patients Age of Cardiology patients	48.15±21.49 9.2±16.85 59.27±9.57 49.38±14.58
Gender Male Female	 601 (57.5%) 445 (42.5%)

Figure 2: Proportion of patients in the cohort by surgery type

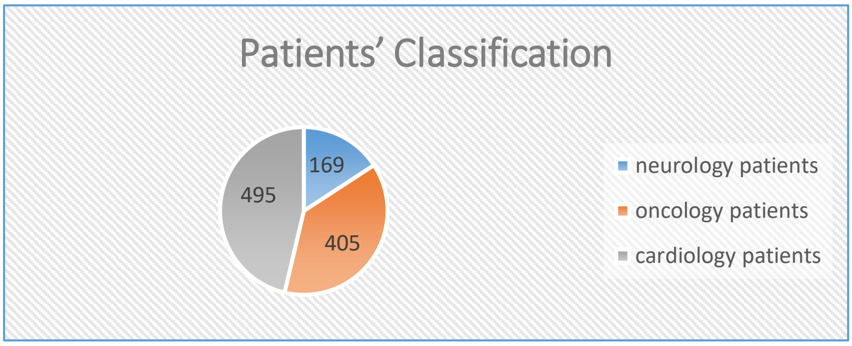

Figure 3: Proportion of patients in the cohort by gender.

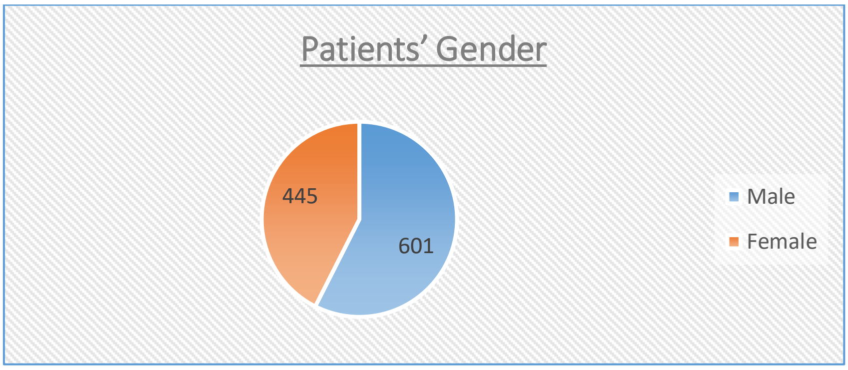

Table 5, below, shows the prevalence of comorbidities among the study participants for the total population considered. About 489 (46.4%) reported a history of cardiac disease, and nearly half of them were diabetic. The mean number of patients' comorbidities was 1.81±1.06, and the majority indicated the presence of two comorbidities, 433 (40.5%). Moreover, slightly more than two-thirds of the participants revealed negative surgical history, and 254 (23.8%) had a history of one surgery. Nevertheless, the mean number of patients' previous surgeries was 0.44±0.79[120].

Table 5: Patients' Medical and Surgical Histories

	n (%)
Cardiac Diseases Yes No	 489 (46.4%) 566 (53.6%)
Neurological Diseases Yes No	 169 (15.8%) 901 (84.6%)
Respiratory Diseases Yes No	 116 (10.9%) 952 (89.1%)
Diabetes Mellitus Yes No	 527 (49.5%) 537 (50.5%)

[120] (Showstack, et al., 1987)

Table 5: Patients' Medical and Surgical Histories	
Gastroenterological Diseases Yes No	 82 (7.7%) 987 (92.3%)
Renal Diseases Yes No	 44 (4.1%) 1022 (95.9%)
Cancer Yes No	 236 (22.1%) 832 (77.9%)
Other Disease Yes No	 277 (26.1%) 785 (73.9%)
Mean Number of Patients' Comorbidities (Mean ±SD)	1.81±1.06
Frequency of Patients' Comorbidities 0 1 2 3 4 5 6	 96 (9%) 320 (29.9%) 433 (40.5%) 148 (13.8%) 56 (5.2%) 14 (1.3%) 2 (0.2%)
Mean Number of Patients' Previous Surgeries (Mean ±SD)	0.44±0.79
Frequency of Patients' Previous Surgeries 0 1 2 3 4 5 6 7	 727 (68.3%) 254 (23.8%) 59 (5.5%) 14 (1.3%) 7 (0.7%) 2 (0.2%) 1 (0.1%) 1 (0.1%)

The majority of the surgeons were males, 878 (82.1%). About 377 (35.3%) were Saudi-board-certified, and 692 (64.7%) were Canadian-board-certified. The vast majority (955 (90.1%) of the performed surgeries were elective. Cardiac (CABG) surgeries represented the highest percentage of surgeries, 495 (46.3%). This is illustrated in Table 6, below.

Table 6: Physicians' Characteristics	
	n (%)
Gender	
Male	878 (82.1%)
Female	191 (17.9%)
Professional Board	
Saudi	377 (35.3%)
Canadian	692 (64.7%)
Type of Surgery	

Elective	955 (90.1%)
Urgent	105 (9.9%)
Surgeries Performed	
Neurosurgeries (VPS[121] Insertion and Removal)	169 (15.8%)
Oncology Surgeries (Hemicolectomy and Mastectomy)	405 (37.9%)
Cardiac Surgeries	405 (46.3%)

Table 7, below, shows the linear regression analyses of overall patients' outcomes (duration of surgery, number of clinic visits, length of hospitalization, morbidity grade, morbidity onset) for Saudi-board-certified surgeons versus Canadian-board-certified surgeons.

The Location of Training systems (Canada versus Saudi Arabia) made no significant difference in the duration of surgery; in other words, with a P-value of .510, which is higher than .05, this indicates that there is little evidence of a link between the location of board training and duration of surgery in minutes. However, when conducting a correlation between the location of training and the number of clinical visits, we would find, from the table below, that there is a direct relationship, with a significant P-value of .000, which is less than the .05. The Canadian-board-certified surgeons' patients visited clinics more often than the Saudi-board-certified surgeons' patients by 5.61. Also, of note, the location of training, statistically, had no significant effect when it concerns the length of hospitalization, morbidity grade and morbidity onset, with P-values of .000, .004 and .001, respectively.

Years of Experience: In the linear regression conducted below, we would find that the only statistically significant value occurred in the number of clinical visits with

[121] VPS: Ventriculoperitoneal shunt insertion; EVD: External ventricular drain; CABG: Coronary artery bypass

a P-value of .033, which indicates that there is a slight increase in clinical visits when associated with years of experience. Years of experience statistically had no significant effect on the variables, such as duration of surgery in minutes, length of hospitalization, morbidity grade and morbidity onset, with P-values of .866, .000, .915 and .923, respectively.

Surgery Volume: In the linear regression conducted below, we would find that there is an inverse relationship between surgery volume and the duration of surgery, as well as the number of clinical visits and length of hospitalization, with P-values of .000, .000 and .007, respectively, indicating that, as surgery volume increases, all the factors mentioned above decrease by B-coefficient Values of -2.60, -0.13 and -0.18, respectively. The beta coefficients represent the degree of change in the outcomes for every one-unit increase in surgery volume for all surgeries included in this study. In other words, for every one-unit increase in the surgical volume for all cases, the Canadian-trained Saudi surgeon would have a -2.60-minute decrease in time needed for operations; further, the Canadian-trained Saudi surgeon would have -0.13 less clinical visits than the Saudi-trained surgeons, and, finally, they would have -0.18 less in length of hospitalization stay (days). These results are consistent with the studies that say there is a relationship between surgery volume and patient outcomes, indicating that, with increased volume, patient outcomes tend to improve. Surgery volume had no statistical significance on morbidity grade and morbidly onset, as their P-values were .915 and .923, respectively.

Surgery Classification, According to Urgency (Elective versus Urgent): In the linear regression, which can be seen in Table 7, below, we find that the urgent surgeries were associated with the increased length of hospitalization with a B-coefficient Value of 8.78 and a P-value of .026. The type of surgery[122] had no statistical significance on

[122] In this case, we are talking only about urgent surgeries

the duration of surgery, number of clinical visits, morbidity grade and morbidity onset, with P-values of .800, .213, 0.37 and 0.28, respectively[123]

[123] Cardiac surgery, neurosurgery and surgical oncology will be discussed in detail in the tables that follow in the next several pages.

3.2 Regression Analyses (Not counting the organization as a confounding variable)

3.2.1 Saudi versus Canadian-Trained Resident Surgery across all Specialties

Table 7: Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic Visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons.[124]

	Duration of Surgery (min.)		Number of Clinic Visits		Length of Hospitalization (days)		Morbidity Grade		Morbidity Onset	
	B	P-Value	B	P-Value	B	P-Value	B	P-Value	B	P-Value
(Constant)	499.96	.000	3.58	.009	2.64	.696	0.45	.015	0.45	.001
Board	15.85	.510	5.61	.000	-17.70	.000	-0.25	.004	-0.22	.001
Years of Experience	0.28	.866	0.09	.033	1.26	.000	0.00	.915	0.00	.923
Surgery Volume	-2.60	.000	-0.13	.000	-0.18	.007	0.00	.228	0.00	.020
Neurosurgery	-386.23	.000	-2.25	.089	43.23	.000	0.30	.094	0.20	.130
Cardiac Surgery	-183.93	.000	6.79	.000	-1.74	.635	0.23	.026	0.15	.047

124 ** Significant P-Value
Duration of Surgery (min.) = 499.96 + 15.85 (Board) + 0.28 (Years of experience) -2.60 (Surgery Volume) - 386.23 (Neurosurgery) -183.93 (Cardiac surgery) +7.63 (Surgery) -3.42 (Gender of the patient) -0.84 (Age of the patient) -6.03 (Number of Comorbidities) +0.01 (Number of previous surgeries) + 147.57 (Gender of the Doctor)

Number of Clinic Visits = 3.58 + 5.61 (Board) + 0.09 (Years of experience) - 0.13 (Surgery Volume) - 2.25 (Neurosurgery) - 6.79 (Cardiac surgery) -1.00 (Surgery) + 0.60 (Gender of the patient) -0.02 (Age of the patient) + 0.25 (Number of Comorbidities) -1.23 (Number of previous surgeries) + 5.71 (Gender of the Doctor)

Length of hospitalization (days) = 2.64 -17.70 (Board) + 1.26 (Years of experience) - 0.18 (Surgery Volume + 43.23 (Neurosurgery) -1.74 (Cardiac surgery) + 8.78 (Surgery) -5.81 (Gender of the patient) + 0.17 (Age of the patient) -2.29 (Number of Comorbidities) +6.39 (Number of previous surgeries) + 9.51 (Gender of the Doctor)

Morbidity Grade = 0.45 - 0.25 (Board) + 0.30 (Neurosurgery) + 0.23 (Cardiac surgery) + 0.37 (Surgery) - 0.09 (Gender of the patient) - 0.01 (Age of the patient) + 0.15 (Number of Comorbidities) +0.01 (Number of previous surgeries)+ 147.57 (Gender of the Doctor)

Morbidity Onset = 0.45 - 0.22 (Board) + 0.20 (Neurosurgery) + 0.15 (Cardiac surgery) + 0.28 (Surgery) - 0.08 (Gender of the patient) +0.08 (Number of Comorbidities) + 0.01 (Number of previous surgeries) - 0.07 (Gender of the Doctor)

(For Categorical variable: Board: 0 = Saudi, 1 = Canadian. Neurosurgery: 0 = Other, 1 = Neurosurgery. Cardiac surgery: 0 = Other, 1 = Cardiac surgery / Surgery: 0 = Elective, 1 = Urgent. Gender: 0 = Male, 1 = Female.)

Oncological Surgery	7.63	.800	-1.00	.213	8.78	.027	0.37	.001	0.28	.000
Gender (Patient)	-3.42	.884	0.60	.319	-5.81	.055	-0.09	.294	-0.08	.196
Age of Patient (yrs.)	-0.84	.248	0.02	.248	0.17	.073	-0.01	.027	0.00	.116
Number of Comorbidities	-6.03	.512	0.25	.300	-2.29	.050	0.15	.000	0.08	.001
Number of Previous Surgeries	0.01	.999	-1.23	.001	6.39	.000	0.01	.863	0.01	.712
Gender (Physician)	14.75	.001	5.71	.000	9.51	.078	-0.17	.263	-0.07	.557
F	16.82		31.96		24.82		9.11		8.24	
P-Value	<0.001		<0.001		<0.001		<0.001		<0.001	
R2	0.18		0.29		0.27		0.10		0.09	

3.2.2 Saudi versus Canadian-Trained Resident Surgery in Neurosurgery

Below, Table 8 shows the linear-regression analyses of patients' outcomes (duration of surgery, number of clinic visits, length of hospital stay, morbidity grade and morbidity onset) for Saudi-board-certified surgeons versus Canadian-board-certified surgeons (neurosurgery).

Table 8: Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons (Neurosurgery)

	Duration of Surgery (Min.)		Number of Clinic Visits		Length of Hospitalization (Days)		Morbidity Grade		Morbidity Onset	
	B	P-Value	B	P-Value	B	P-Value	B	P-Value	B	P-Value
(Constant)	30.993	.062	1.363	.374	15.033	.560	.065	.897	.391	.247
Board	31.303	.005	4.022	.000	-53.336	.003	-.336	.321	-.227	.310
Years of Experience	1.669	.036	.078	.289	4.904	.000	.016	.525	.010	.529
Surgery Volume	.037	.966	.034	.663	1.353	.310	.042	.111	.012	.472
Surgery Type (Urgent)	-10.651	.249	-1.028	.229	23.602	.103	.350	.215	.252	.182
Gender (Patient)	-16.336	.058	-.325	.673	-20.716	.115	-.263	.305	-.117	.493
Age of the Patient (Yrs.)	.285	.252	-.017	.470	.265	.505	-.005	.508	-.005	.364
Number of Comorbidities	1.176	.751	-.487	.146	-6.891	.232	.207	.062	.083	.261
Number of Previous Surgeries	9.776	.002	-.234	.418	8.116	.097	-.024	.803	-.011	.856
Gender (Physician)	6.269	.794	.413	.856	-34.726	.368	.779	.303	.344	.493
F	4.449		3.750		4.491		1.138		.666	
P-Value	<0.001*		<0.001*		<0.001*		0.341		0.738	
R2	0.253		.204		0.236		.073		.043	

Board Certification (Canada versus Saudi Arabia): The table 8 above shows that the Canadian board is significantly associated with increased duration of surgery and increased number of clinical visits in neurosurgery (shunt and shunt revision) with a P-value of .005 and .000, respectively. However, the table also indicates that there is a significant reduction in length of hospital days, morbidity grade and morbidity onset. The significant association is clearly evident in their B-coefficient Values of -53.336, -.336 and -.227, respectively. As mentioned, in the results in Table 8, the beta coefficients represent the degree of change in the outcomes; the table indicates that the origin of the board, and, based on the number of neurosurgery cases, the Canadian-trained Saudi surgeons have 53.336 less patient-hospitalization days than the Saudi-trained surgeons. Further, they also have less morbidity grade[125] by -0.336 and less morbidity onset by -0.227.

Years of Experience: The table 8 above shows that there is moderate evidence that shows that years of experience increases the length of surgery with a P-value of .036; however, there is strong evidence that years of experience also increases the length of stay with a P-value of .000. The table shows that years of experience have no effect on the number of clinical visits, morbidity grade and morbidity onset, with P-values of .289, .525 and .529, respectively.

Surgery Volume: Also, Table 8, above, shows no evidence of association between the independent variable (surgery volume) and the dependent variables, such as duration of surgery in minutes, number of clinical visits, length of hospitalization in days, morbidity grade and morbidity onset, with P-values of .966, .663, .310, .111 and .472, respectively.

Surgery Classification, According to Urgency (Elective versus Urgent): Table 8, above, also shows no evidence of any association between the independent variable (surgery type) and the dependent variables, such as duration of surgery in minutes, number of clinical visits, length of

[125] Refers to postoperative complications, and there are five classifications, which are explained in Appendix 4

hospitalization in days, morbidity grade and morbidity onset, with P-values of .249, .229, .103, .215 and .182, respectively.

Table 9 (below): This table shows the linear regression analyses of patients' outcomes (duration of surgery, number of clinic visits, length of hospitalization, morbidity grade and morbidity onset) for Saudi-board-certified surgeons versus Canadian-board-certified surgeons (cardiac surgery).

Board Certification (Canada versus Saudi Arabia): Table 9, below, shows some statistical significance with an increased number of clinical visits for the Canadian-board-certified surgeons performing cardiac surgery (CABG), with a P-value of .000. However, the board-certification location had no statistical association to the rest of the dependent variables, such as duration of surgery in minutes, length of hospitalization in days, morbidity grade and morbidity onset, with P-values of .882, .203, .873 and .661, respectively.

Years of Experience: The table 9 below shows no evidence of association between the independent variable (years of experience) and the dependent variables, such as duration of surgery in minutes, number of clinical visits, length of hospitalization in days, morbidity grade and morbidity onset, with P-values of .609, .678, .065, .810 and .498, respectively.

Surgery Volume: Below, Table 9, shows a moderate statistical link between the surgery volume and the dependent variable of duration of surgery in minutes, with a P-value of .042, indicating that, with increased volume, the duration of surgery decreases by 3.987 minutes. However, surgery volume had no statistical association to the rest of the dependent variables, such as number of clinical visits, length of hospitalization in days, morbidity grade and morbidity onset, with P-values of .233, .920, .874 and .694, respectively.

Surgery Classification, According to Urgency (Elective versus Urgent): The below table shows a statistical significant association with morbidity grade and morbidity onset, with P-values of .000 and .000, respectively, which indicates that urgent surgeries have higher morbidity grades, as well as a higher morbidity onset. The table also indicates a moderately significant, statistical link between urgent surgeries (independent variable) and length of hospitalization in days, with a P-value of .048 and a B-coefficient value of 3.330, where the beta coefficient indicates that, when there is an increase of one surgery in cardiac surgeries (CABG) that are classified as urgent surgeries, there is an increase in length of stay by 3.330 days.

3.2.3 Saudi versus Canadian-Trained Resident Surgery in Cardiac Surgery

Table 9: Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic Visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons Versus Canadian-Board-Certified Surgeons (Cardiac Surgery)

	Duration of Surgery (Min.)		Number of Clinic Visits		Length of Hospitalization (Days)		Morbidity Grade		Morbidity Onset	
	B	P-Value	B	P-Value	B	P-Value	B	P-Value	B	P-Value
(Constant)	331.008	.057	1.114	.719	14.885	.000	.705	.019	.776	.001
Board	-21.925	.882	24.199	.000	2.583	.203	-.041	.873	-.086	.661
Years of Experience	7.098	.609	-.105	.678	-.361	.065	-.006	.810	-.013	.498
Surgery Volume	-3.987	.042	.041	.233	.003	.920	.001	.874	-.001	.694
Surgery (Urgent)	-18.800	.880	-.468	.837	3.330	.048	.958	.000	.714	.000
Gender (Patient)	-26.706	.718	.301	.815	-4.053	.000	-.338	.006	-.212	.025
Age of the Patient (Yrs.)	-1.641	.413	.015	.661	-.031	.245	-.005	.140	-.004	.173
Number of Comorbidities	1.396	.955	.694	.114	.532	.103	.108	.008	.028	.375
Number of Previous Surgeries	12.118	.832	-.031	.973	1.565	.025	.118	.177	.049	.466
Gender (Physician)	251.678	.059	-1.856	.425	-3.606	.044	-.202	.367	-.133	.439
F	168.5		33.050		10.089		8.333		6.929	
P-Value	0.093		<0.001*		<0.001*		<0.001*		<0.001*	
R2	0.055		.518		0.241		.207		.176	
* Significant P-Value										

Table 10 (below): Shows the linear regression analyses of patients' outcomes (duration of surgery, number of clinic visits, length of hospitalization, morbidity grade and morbidity onset) for Saudi-board-certified surgeons versus Canadian-board-certified surgeons (surgical oncology).

Board Certification (Canada versus Saudi Arabia): The table 10 below shows that the Canadian board is significantly associated with decreased duration of surgery in surgical oncology cases (colon and breast cancers), with a P-value of .001 and the Beta coefficient is -56.284. This means that, when a Canadian-trained Saudi surgeon performs one surgical oncology operation, there is a decrease in time required to complete the surgery, by 56.284 minutes, in comparison with the Saudi-trained surgeon. The table also indicates that there is a mild significance and reduction for both the Canadian-board- and Saudi-trained surgeons, with regards to morbidity grade and morbidity onset, with P-values of .043 and .043, respectively.

Years of Experience: By using years of experience as the independent variable in correlation with duration of surgery in minutes, the table 10 below shows mild significance, with a P-value of .023, in surgical oncology cases, indicating that, with increased years of experience, the duration of surgery decreases by a B-coefficient value of -1.563. Years of experience in surgical oncology had no impact on the other dependent variables, such as number of clinic visits, length of hospitalization stay in days, morbidity grade and morbidity onset, with P-values of .252, .079, .861 and .907, respectively.

Surgery Volume: The table 10 below shows no statistical evidence, using surgery volume, in surgical oncology cases, when gathered as an independent variable, had a correlation with the dependent variables, such as duration of surgery in minutes, number of clinical visits, length of hospitalization in days, morbidity grade and morbidity onset, with P-values of .061, .820, .192, .592 and .284, respectively.

Surgery Classification, According to Urgency (Elective versus Urgent): The table 10 below shows no statistical evidence using the surgery type (urgent cases only), in surgical oncology cases, when gathered as an independent variable had a correlation with the dependent variables, such as duration of surgery in minutes, number of clinical visits, length of hospitalization in days, morbidity grade and morbidity onset, with P-values of .317, .885, .516, .377 and .313, respectively.

3.2.4 Saudi versus Canadian-Trained Resident Surgery in Oncology

Table 10: Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic Visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons Versus Canadian-Board-Certified Surgeons (Surgical Oncology)

	Duration of Surgery (Min.)		Number of Clinic Visits		Length of Hospitalization (Days)		Morbidity Grade		Morbidity Onset	
	B	P-Value	B	P-Value	B	P-Value	B	P-Value	B	P-Value
(Constant)	418.809	.000	.070	.970	-.281	.960	.362	.223	.075	.749
Board	-56.284	.001	-.874	.361	-.060	.983	-.313	.043	-.247	.043
Years of Experience	-1.563	.023	.044	.252	.216	.079	-.001	.861	-.001	.907
Surgery Volume	.796	.061	.005	.820	-.100	.192	-.002	.592	-.003	.284
Surgery (Urgent)	15.134	.317	-.127	.885	1.720	.516	.125	.377	.113	.313
Gender (Patient)	5.409	.662	1.326	.063	2.791	.200	.241	.036	.077	.396
Age of the Patient (Yrs.)	-.669	.145	.045	.090	.210	.010	-.003	.440	.002	.549
Number of Comorbidities	-5.609	.299	.047	.877	.837	.378	.123	.014	.114	.004
Number of Previous Surgeries	-7.380	.619	-.284	.738	2.459	.321	.040	.770	.078	.473
F	6.093		1.499		1.993		3.547		3.682	
P-Value	<0.001*		0.155		0.046*		0.001*		<0.001*	
R2	0.317		.027		0.043		.060		.062	
* Significant P-Value										

Table 11 (below): Shows the logistic regression analyses of patients' outcomes (complications) for operations performed by Canadian-board-certified surgeons versus Saudi-board-certified surgeons.

Board Certification: Table 11 indicates that, when using complications as a dependent variable and the location of board certification as an independent variable (Canada versus Saudi Arabia), and using the Saudi board as a point of reference, in the combined data of the surgeries that were collected, the Canadian-board-certified Saudi surgeons were associated with fewer complications, with a P-value of .001 and an odds ratio of .349; the odds ratio indicates the likelihood that an event may occur, so, in the case above, the likelihood of complication occurrence for Canadian-trained Saudi surgeons is 0.349.

Years of Experience: Table 11, below, indicates that, when using complications as a dependent variable and the years of experience as an independent variable, there was no significant association between those variables, with a P-value of .696 and a positive odds ratio of 1.006, which means that the association does not affect the odds of a complication outcome[126].

Surgery Volume: Table 11, below, indicates that, when using complications as s dependent variable and surgery volume as an independent variable, there was no significant association between them, with a P-value of .083 and a positive odds ratio of .990, which indicates lower odds of a complication outcome[127].

Surgery Type: The analysis, as mentioned previously, included three types of surgeries: neurosurgery, cardiac surgery and surgical oncology. In Table 11, below, we used surgical oncology as a point of reference and also to measure the effect of surgery type and an independent variable on complications as a dependent variable. The table shows no significant

[126] (Szumilas, 2010, p. 227)
[127] (Szumilas, 2010, p. 227)

increase in the odds of a complication outcome in neurosurgery, with a P-value of .096 and an odds ratio of 2.270.

Further, the table also indicates that there is a significant positive association between cardiac (CABG) surgeries and an increase in complications, which happens with cardiac surgery and is evident in the logistic regression, with a P-value of .004 and an odds ratio of 2.174.

Surgery Classification, According to Urgency (Elective versus Urgent): Table 11 indicates that, when using complications as a dependent variable and the surgery classification as an independent variable, there is a positive association between urgent surgeries and increased number of complications, with a P-value of .015 and an odds ratio of 1.853.

3.2.5 Saudi versus Canadian-Trained Resident Surgery upon Complications

Table 11: Logistic Regression Analyses of Patients' Outcomes (Complications) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons[128]

		B	Odds Ratio[129]	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-1.054	0.349	0.210	0.580	< 0.001*
	Saudi$	1.000				
Years of Experience		0.006	1.006	0.975	1.038	0.696
Surgery Volume		-0.010	0.990	0.979	1.001	0.083
Type of Surgery	Neuro	0.820	2.270	0.864	5.966	0.096
	Cardiac	0.777	2.174	1.271	3.720	0.004*
	Oncology$	1.000				
Surgery	Elective$	1.000				
	Urgent	0.617	1.853	1.125	3.053	0.015*
Gender of the Patient	Female	-0.460	0.632	0.402	0.993	0.046*
	Male$	1.000				
Age of the Patient (Yrs.)		-0.008	0.993	0.979	1.006	0.289
Number of Comorbidities		0.250	1.285	1.088	1.517	0.003*
Number of Previous Surgeries		0.030	1.030	0.805	1.319	0.813

[128] [128] Logit (pi) = Ln(Odds) = -1.382 - 1.054 (Board) + 0.006 (Years of experience) - 0.010 (Surgery Volume) + 0.820 (Type of Surgery - Neuro) + 0.777 (Type of Surgery - Cardiac) + 0.617 (Surgery) - 0.460 (Gender of the patient) - 0.008 (Age of the patient)+ 0.250 (Number of Co-morbidities) + 0.030 (Number of previous surgeries) - 0.478 (Gender of the Doctor)
(For Categorical variable / Board: 0 = Saudi, 1 = Canadian / Type of Surgery: 0 = Oncology, 1 = Neurosurgery, 1 = Cardiac surgery / Surgery: 0 = Elective, 1= Urgent / Gender: 0 = Male, 1 = Female)
[128] The odds ratio … approximates how much more likely (or unlikely) it is for the outcome to be present among those with x= 1 than among those with x= 0. (Hellevik, 2009, p. 66)
[129] The odds ratio … approximates how much more likely (or unlikely) it is for the outcome to be present among those with x= 1 than among those with x= 0. (Hellevik, 2009, p. 66)

Gender of the Physician	Female	-0.478	0.620	0.247	1.560	0.310
	Male$	1.000				
Constant		-1.382	0.251			0.006*
* Significant P-Value $ Used as a Reference.						

Table 12 (below): Shows the logistic regression analyses of patients' outcomes (mortality) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons.

Board Certification: The logistic regression in Table 12, below, shows that when using the location of training as an independent variable and the mortality rate as a dependent variable, the Canadian-board-trained Saudi surgeons have lower mortality rates than the Saudi-board-trained Saudi surgeons, with a P-value of .012, B-coefficient value of -1.126 and an odds ratio of .324. In other words, when looking at the Beta coefficient, we find that the Canadian-trained Saudi surgeons have lower mortality rates by 1.126 with every one-operation increase preformed, compared to the Saudi-trained surgeon. Further, the odds ratio is lower than 1, which indicates a decreased possibility of an event occurring; in this case, it means that the Canadian-trained surgeon would have less probability of mortality occurrence by 0.324.

Years of Experience: The logistic regression in Table 12, below, shows no significance when using years of experience as an independent variable and mortality rate as a dependent variable, with a P-value of .767 and an odds ratio of 1.011.

Surgery Volume: The logistic regression in Table 12, below, shows no significance when using surgery volume as an independent variable and mortality rate as a dependent variable, with a P-value of .731 and an odds ratio of 1.005.

Surgery Type: The logistic regression in Table 12, below, shows statistical significance when using the type of surgery as an independent variable and mortality rate as a dependent variable. The increased mortality rates occurred in neurosurgery, as well as cardiac surgery, by using surgical oncology as a point of reference, with P-values of < .001 and .023, respectively, and an odds ratio of 154.652.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 12, below, shows statistical significance when using the surgery classification, according to urgency, as an independent variable and mortality rate as a dependent variable. The increased mortality rates occurred in urgent case surgeries, with a P-value of .031 and an odds ratio of 2.656.

3.2.6 Saudi versus Canadian-Trained Resident Surgery upon Mortality

Table 12: Logistic Regression Analyses of Patients' Outcomes (Mortality) for Canadian-Board-Certified Surgeons versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-1.126	0.324	0.126	0.835	0.012*
	Saudi$	1.000				
Years of Experience		0.011	1.011	0.938	1.091	0.767
Surgery Volume		0.005	1.005	0.979	1.031	0.731
Type of Surgery	Neuro	5.041	154.652	12.288	1946.383	<0.001*
	Cardiac	2.622	13.769	1.444	131.285	0.023*
	Oncology$	1.000				
Surgery	Elective$	1.000				
	Urgent	0.977	2.656	1.092	6.461	0.031*
Gender of the Patient	Female	-0.369	0.692	0.287	1.667	0.411
	Male$	1.000				
Age of the Patient (Yrs.)		-0.007	0.993	0.969	1.018	0.576
Number of Comorbidities		0.118	1.125	0.815	1.554	0.474
Number of Previous Surgeries		-0.340	0.712	0.458	1.106	0.131
Gender of the Physician	Female	0.098	1.103	0.210	5.802	0.908
	Male$	1.000				
Constant		-6.102	0.002			<0.001*
* Significant P-Value. $ Used as a Reference.						

Table 13 (below): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the O.R.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons.

Board Certification: The logistic regression in Table 13, below, shows that, when using the location of training as an independent variable and readmission to the O.R. within 30 days as a dependent variable, the Canadian-board-trained Saudi surgeons have fewer readmissions to the O.R. within 30 days than the Saudi-board-trained Saudi surgeons, with a P-value of < .001, a B-coefficient Value of -1.054 and an odds ratio of .349. Both the beta coefficient and the odds ratio give an indication of the lower probability of an event (in this case, readmission to the O.R. within 30 days) occurring, whereas the Canadian-trained Saudi surgeon's lower readmission rate to the O.R. was 1.054 for every one-surgery increase and had a lower probability of readmission to the O.R. within 30 days by 0.349.

Years of Experience: The logistic regression in Table 13, below, shows no significance when using years of experience as an independent variable and readmission to the O.R. within 30 days as a dependent variable, with a P-value of .696 and an odds ratio of 1.006.

Surgery Volume: The logistic regression in Table 13, below, shows no significance when using surgery volume as an independent variable and readmission to O.R. within 30 days as a dependent variable, with a P-value of .083 and an odds ratio of .990.

Surgery Type: The logistic regression in Table 13, below, shows statistical significance when using type of surgery as an independent variable and readmission to O.R. within 30 days as a dependent variable; the increased readmission to the O.R. within 30 days occurred in cardiac surgery, when using surgical oncology as a point of reference, with a P-value of .004 and odds ratio 2.174. The table shows no statistical significance in neurosurgery, when using surgical oncology as a point of reference.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 13, below, shows statistical significance, when using surgery classification, according to urgency, as an independent variable and readmission to the O.R. within 30 days as a dependent variable; the increased readmission to the O.R. within 30 days occurred in urgent-care surgeries, with a P-value of .015 and an odds ratio of 1.853.

3.2.7 Saudi versus Canadian-Trained Resident Surgery upon 30-day readmissions (operating room).

Table 13: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 days to the O.R.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-1.054	0.349	0.210	0.580	<0.001*
	Saudi$	1.000				
Years of Experience		0.006	1.006	0.975	1.038	0.696
Surgery Volume		-0.010	0.990	0.979	1.001	0.083
Type of Surgery	Neuro	0.820	2.270	0.864	5.966	0.096
	Cardiac	0.777	2.174	1.271	3.720	0.004*
	Oncology$					
Surgery	Elective$					
	Urgent	0.617	1.853	1.125	3.053	0.015*
Gender of the Patient	Female	-0.460	0.632	0.402	0.993	0.047*
	Male$					
Age of the Patient (Yrs.)		-0.008	0.993	0.979	1.006	0.289
Number of Comorbidities		0.250	1.285	1.088	1.517	0.003*
Number of Previous Surgeries		0.030	1.030	0.805	1.319	0.813
Gender of the Physician	Female	-0.478	0.620	0.247	1.560	0.310
	Male$					
Constant		-1.382	0.251			0.007*
* Significant P-Value $ Used as a Reference.						

Table 14 (below): shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the G.W.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons.

Board Certification: The logistic regression in Table 14, below, shows that, when using the location of training as an independent variable and readmission to the G.W within 30 days as a dependent variable, the Canadian-board-trained Saudi surgeons have lower readmission rates to the G.W. within 30 days than the Saudi-board-trained Saudi surgeons, with a P-value of .196, a B-coefficient value of -.471 and an odds ratio of .624. Both the beta coefficient and the odds ratio give an indication of the lower probability of event (in this case, readmission to the G.W. within 30 days) occurrence, whereas the Canadian-trained Saudi surgeon has a lower readmission to the G.W. by 0.471 for every one-surgery increase and lower probability of readmission to the G.W. within 30 days by 0.624.

Years of Experience: The logistic regression in Table 14, below, shows no significance when using the years of experience as an independent variable and readmission to the G.W. within 30 days as a dependent variable, with a P-value of .549 and an odds ratio of .940.
Surgery Volume: The logistic regression in Table 14, below, shows no significance when using the surgery volume as an independent variable and readmission to the G.W. within 30 days as a dependent variable, with a P-value of .813 and an odds ratio of .998.

Surgery Type: The logistic regression in Table 14, below, shows statistical significance when using the type of surgery as an independent variable and readmission to the G.W. within 30 days as a dependent variable, the increased readmission to the G.W. within 30 days occurred in neurosurgery while using surgical oncology as a point of reference, with a P-value of .019 and odds ratio of 4.678. The table shows no statistical significance in cardiac surgery, when using surgical oncology as a point of reference.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 14, below, shows no statistical significance when treating surgery classification, according to urgency, as an independent variable and readmission to the G.W. within 30 days as a dependent variable, with a P-value of .370 and an odds ratio of 1.404.

3.2.8 Saudi versus Canadian-Trained Resident Surgery upon 30-day readmissions (ward).

Table 14: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 days to the G.W.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-0.471	0.624	0.305	1.276	0.196
	Saudi$					
Years of Experience		-0.014	0.986	0.940	1.033	0.549
Surgery Volume		-0.002	0.998	0.983	1.013	0.813
Type of Surgery	Neuro	1.543	4.678	1.282	17.066	0.019*
	Cardiac	0.035	1.036	0.406	2.641	0.941
	Oncology$					
Surgery	Elective$					
	Urgent	0.339	1.404	0.669	2.947	0.370
Gender of the Patient	Female	-0.632	0.532	0.261	1.082	0.081
	Male$					
Age of the Patient (Yrs.)		0.001	1.001	0.982	1.020	0.955
Number of Comorbidities		0.069	1.071	0.837	1.371	0.585
Number of Previous Surgeries		-0.227	0.797	0.539	1.178	0.256
Gender of the Physician	Female	0.952	2.590	0.807	8.320	0.110
	Male$					
Constant		-2.622	0.073			<0.001*

* Significant P-Value
$ Used as a Reference.

3.3 Per Specialty Regressions Analyses Regarding Patient Outcomes (Not counting for hospital as a confounding variable)

3.3.1 Neurosurgery

Table 15: Logistic Regression Analyses of Patients' Outcomes (Complications) for Canadian-Board-Certified Surgeons Versus Saudi Board-Certified Surgeons (Neurosurgery)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-0.691	0.501	0.173	1.452	0.203
	Saudi$	1.000				
Years of Experience		0.053	1.055	0.980	1.136	0.156
Surgery Volume		0.018	1.018	0.937	1.107	0.667
Surgery	Elective$	1.000				
	Urgent	0.396	1.486	0.632	3.496	0.364
Gender of the Patient	Female	-0.122	0.885	0.398	1.966	0.764
	Male$	1.000				
Age of the Patient (Yrs.)		-0.011	0.989	0.964	1.015	0.399
Number of Comorbidities		0.252	1.287	0.912	1.816	0.152
Number of Previous Surgeries		-0.039	0.962	0.706	1.310	0.804
Gender of the Physician	Female	0.667	1.949	0.224	16.930	0.545
	Male$	1.000				
Constant		-1.691	0.184			0.038*
* Significant P-Value $ Used as a Reference.						

Table 15 (above): Shows the logistic regression analyses of patients' outcomes (complications) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (in neurosurgery).

Board Certification: The logistic regression in Table 15, above, shows that, when using the location of training as an independent variable and patient complications as a dependent variable, there was no statistical significant evidence in the analysis, with a P-value of .203, a

B-coefficient value of -0.691 and an odds ratio of .501. Therefore, the location of training has no effect on complications in the neurosurgery cases (shunt and shunt revision).

Years of Experience: The logistic regression in Table 15, above, shows that, when using the years of experience as an independent variable and patient complications as a dependent variable, there was no statistical significant evidence in the analysis, with a P-value of .156, a B-coefficient value of .053 and an odds ratio 1.055.

Surgery Volume: The logistic regression in Table 15, above, shows that, when using surgery volume as an independent variable and patient complications as a dependent variable, there was no statistical significant evidence of a link between the two variables, in the analysis, with a P-value of .667, a B-coefficient value of .018 and an odds ratio of 1.018.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 15, above, shows that, when treating surgery classification, based on urgency, as an independent variable and patient complications as a dependent variable, there were no statistical significant evidence in the analysis, with a P-value of .364, a B-coefficient value of .396 and an odds ratio 1.486.

Table 16 (below): Shows the logistic regression analyses of patients' outcomes (mortality) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (Neurosurgery).

Board Certification: The logistic regression in Table 16, below, shows that when using the location of training as an independent variable and mortality as a dependent variable, the location of board training (Canada versus Saudi Arabia) has no statistically significant bearing on mortality, with a P-value of .978 and a B-coefficient value of 125.438.

Years of Experience: The logistic regression in Table 16, below, shows no significant link, when treating the years of experience as an independent variable and mortality rates as a dependent variable, with a P-value of .967 and an odds ratio of 337.736.

Surgery Volume: The logistic regression in Table 16, below, shows no significant relationship, when using surgery volume as an independent variable and mortality as a dependent variable, with a P-value of .964.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 16, below, shows no significant link, when using surgery classification, according to urgency, as an independent variable and mortality as a dependent variable, with a P-value of .982 and an odds ratio of 0.00.

Table 16: Logistic Regression Analyses of Patients' Outcomes (Mortality) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons (Neurosurgery)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	125.438	3.0E+54	0.000		0.978
	Saudi$					
Years of Experience		5.822	337.736	0.000	9.8E+12 3	0.967
Surgery Volume		16.503	1.5E+07	0.000		0.964
Surgery	Elective$					
	Urgent	-103.794	0.000	0.000		0.982
Gender of the Patient	Female	-162.198	0.000	0.000		0.964
	Male$					
Age of the Patient (Yrs.)		0.369	1.447	0.449	4.668	0.536
Number of Comorbidities		87.825	1.4E+38	0.000		0.964
Number of Previous Surgeries		0.089	1.093	0.239	4.991	0.908
Gender of the Physician	Female	221.702	1.9E+96	0.000		0.989
	Male$					
Constant		-713.853	0.000			0.964
* Significant P-Value $ Used as a Reference.						

Table 17 (below): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the O.R.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (neurosurgery).

Board Certification: The logistic regression in Table 17, below, shows that when treating the location of training as an independent variable and readmission to the O.R. within 30 days as a dependent variable, the location of training had no statistically significant effect on readmission to the O.R. within 30 days for the Saudi-board-trained Saudi surgeons, with a P-value of .332, a B-coefficient value of -.670 and an odds ratio of .512.

Years of Experience: The logistic regression in Table 17, below, shows no significance, when using years of experience as an independent variable and readmission to the O.R. within 30 days as a dependent variable, with a P-value of .945 and an odds ratio of .997.

Surgery Volume: The logistic regression in Table 17, below, shows no significance, when using surgery volume as an independent variable and readmission to the O.R. within 30 days as a dependent variable, with a P-value of .919 and an odds ratio of .994.

Table 17: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 Days to the O.R.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons (Neurosurgery)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-.670	.512	.132	1.980	.332
	Saudi$					
Years of Experience		-.003	.997	.913	1.089	.945
Surgery Volume		-.006	.994	.887	1.114	.919
Surgery	Elective$					
	Urgent	1.366	3.921	1.369	11.230	.011*
Gender of the Patient	Female	-.643	.526	.173	1.596	.256
	Male$					
Age of the Patient (Yrs.)		-.015	.985	.954	1.018	.380
Number of Comorbidities		-.048	.954	.602	1.512	.840
Number of Previous Surgeries		-.589	.555	.321	.957	.034
Gender of the Physician	Female	1.199	3.318	.260	42.292	.356
	Male$					
Constant		-.506	.603			.605
* Significant P-Value $ Used as a Reference.						

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 17, above, shows statistical significance, when using surgery classification, according to urgency, as an independent variable and readmission to the O.R. within 30 days as a dependent variable, the increased readmission to the O.R. within 30 days occurred in urgent-case surgeries, with a P-value of .011 and an odds ratio of 3.921.

Table 18: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 Days to the G.W.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons (Neurosurgery)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-1.147	.318	.060	1.683	0.178
	Saudi$					
Years of Experience		-.010	.990	.898	1.091	0.833
Surgery Volume		.102	1.107	.964	1.272	0.151
Surgery Type	Elective$					
	Urgent	.459	1.583	.491	5.105	0.442
Gender of the Patient	Female	-1.038	.354	.102	1.226	0.101
	Male$					
Age of the Patient (yrs.)		-.005	.995	.961	1.031	0.798
Number of Comorbidities		-.325	.722	.426	1.223	0.226
Number of Previous Surgeries		-.318	.728	.434	1.219	0.227
Gender of the Physician	Female	3.126	22.772	1.603	323.565	0.021*
	Male$					
Constant		-1.208	.299			0.271
* Significant P-Value $ Used as a Reference.						

Table 18 (above): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the G.W.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (Neurosurgery).

Board Certification: The logistic regression in Table 18 shows that when using the location of training as an independent variable and readmission to the G.W. within 30 days as a dependent variable, the location of training had no statistically significant effect on readmission to the G.W. within 30 days than the Saudi-board-trained Saudi surgeons, with a P-value of .178, a B-coefficient value of –1.147 and an odds ratio of .318. Both the beta coefficient and the odds ratio give an indication of the lower probability of event (in this case, readmission to the G.W. within 30 days in neurosurgery cases) occurrence, whereas the

Canadian-trained Saudi surgeon has a lower readmission rate to the G.W. by 1.147 for every one-surgery increase, and lower probability of readmission to the G.W. within 30 days by 0.318.

Years of Experience: The logistic regression in Table 18 shows no significant link, when using years of experience as an independent variable and readmission to the G.W within 30 days as a dependent variable, with a P-value of .833 and an odds ratio of .990.

Surgery Volume: The logistic regression in Table 18 shows no significance, when using surgery volume as an independent variable and readmission to the G.W. within 30 days as a dependent variable, with a P-value of .151 and an odds ratio of 1.107.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 18 shows no statistical significance, when using surgery classification, according to urgency, as an independent variable and readmission to the G.W. within 30 days as a dependent variable, with a P-value of .442 and an odds ratio of 1.583.

3.3.2 Cardiac Surgery

Table 19: Logistic Regression Analyses of Patients' Outcomes (Complications) for Canadian-Board-Certified Surgeons versus Saudi-Board-Certified Surgeons (Cardiac Surgery)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-0.39	0.68	0.13	3.67	0.653
	Saudi$	1.00				
Years of Experience		-0.05	0.96	0.77	1.19	0.679
Surgery Volume		0.00	1.00	0.98	1.02	0.964
Surgery	Elective$	1.00				
	Urgent	1.59	4.92	1.60	15.18	0.006*
Gender of the Patient	Female	-0.99	0.37	0.17	0.80	0.011
	Male$	1.00				
Age of the Patient (Yrs.)		-0.01	0.99	0.97	1.01	0.427
Number of Comorbidities		0.06	1.06	0.80	1.42	0.670

Number of Previous Surgeries		0.25	1.28	0.73	2.25	0.383
Gender of the Physician	Female	-0.79	0.45	0.09	2.35	0.346
	Male$	1.00				
Constant		-0.02	0.98			0.987
* Significant P-Value $ Used as a Reference.						

Table 19 (above): shows the logistic regression analyses of patients' outcomes (complications) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (cardiac surgery). Board Certification: The logistic regression in Table 19, above, shows that, when using the location of training as an independent variable and complication as a dependent variable, the location of board training (Canada versus Saudi Arabia) has no statistically significant association with each other, with a P-value of .653, a B-coefficient value of -.39 and an odds ratio of .68.

Years of Experience: The logistic regression in Table 19, above, shows that when using years of experience as an independent variable and complication as a dependent variable, years of experience has no statistically significant association to complication, with a P-value of .679, a B-coefficient value of -.05 and an odds ratio of .96.

Surgery Volume: The logistic regression in Table 19, above, shows that, when treating surgery volume as an independent variable and complication as a dependent variable, surgery volume has no statistically significant association to complication, with a P-value of .964, a B-coefficient value of 0.00 and an odds ratio of 1.00.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 19, above, shows that, when using surgery classification, according to urgency, as an independent variable and complication as a dependent variable, surgery classification is statistically significant in the cardiac urgent cases, with a P-value of .006, a B-coefficient value of 1.59 and an odds ratio of 4.92.

According to the logistic regression analyses of patients' outcomes' (mortality) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (cardiac), there is no output, because there are no death cases for the Saudi board as shown in the next table, Table 20.

Table 20: Logistic Regression Analyses of Patients' Outcomes (Mortality) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons (Cardiac Surgery)

Board * Death Crosstabulation

		Death		Total
		No	Yes	
Board	Saudi	265	0	265
	Canadian	137	3	140
Total		402	3	405

Table 21: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 Days to the O.R.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons (Cardiac Surgery)

		B	Odds ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-23.49	0.00	0.00		0.996
	Saudi$	1.00				
Years of Experience		0.68	1.97	0.38	10.18	0.418
Surgery Volume		-0.02	0.98	0.90	1.06	0.580
Surgery	Elective$	1.00				
	Urgent	-18.69	0.00	0.00		0.998
Gender of the Patient	Female	-0.51	0.60	0.11	3.23	0.550
	Male$	1.00				
Age of the Patient (Yrs.)		0.00	1.00	0.95	1.05	0.942
Number of Comorbidities		0.35	1.42	0.83	2.41	0.199
Number of Previous Surgeries		0.45	1.57	0.56	4.40	0.388
Gender of the Physician	Female	2.22	9.20	0.01	13511.38	0.551
	Male$	1.00				
Constant		-10.12	0.00			0.197
* Significant P-Value. $ Used as a Reference.						

Table 21 (above): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the O.R.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (cardiac surgery).

Board Certification: The logistic regression in Table 21, above, shows that, when using the location of training as an independent variable and readmission within 30 days to the O.R. as a dependent variable, the location of board training (Canada versus Saudi Arabia) does not have a statistically significant association to 30 days in the O.R., with a P-value of .996, a B-coefficient value of -23.49 and an odds ratio of 0.00.

Years of Experience: The logistic regression in Table 21, above, illustrates that, when using the years of experience as an independent variable and readmission within 30 days to the O.R. as a dependent variable, there is no statistically significant link between the two variables, with a P-value of .418, a B-coefficient value of .68 and an odds ratio of 1.97.

Surgery Volume: The logistic regression in Table 21, above, shows that, when treating surgery volume as an independent variable and readmission within 30 days to the O.R. as a dependent variable, there is no statistically significant association between the two variables, with a P-value of 0.580, a B-coefficient value of -0.02 value and an odds ratio of 0.98.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 21, above, shows that, when using surgery classification, according to urgency, as an independent variable and readmission within 30 days to the O.R. as a dependent variable, surgery classification, according to urgency, has no statistically significant association with the dependent variable, with a P-value of 0.998, a B-coefficient value of -18.69 and an odds ratio of 0.00.

Table 22 (below): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the G.W.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (cardiac surgery).

Board Certification: The logistic regression in Table 22, below, shows that, when using the location of training as an independent variable and readmission within 30 days to the G.W. as a dependent variable, the location of board training (Canada versus Saudi Arabia) has no statistically significant association to the dependent variable, with a P-value of .894, a B-coefficient value of -0.20 and an odds ratio of 0.82.

Years of Experience: The logistic regression in Table 22, below, shows that, when treating the years of experience as an independent variable and readmission within 30 days to the G.W. as a dependent variable, there is no statistically significant association between the two variables, with a P-value of .758, a B-coefficient value of -0.06 and an odds ratio of .94.

Surgery Volume: The logistic regression in Table 21, below, shows that, when using surgery volume as an independent variable and readmission within 30 days to the G.W. as a dependent variable, surgery volume has no statistically significant association to the readmission rate, with a P-value 0.758, a B-coefficient value of 0.00and an odds ratio of 1.00.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 22, below, shows that when using surgery classification, according to urgency, as an independent variable and readmission within 30 days to the G.W. as a dependent variable, surgery classification, according to urgency, has no statistically significant association with the dependent variable, with a P-value of 0.635, a B-coefficient value of -0.56 and an odds ratio of 0.57.

Table 22: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 Days to the G.W.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons (Cardiac Surgery)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-0.20	0.82	0.04	15.68	0.894
	Saudi$					
Years of Experience		-0.06	0.94	0.64	1.39	0.758
Surgery Volume		0.00	1.00	0.96	1.04	0.993
Surgery Type	Elective$					
	Urgent	-0.56	0.57	0.06	5.69	0.635
Gender of the Patient	Female	-0.76	0.47	0.14	1.59	0.224
	Male$					
Age of the Patient (Yrs.)		-0.02	0.98	0.95	1.02	0.357
Number of Comorbidities		0.30	1.35	0.91	2.00	0.137
Number of Previous Surgeries		0.28	1.32	0.59	2.96	0.505
Gender of the Physician	Female	0.54	1.71	0.13	23.27	0.686
	Male$					
Constant		-1.62	0.20			0.442
* Significant P-Value $ Used as a Reference.						

3.3.3 Surgical Oncology

Table 23: Logistic Regression Analyses of Patients' Outcomes (Complications) for Canadian-Board-Certified Surgeons versus Saudi-Board-Certified Surgeons (Surgical Oncology)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-1.86	0.16	0.04	0.55	0.004*
	Saudi$	1.00				
Years of Experience		0.00	1.00	0.96	1.04	0.839
Surgery Volume		0.00	1.00	0.97	1.02	0.759
Surgery Type	Elective$	1.00				
	Urgent	0.28	1.32	0.57	3.09	0.517
Gender of the Patient	Female	-0.17	0.84	0.39	1.80	0.656
	Male$	1.00				
Age of the Patient (Yrs.)		0.01	1.01	0.98	1.04	0.543
Number of Comorbidities		0.39	1.48	1.09	1.99	0.010*
Number of Previous Surgeries		0.44	1.56	0.65	3.71	0.316
Constant		-2.72	0.07			0.007*
* Significant P-Value $ Used as a Reference.						

Table 23 (above): Shows the logistic regression analyses of patients' outcomes (complications) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (surgical oncology).

Board Certification: The logistic regression in Table 23, above, shows that when using the location of training as an independent variable and complications in surgical oncology as a dependent variable, the Canadian-board-trained Saudi surgeons have lower complications in the combined surgical oncology cases (colon & breast cancers) than the Saudi-board-trained Saudi surgeons, with a P-value of .004, a B-coefficient value of -1.86 and an odds ratio of .16. Both the beta coefficient and the odds ratio give an indication of the lower probability of event (in this lower complication) occurrence, whereas the Canadian-trained Saudi surgeon has a lower complication occurrence by 1.86 for everyone surgery increase, and lower probability of complication occurrence by 0.16.

Years of Experience: The logistic regression in Table 23, above, shows that, when using years of experience as an independent variable and complications in surgical oncology as a dependent variable, there was no statistical significant relationship between each variable, with a P-value .839, a B-coefficient value of 0.00 and odds ratio of 1.00.

Surgery Volume: The logistic regression in Table 23, above, shows that, when treating surgery volume as an independent variable and complications in surgical oncology as a dependent variable, there was no statistical significant link, with a P-value of .759, a B-coefficient value of 0.00 and an odds ratio of 1.00.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 23, above, shows that, when using surgery classification, based on urgency, as an independent variable and complications in surgical oncology as a dependent variable, there was no statistical significance in the analysis with a P-value of 0.517, a B-coefficient value of 0.28 and an odds ratio of 1.32.

Table 24: Logistic Regression Analyses of Patients' Outcomes (Mortality) for Canadian-Board-Certified Surgeons versus Saudi-Board-Certified Surgeons (Surgical Oncology)				95% CI for Odds Ratio		
		B	Odds Ratio	Lower	Upper	P-Value
Board	Canadian	-15.29	0.00	0.00		0.996
	Saudi$	1.00				
Years of Experience		-0.01	0.99	0.91	1.09	0.882
Surgery Volume		0.00	1.00	0.94	1.06	0.985
Surgery	Elective$	1.00				
	Urgent	1.22	3.40	0.79	14.65	0.101
Gender of the Patient	Female	1.64	5.14	1.46	18.14	0.010*
	Male$	1.00				
Age of the Patient (Yrs.)		0.01	1.01	0.94	1.09	0.732
Number of Comorbidities		0.29	1.33	0.66	2.68	0.419
Number of Previous Surgeries		-15.06	0.00	0.00		0.996
Constant		-5.32	0.00			0.029*
* Significant P-Value $ Used as a Reference.						

Table 24 (above): Shows the logistic regression analyses of patients' outcomes (mortality) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (surgical oncology).

Board Certification: The logistic regression in Table 24, above, shows that, when using the location of training as an independent variable and mortality rates in surgical oncology as a dependent variable, the analysis found that there was no statistical significant link, with a P-value of .996, a B-coefficient value of -15.29 and an odds ratio of 0.00.

Years of Experience: The logistic regression in Table 24, above, shows that, when treating the years of experience as an independent variable and mortality rates in surgical oncology as a dependent variable, the analysis found that there was no statistical significant relationship between the two variables, with a P-value of .882, a B-coefficient value of -0.01 and an odds ratio of 0.99.

Surgery Volume: The logistic regression in Table 24, above, shows that, when using the surgery volume as an independent variable and mortality rates in surgical oncology as a dependent variable, the analysis found that there was no statistical significance with a P-value of 0.985, a B-coefficient value of 0.00 and an odds ratio of 1.00.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 24, above, shows that, when using the surgery classification, according to urgency, as an independent variable and mortality rates in surgical oncology as a dependent variable, there was no statistical significant link, from the analysis, with a P-value of 0.101, a B-coefficient value of 1.22 and an odds ratio of 3.40.

Table 25: Logistic Regression Analyses of Patients' Outcomes (Readmission within 30 Days to the O.R.) for Canadian-Board-Certified Surgeons versus Saudi-Board-Certified Surgeons (Surgical Oncology)

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-11.17	0.00	0.00		0.997
	Saudi$	1.00				
Years of Experience		0.19	1.21	0.81	1.81	0.351
Surgery Volume		-0.09	0.91	0.70	1.19	0.510
Surgery	Elective$	1.00				
	Urgent	-13.68	0.00	0.00		0.998
Gender of the Patient	Female	16.98	2.4E+07	0.00		0.992
	Male$	1.00				
Age of the Patient (Yrs.)		-0.10			1.21	0.491
Number of Comorbidities		-0.57	0.57	0.90	13.02	0.722
Number of Previous Surgeries		-10.15	0.00	0.00		0.997
Constant		-14.17	0.00			0.993
$ Used as a Reference.						

Table 25 (above): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the O.R.) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (surgical oncology).

Board Certification: The logistic regression in Table 25, above, shows that, when using the location of training as an independent variable and readmission within 30 days to the O.R. in surgical oncology as a dependent variable, there was no statistical significant link between the two variables, from the analysis, with a P-value of .997, a B-coefficient value of -11.17 and an odds ratio of 0.00.

Years of Experience: The logistic regression in Table 25, above, shows that, when treating years of experience as an independent variable and readmission within 30 days to the O.R. in surgical oncology as a dependent variable, there was no statistical significant association between the two, from the analysis, with a P-value of .351, a B-coefficient value of .19 and an odds ratio of 1.21.

Surgery Volume: The logistic regression in Table 25, above, shows that, when linking surgery volume as an independent variable and readmission within 30 days to the O.R. in surgical oncology as a dependent variable, there was no statistical significance from the analysis, with a P-value of 0.510, a B-coefficient value of -0.09 and an odds ratio of 0.91.

Surgery Classification, According to Urgency (Elective Versus Urgent): The logistic regression in Table 25, above, shows that, when treating surgery classification, based on urgency, as an independent variable and readmission within 30 days to the O.R. in surgical oncology as a dependent variable, the analysis found that there was no statistical significance between the two variables, with a P-value of 0.998, a B-coefficient value of -13.68 and an odds ratio of 0.00.

Table 26: Logistic Regression Analyses of Patients' Outcomes (Readmission within 30 Days to the G.W.) for Canadian-Board-Certified Surgeons versus Saudi-Board-Certified Surgeons (Surgical Oncology)						
		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	1.02	2.76	0.60	12.69	0.192
	Saudi$	1.00				
Years of Experience		-0.04	0.96	0.90	1.03	0.229
Surgery Volume		0.00	1.00	0.96	1.05	0.886
Surgery	Elective$	1.00				
	Urgent	0.22	1.25	0.35	4.47	0.729
Gender of the Patient	Female	-0.19	0.83	0.24	2.90	0.770
	Male$	1.00				
Age of the Patient (Yrs.)		0.02	1.02	0.97	1.07	0.399
Number of Comorbidities		0.15	1.16	0.73	1.85	0.530
Number of Previous Surgeries		-1.49	0.22	0.04	1.24	0.087
Constant		-3.89	0.02			0.014*
* Significant P-Value $ Used as a Reference.						

Table 26 (above): Shows the logistic regression analyses of patients' outcomes (readmission within 30 days to the G.W) for Canadian-board-certified surgeons versus Saudi-board-certified surgeons (surgical oncology).

Board Certification: The logistic regression in Table 26, above, shows that, when using the location of training as an independent variable and readmission within 30 days to the G.W. in surgical oncology as a dependent variable, there was no statistical significance between the two variables, from the analysis, with a P-value of .192, a B-coefficient value of 1.02 and an odds ratio of 2.76.

Years of Experience: The logistic regression in Table 26, above, shows that, when treating years of experience as an independent variable and readmission within 30 days to the G.W. in surgical oncology as a dependent variable, there was no statistical significant link, from the analysis, with a P-value of 0.229, a B-coefficient value of -0.04 and an odds ratio of 0.96.

Surgery Volume: The logistic regression shown in Table 26, above, shows that, when using surgery volume as an independent variable and readmission within 30 days to the G.W. in surgical oncology as a dependent variable, there was no statistical significant relationship between the two variables, from the analysis, with a P-value of 0.886, a B-coefficient value of 0.00 and an odds ratio of 1.00.

Surgery Classification, According to Urgency (Elective versus Urgent): The logistic regression in Table 26, above, shows that, when viewing surgery classification, based on urgency, as an independent variable and readmission within 30 days to the G.W. in surgical oncology as a dependent variable, it was found that there was no statistically significant link between the two variables, from the analysis with a P-value of 0.729, a B-coefficient value of 0.22 and an odds ratio of 1.25.

3.4 Linear Regression Model for Hospital Centre Variable

3.4.1 Model Outcomes for All Types of Surgery

Table 27 reveals that outcomes of the General linear regression model when accounting for the additional confounding variable of hospital centre. Surgical oncology and the centre of KFMC was excluded due to the fact that there were no relationship established between the patient outcomes and organization. The findings show that the centre of KSU-MC was associated with significantly longer duration of surgery ($B=65.4$, $p<0.001$) and a greater number of clinical visits ($B=11.7$, $p<0.001$) but no significant associations with length of stay ($B=-0.076$, $p=0.405$), morbidity grade ($B=0.018$, $p=0.887$), or morbidity onset ($B=-0.065$, p=0.482) were recognised. Similarly, the centre of KSMC observed a significantly higher number of clinic visits (B=6.7, p<0.001) but there were no significant associations with surgery duration, length of stay, morbidity grade or morbidity onset (all p>0.05).

Table 27: General Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic Visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons.

	Duration of Surgery (min.)		Number of Clinic Visits		Length of Hospitalization (days)		Morbidity Grade		Morbidity Onset	
	B	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
(Constant)	227.239	<0.001*	1.958	.191	.768	<0.001*	.821	<0.001*	.732	<0.001*
Board	7.268	.467	10.461	<0.001*	-.252	0.002*	-.279	0.012*	-.251	0.002*
Years of Experience	-.949	.069	.035	.355	-.001	.860	-.002	.695	-.002	.719
Surgery Volume	.159	.484	.024	.140	-.004	0.042*	-.002	.513	-.004	0.046*
Type of Surgery										
Neurosurgery	-71.266	<0.001*	-8.533	<0.001*	.144	.210	.472	0.002*	.243	0.035*
Cardiac Surgery	152.492	<0.001*	-11.485	<0.001*	-.162	.052	-.277	.015	-.145	.085
Gender (Patient)	-13.525	.065	.724	.167	-.107	.075	-.114	.159	-.089	.138
Age of Patient (yrs.)	-.019	.204	.000	.751	-2.202E-05	.857	-3.907E-05	.815	-2.115E-05	.865
Number of Comorbidities	-2.769	.339	.279	.171	.053	.022	.125	<0.001*	.065	.006
Number of Previous Surgeries	4.055	.377	-.171	.593	.014	.705	.027	.593	.009	.806
Gender (Physician)	-42.592	.006	-.963	.367	-.072	.555	-.222	.184	-.078	.532
Hospital										
KSU-MC	65.425	<0.001*	11.701	<0.001*	-.076	.405	.018	.887	-.065	.482
KSMC	-24.056	.193	6.766	<0.001*	.046	.758	-.173	.400	-.037	.811
F	157.28		54.751		32.203		7.642		7.220	
P-Value	<0.001*		<0.001*		<0.001*		<0.001*		<0.001*	
R^2	0.687		.425		.324		.091		.086	

Oncological Surgery & KFMC were excluded from the model

* Significant P-Value

3.4.2 Model Outcomes for Neurosurgery

Table 28 shows that outcomes of the linear regression model when accounting for the additional confounding variable of hospital centre for neurosurgery. The centres of KFMC and KSU-MC were excluded due to the same reason for not being able to establish a relation between patient surgical outcomes and the organization. The findings show that the centre of KSMC was associated with significantly shorter duration of surgery (B=-36.6, p<0.001), a lower number of clinical visits (B=-3.9, p<0.001) and a shorter length of stay (B=-38.9, p<0.001) but no significant associations with morbidity grade or morbidity onset were observed.

Table 28: General Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons (Neurosurgery)

	Duration of Surgery (min.)		Number of Clinic Visits		Length of Hospitalization (days)		Morbidity Grade		Morbidity Onset	
	B	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
(Constant)	82.359	0.004*	5.189	0.041	76.141	0.110	0.164	0.853	0.567	0.350
Years of Experience	1.427	0.018*	0.035	0.524	2.429	0.020*	-0.010	0.612	-0.003	0.794
Surgery Volume	-0.105	0.894	0.045	0.511	0.621	0.639	0.027	0.274	0.003	0.850
Gender (Patient)	-11.073	0.141	-0.136	0.837	-27.293	0.033	-0.223	0.339	-0.090	0.571
Age of Patient (yrs.)	0.273	0.266	-0.009	0.686	0.105	0.804	-0.003	0.679	-0.004	0.473
Number of Comorbidities	0.290	0.931	-0.444	0.135	-9.463	0.107	0.163	0.117	0.052	0.469
Number of Previous Surgeries	9.144	0.002*	-0.206	0.425	10.708	0.031*	0.002	0.982	-0.006	0.917
Gender (Physician)	-6.318	0.757	0.171	0.928	-38.931	0.271	0.433	0.513	0.076	0.867
KSMC hospital	-36.647	<0.001*	-3.944	<0.001*	56.974	0.001*	0.307	0.323	0.258	0.223
F	6.453		5.298		1.503		6.660		0.421	
P-Value	<0.001*		<0.001*		0.160		<0.001*		0.907	
R^2	0.269		0.216		0.072		0.068		0.021	

Board & KSU-MC& KFMC were excluded from the model

* Significant P-Value

3.4.3 Model Outcomes for Surgical Oncology

Table 29 shows that outcomes of the linear regression model that failed to show aa relationship between patient outcomes and the organization when attempting to account for hospital centre for surgical oncology outcomes. This problem was also observed for cardiac surgery, see Table 30.

Table 29: General linear model Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons (Oncology surgery)

Dependent Variable:	**Duration of Surgery (min.)**		**Number of Clinic Visits**		**Length of Hospitalization (days)**		**Morbidity Grade**		**Morbidity Onset**	
	B	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
Intercept	272.972	.000	2.048	.541	16.817	.000	1.079	.001	1.207	.000
Board										
Canadian	115.260	.002	25.714	.000	-3.253	.254	-.748	.031	-.668	.011
Saudi	0[a]		0[a]		0[a]		0[a]		0[a]	
Years of Experience	-7.267	.016	.093	.742	-.547	.019	-.015	.596	-.024	.259
Years of Experience	-.173	.722	-.010	.796	.038	.236	-.001	.835	-.004	.206
Age	-.016	.297	.000	.748	-.001	.569	-3.336E-05	.814	-2.968E-05	.785
Number of Comorbidities	-.149	.974	.696	.092	.457	.160	.077	.048	.009	.769
Number of Previous Surgeries	-11.014	.326	.208	.821	.787	.286	.081	.362	.031	.651
Gender (Patient)										
Female	-46.851	.012	-.421	.795	-6.602	.000	-.754	.000	-.577	.000
Male	0[a]		0[a]		0[a]		0[a]		0[a]	
Gender (Physician)										
Female	-3.821	.940	.514	.906	-9.955	.006	-.980	.023	-.607	.065
Male	0[a]		0[a]		0[a]		0[a]		0[a]	
Hospital										
KFMC	0[a]		0[a]		0[a]		0[a]		0[a]	
KSU-MC	0[a]		0[a]		0[a]		0[a]		0[a]	

a. This parameter is set to zero because it is redundant.

Table 30: General linear model Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons (Cardiac surgery)

Dependent Variable:	**Duration of Surgery (min.)**		**Number of Clinic Visits**		**Length of Hospitalization (days)**		**Morbidity Grade**		**Morbidity Onset**	
	B	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
Intercept	399.687	.000	.558	.728	36.967	.838	.241	.357	.041	.842
Board										
Canadian	-54.645	.002	-.559	.564	0[a]		-.251	.110	-.192	.124
Saudi	0[a]		0[a]		-78.554	.373	0[a]		0[a]	
Years of Experience	-1.601	.019	.043	.251	-3.178	.729	-.002	.775	-.002	.739
Years of Experience	.782	.065	.010	.683	1.450	.767	-.001	.748	-.003	.329
Age	-.359	.367	.033	.137	-.702	.832	-.002	.603	.002	.458
Number of Comorbidities	-4.578	.393	.075	.802	28.099	.503	.129	.009	.129	.001
Number of Previous Surgeries	-7.399	.619	-.368	.661	0[a]		.033	.811	.073	.499
Gender (Patient)										
Female	6.310	.658	1.913	.019	0[a]		.341	.009	.130	.210
Male	0[a]		0[a]		0[a]		0[a]		0[a]	
Gender (Physician)										
Female[$]										
Male	0[a]		0[a]		0[a]		0[a]		0[a]	
Hospital										
KFMC	0[a]		0[a]		0[a]		0[a]		0[a]	
KSU-MC	0[a]		0[a]		0[a]		0[a]		0[a]	

a. This parameter is set to zero because it is redundant.

$ Number of female = 0

3.5 Logistic Regression Model for Hospital Centre Variable

3.5.1 Model Outcomes for All Types of Surgery (Post-Operative Complications)

Based on logistic regression analysis, controlling for hospital centre did not derive any significant associations with post-operative complications when considering data for all types of surgery (Table 31). When compared to the centre of KSMC, there was no significant relationship between post-operative complications and the centres of KFMC (odds ratio 1.91; 95% CI 0.65, 5.59, p=0.240) or KSU-MC (odds ratio 2.53; 95% CI 0.76, 8.38, p=0.128).

Table 31: Logistic Regression Analyses of Patients' Outcomes (Complications) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-1.309	.270	.128	.570	0.001*
	Saudi$	1				
Years of Experience		.006	1.006	.976	1.037	.713
Surgery Volume		-.008	.992	.979	1.005	.222
Type of Surgery	Neuro	.761	2.139	.706	6.485	.179
	Cardiac	-1.023	.359	.168	.767	0.008*
	Oncology$	1				
Surgery	Elective$	1				
	Urgent	.661	1.937	1.191	3.151	0.008*
Gender of the Patient	Female	-.436	.646	.419	.996	0.048*
	Male$	1				
Age of the Patient (Yrs.)		-.003	.997	.984	1.010	.635
Number of Comorbidities		.205	1.227	1.042	1.445	0.014*
Number of Previous Surgeries		.028	1.029	.812	1.304	.814
Gender of the Physician	Female	-.585	.557	.210	1.476	.240
	Male$	1				
Hospital	KFMC	.644	1.905	.650	5.585	.240
	KSU-MC	.929	2.532	.765	8.376	.128
	KSMC$	1				

* Significant P-Value

$ Used as a Reference.

3.5.2 Model Outcomes for All Types of Surgery (Mortality)

Based on logistic regression analysis, controlling for hospital centre also failed to derive any significant associations with mortality when considering data for all types of surgery (Table 32). When compared to the centre of KSMC as the reference centre, there was no significant relationship between mortality and the centres of KFMC (B=26.0, p=0.996) or KSU-MC (B=35.7, p=0.996).

Table 32: Logistic Regression Analyses of Patients' Outcomes (Mortality) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-7.985	0.000	0.000		0.998
	Saudi$	1.000				
Years of Experience		-0.017	0.984	0.906	1.068	0.694
Surgery Volume		0.023	1.023	0.968	1.081	0.424
Type of Surgery	Neuro	27.670	1040006169348.7	0.000		0.994
	Cardiac	8.965	7821.721	0.000		0.998
	Oncology$	1.000				
Surgery	Elective$	1.000				
	Urgent	0.211	1.234	0.325	4.695	0.757
Gender of the Patient	Female	0.578	1.783	0.598	5.316	0.300
	Male$	1.000				
Age of the Patient (Yrs.)		-0.001	0.999	0.955	1.045	0.963
Number of Comorbidities		0.631	1.879	1.170	3.018	0.009
Number of Previous Surgeries		-0.181	0.835	0.380	1.832	0.652
Gender of the Physician	Female	-1.079	0.340	0.000		1.000
	Male$	1.000				
Hospital	KFMC	26.029	201474532528.1	0.000		0.996
	KSU-MC	35.694	3174150188503390.0	0.000		0.995
	KSMC$	1.000				

$ Used as a Reference.

3.5.3 Model Outcomes for All Types of Surgery (Readmission to O.R.)

Based on logistic regression analysis, controlling for hospital centre also failed to derive any significant associations with readmission to the O.R. within 30 days (Table 33). When compared to the centre of KSMC as the reference, there was no significant relationship between readmissions to the O.R. and the centres of KFMC (B=15.5, p=0.996) or KSU-MC (B=14.2, p=0.997).

Table 33: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 days to the O.R.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-16.487	0.000	0.000		0.996
	Saudi$	1.000				
Years of Experience		0.009	1.009	0.949	1.073	0.770
Surgery Volume		0.000	1.000	0.972	1.028	0.990
Type of Surgery	Neuro	17.666	46993906.0	0.000		0.996
	Cardiac	-1.373	0.253	0.000		1.000
	Oncology$	1.000				
Surgery	Elective$	1.000				
	Urgent	1.011	2.749	1.191	6.347	0.017*
Gender of the Patient	Female	-0.193	0.824	0.379	1.795	0.627
	Male$	1.000				
Age of the Patient (Yrs.)		-0.003	0.997	0.973	1.021	0.795
Number of Comorbidities		0.101	1.107	0.819	1.496	0.510
Number of Previous Surgeries		-0.242	0.785	0.536	1.149	0.213
Gender of the Physician	Female	0.153	1.165	0.220	6.162	0.857
	Male$	1.000				
Hospital	KFMC	15.506	5422485.3	0.000		0.996
	KSU-MC	14.172	1428883.6	0.000		0.997
	KSMC$	1.000				

* Significant P-Value

$ Used as a Reference.

3.5.4 Model Outcomes for All Types of Surgery (Readmission to G.W.)

Based on logistic regression analysis, controlling for hospital centre also failed to derive any significant associations with readmission to the G.W. within 30 days (Table 34). When compared to the centre of KSMC as the reference, there was no significant relationship between readmissions to the G.W. and the centres of KFMC (B=0.107, p=0.895) or KSU-MC (B=-0.390, p=0.594).

Table 34: Logistic Regression Analyses of Patients' Outcomes (Readmission Within 30 days to the G.W.) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons

		B	Odds Ratio	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	Canadian	-0.440	0.644	0.214	1.938	0.434
	Saudi$	1.000				
Years of Experience		-0.019	0.981	0.936	1.028	0.428
Surgery Volume		-0.005	0.995	0.975	1.015	0.604
Type of Surgery	Neuro	1.257	3.516	0.929	13.312	0.064
	Cardiac	0.279	1.321	0.422	4.142	0.632
	Oncology$	1.000				
Surgery	Elective$	1.000				
	Urgent	0.347	1.414	0.676	2.958	0.357
Gender of the Patient	Female	-0.490	0.613	0.312	1.202	0.154
	Male$	1.000				
Age of the Patient (Yrs.)		-0.001	0.999	0.996	1.003	0.779
Number of Comorbidities		0.059	1.060	0.830	1.355	0.639
Number of Previous Surgeries		-0.277	0.758	0.509	1.129	0.173
Gender of the Physician	Female	1.001	2.722	0.741	10.000	0.132
	Male$	1.000				
Hospital	KFMC	0.107	1.113	0.229	5.399	0.895
	KSU-MC	-0.390	0.677	0.161	2.844	0.594
	KSMC$	1.000				

$ Used as a Reference.

Chapter 4. Discussion

4.1 Summary of Findings

In summary, this cross-sectional study showed that the duration of surgery was significantly longer among Canadian-trained surgeons, than compared to Saudi-trained surgeons for both neurosurgical ($B=386.23$, $p<0.001$) and cardiac surgeries ($B=-183.93$, $p<0.001$) but not for oncological surgery ($B=7.63$, $p=0.8$). Patients within the Saudi-trained group observed a significantly higher number of clinic visits for cardiac surgery, as compared to the Canadian-counterpart group ($B=6.79$, $p<0.001$) but clinic visits were comparable for neurosurgery and oncological surgery (both $p>0.05$). Notably, the duration of hospital admission was significantly longer for patients exposed to Saudi-trained surgeons, than compared to Canadian-trained surgeons within the specialty of neurosurgery ($B=43.23$, $p<0.001$) but this effect was not evident for cardiac or oncological surgery (both $p>0.05$). In addition, Saudi-trained surgeons within cardiac and oncological surgery were associated with a more desirable post-operative morbidity grade, than compared to Canadian-trained surgeons but this was not present for cardiac surgery (data in table 7). Furthermore, after account for hospital centre, it was found that there was a significant association between the duration of surgery and number of clinics visits with KSU-MC (both $p<0.001$) and between the number of clinic visits and KSMC ($p<0.001$). There was also a significant association between KSMC and the duration of surgery, number of clinic visits and length of stay when the type of surgery was limited to neurosurgery (all $p<0.001$). However, it was not possible to assess these effects for surgical oncology and cardiac surgery. In logistic regression, hospital centre was not significantly associated with any patient outcomes including post-operative complications, mortality, readmission to the O.R. and readmission to the G.W. (all $p>0.05$). This was based on the centres of KFMC and KSU-MC using KSMC as the reference centre.

4.2 Evaluation and Wider Literature

Although finding studies that evaluated the effects of board certification based on the system of training in two countries with identical systems and processes, which were close to non-existent, was a big challenge, the majority of studies compared training outcomes of training programs within the same country and in most cases within the same region. Type of training was a well-researched area, as shown in the introductory paper of this thesis, where advancement in training showed a positive association with patient outcomes. However, none of the studies mentioned in this thesis directly compared the location of postgraduate surgical training to patient outcomes. The studies included in this thesis here either compared the training location within the same countries but in different postgraduate surgical training institutions. In addition, they looked at the impact of foreign training on local patient outcomes, measured by the number of complaints received.

One study, conducted by Asch et al[130]. (2009) evaluated the quality of patient care by assessing the training programs from which the alumnus has graduated. It was found that the location of program training does affect the quality of patient care provided by the alumni of these programs. On the other hand, a different study conducted by Elkin et al. (2012), although not directly examining the location of training impact on patient care, researchers looked into patient complaints and adverse events associated with international medical doctors who have completed their training in their country of origin. The study found that international medical graduates "faced 24% (more) complaints than Australian-trained doctor(s), and 41% higher adverse findings[131]".

When considering the type of training and its impact on patient outcomes, literature was rich with articles that discussed the effects of specialized training in specific surgical procedures on patient outcomes. For example, in the paper, "Impact of Surgeon Training on

[130] (Asch, Nicholson, Srinivas, Herrian, & Epestein, 2009, p. 1277)
[131] (Elkin, Spittal, & Studdert, 2012, p. 448)

Outcomes After Respective Hepatic Surgery," by McKay et al. (2008), the authors found that the "surgeon training to be highly predictive of postoperative complications after hepatic resection[132]". Furthermore, they stated that surgeons' training was associated with improved patient outcomes and that training was a significant predictor of postoperative complications [133].

Although only one[134] article somewhat discussed the effects of the training system in different countries when comparing internationally trained physicians with Australian-trained physicians and patient complaints, it did not specifically look into postoperative outcomes. This paper, through its research question, "What is the difference in the quality of health outcomes of patients treated by Saudi surgeons who were trained in Canada and Saudi surgeons who were trained in Saudi Arabia?" has directly addressed the empirical association between the location of training and its direct impact on patient outcomes. Through the data analysis[135] shown in the results, it was evident that there is a difference in patient outcomes between patients who were treated by Canadian-trained Saudi surgeons and Saudi Arabian-trained Saudi surgeons when excluding the hospital effect. Thus, this paper showed that there is an empirical association between the location of training and patient outcomes. Given the above, it is also important to highlight that the results obtained were quite mixed, where there was statistical significance, based on the location of training as an independent variable and other dependent variables, such as complications, mortality, readmission to the O.R. within 30 days, and readmission to the G.W. within 30 days. Yet, not all tables, whether in the linear regression or the logistical regression, unanimously indicated that the Canadian-trained surgeon was superior; rather, when there was no statistical significance, the tables' results

[132] (McKay et al., 2008, p. 1348)
[133] (McKay et al., 2008, p. 1351)
[134] (Elkin, Spittal, & Studdert, 2012)
[135] A total of 1069 medical records were reviewed in the chosen three subspecialties.

also did not indicate that the Saudi Arabian-trained surgeon was superior to the Canadian one.

On the other hand, when including the hospital as a confounding variable and holding it as an independent variable only table 31 showed that the Canadian trained Saudi surgeons had fewer postoperative complications than the Saudi Surgeons, particularly in cardiac surgery and in urgent surgery cases as well as having lower comorbidities than their counterparty. The organization itself did not affect patient complications, nor did it affect mortality rates and readmission to the operating room and the general ward within 30 days. Tables 32-34 also showed no effect of the type of the board in the previously mentioned dependent variables.

Using a combined regression method was quite important in this study, as we have a large sum of data that needed to be analyzed, and the empirical association needed to be established. So, using linear regression as the first step was important to predict the dependent variables based on the values of the independent variable. The linear-regression tables were used to minimize the sum of the distance for each of the dependent variables. In other words, it was important to establish the linkage between the location of training and the various dependent variables that were mentioned previously, as well as predicting the integral value. The general linear model that accounted for the organization as one of the cofounding variables could not establish a linkage between the hospital and patient outcomes.

On the other hand, the logistic regression was used due to the complexity of the system and the settings, as well as the variations of surgery types that were studied, plus the various dependent variables used, the analysis aimed to predict the value of the dependent variable given a set of independent variables, which gave us clear categorical answers for the resulting outcomes. Therefore, using a combined method gave the results clarity in answering the research question by establishing the connection between the training location and patient outcomes and then indicating the amount based on the beta coefficients and the odds ratio. Through the linear regression, tables 7-10[136] have shown that, when using the location of training and the type of board obtained as an independent variable and the length of hospital days, morbidity grade, morbidity onset, duration of surgery, and postoperative complications, the Canadian-trained surgeons have statistically lower P-values. The reduced P-values indicate that patient outcome in all the dependent variables mentioned above are the Canadian-trained surgeons' patients who had better outcomes. However, the Canadian-board-trained surgeons were also associated with increased duration of surgery and increased number of clinical visits in neurosurgery (shunt and shunt revision) and cardiac surgery (CABG) with a P-value of .005, .000, and 0.00, respectively[137]. Tables 27-30 accounted for the organization as a confounding variable. However, the general linear model could not establish a linkage between the organization and patient outcomes, nor was it able to establish a link between the board certification and patient outcomes.

The logistic-regression tables 11-13[138] also show that, when using the training location and type of board as an independent variable and mortality, readmission to the O.R. within 30 days and readmission to the G.W within 30 days, Canadian-trained Saudi Arabian surgeons had patients with better outcomes for all three dependent variables with P-values of .012, < .001 and .196, respectively. However, when accounting for the organization, it showed that the board had no effect on patient outcomes except for overall postoperative complications. Canadian-trained Saudi surgeons showed fewer postoperative complications than Saudi-trained surgeons. They were also associated with better postoperative complications in Cardiac surge Gury with a P-value of .008 and fewer comorbidities than

[136] These tables did not account for the organization as one of the confounding variables.
[137] Tables 8 and 9.
[138] These tables did not account for the organization as one of the confounding variables.

their counterparty. However, when considering dependent variables such as mortality rate, readmission to the operating room, and the general ward within 30 days, the board and the organization (hospital) did not affect patient outcomes (tables 32-34).

The analysis in this paper also considered that the type of surgeries performed, when separating the cases according to the type of surgery, showed no indication that the location of training had any significant impact on the dependent variables. This lack of significance could be a result of a smaller case sample. The logistic regressions, according to Bujang et al., require, at least, a sample size of 500, “for observational studies with a large population size that involve logistic regression in the analysis, taking a minimum sample size of 500 is necessary to derive the statistics that represent the parameters[139]”.

When separating the cases included in this paper, according to surgery type, we found that, in neurosurgery (shunt and shunt revision), the location of board (Canada versus Saudi Arabia) for Saudi-trained surgeons did not have any statistically significant effect on the following dependent variables: patient complications, mortality, readmission to the O.R. within 30, readmission to the G.W. within 30 days, with P-values of .203, .978, .332 and .178, respectively. This could essentially be a direct result of the smaller number (n=169) of collected cases, which is less than the 500 indicated in Bujang’s paper.

In the cardiac (CABG)[140], cases that were collected, n=495, through the logistic regression conducted, it was evident that the training location, as an independent variable, does not affect the following dependent variables: complication, readmission within 30 days to the O.R., readmission within 30 days to the G.W., with P-values of .653, .996 and .894, respectively. The effect of the location of training on mortality was unpredicted. There were no mortality rates for the Saudi surgeons who were our reference points in the logistic

[139] (Bujang, Sa'at, Ikhwan, Sidik, & Joo, 2018, p. 122)
[140] Tables 19 to 22.

analysis. Although the case number is closer to the 500 that Bujang indicated, the effect of location was non-existent.

The final type of surgery that was included in this paper was the surgical oncology cases (colon and breast cancer)[141] with an n=405; it was evident that through the logistic regression conducted, the location of training as an independent variable does not affect the following dependent variables: mortality rates, readmission within 30 days to the O.R., and readmission within 30 days to the G.W., with P-values of .996, .997 and .192, respectively. However, in Table 22 of the same surgery type, we found that the board training location did affect the postoperative complication variable, where the Canadian-trained Saudi surgeons had fewer complications in the combined surgical oncology cases (colon & breast cancer) than the Saudi-board-trained Saudi surgeons, with a P-value of .004.

It was mentioned previously, in the Introduction, that the direct impact of surgical training programs on the patient outcome would be a result of the location of training they received, the amount of experience they have gained after the board certification, and finally, the volume of operations they have conducted throughout the five years of 2012-2017. Therefore, the first element was addressed in the first paragraph of the discussion, supported by what literature was available that addresses the training system outcomes based on patient outcomes and this paper's findings.

The second element examined the amount of experience[142] that they gained after completing their residency, and they become board-certified surgeons. A retrospective literature review was conducted to determine whether experience in other studies impacts patient outcomes and whether this paper is aligned with current findings. It was interesting to find that there are studies that found statistically strong evidence of an association between years of experience and better patient outcomes, and others found no association at all.

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[141] Tables 23 to 26.
[142] Table 15 and 16.

However, it is worth mentioning both perspectives. A study conducted by Thomas et al[143]. (2013) showed that experience does impact patient outcomes, where they have found that "surgeons with high experience in kidney transplantation had significantly lower ischemic time, and lower total operation time, compared with a surgeon with lesser experience[144]".

Another study conducted by Sosa et al. (1998)[145] showed that surgeon experience is significantly associated with complication rates[146]. According to the authors, "This relation was observed in disease and procedure subgroups, and it remained significant after adjustment for patient care mix and time period[147]". Prystowsky et al.[148] (2002) examined patient outcomes for colon resection to determine that, if they varied, according to years of experience, the authors found that "increasing a surgeon's experience has a favorable effect on outcomes, suggesting a continued learning curve subsequent to residency"[149].
The study conducted by Holm et al. (1997) is aligned with the conclusion that surgeon experience is directly related to better patient outcomes. Their research conducted two prospective randomized trials on preoperative radiotherapy in rectal cancer, where they analyzed 1399 patients' postoperative morbidity and mortality, according to different surgeon-related factors. One of these factors is to look at patients who were operated on by surgeons who were certified specialists for at least ten years. They found that these patients have a reduced risk of local recurrence and death from rectal cancer[150].

Duclos et al.[151] (2012), on the other hand, found no association between years of experience and patient outcomes. In their paper, Ayyildiz et al. (2009) found that the success

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[143] (Thomas et al., 2013)
[144] (Thomas et al., 2013, p. 581)
[145] (Sosa et al., 1998)
[146] (Sosa et al., 1998, p. 320)
[147] (Sosa et al., 1998, p. 325)
[148] (Prystowsky, Bordage, & Feinglass, 2002, p. 663)
[149] (Prystowsky, Bordage, & Feinglass, 2002, p. 663)
[150] (Holm, Johansson, Cedermark, Ekelund, & Rutqvist, 1997, p. 657)
[151] (Duclos et al., 2012)

and complication rates in tabularized-incised plate urethroplasty are not affected by the experience of surgeons[152]. This paper, however, supports the view that there is a strong statistical association between years of surgeon experience and better patient outcomes. The time horizon selected for this paper is five years, starting from 2012 to 2017. This paper showed that in tables 6-9, in the combined surgeries and their separate surgery-type linear regression, years of experience did play a role in reducing the dependable variables outcomes, such as a number of clinical visits (combined surgeries), with a P-value of .003, duration of surgery in minutes (neurosurgery and surgical oncology), with P-values of .036 and .023, respectively. The length of hospitalization stays in days (cardiac surgery), with a P-value of .065.

However, it is vital to note that Canadian-trained Saudi surgeons have more clinical visits in the combined surgery-type linear regression analysis than the Saudi-trained surgeon by a B increase of 5.61 and a long duration of surgery by 15.85 minutes more than the Saudi-trained Saudi surgeon. This is due to the high volume of residents they have to train and the lack of simulation centers in the three hospitals examined; so, the operating room is the only hands-on learning experience that the residents will have with the Canadian-trained Saudi surgeon.

The third element examined in this paper is the effect of volume on patient outcomes; quite a few articles addressed the impact of surgery volume on patient outcomes and found a strong association between the volume of surgeries and patient outcomes. This was evident in the study conducted by Pearce et al. (1999) when assessing the impact of surgeon volume on patient outcomes. In this study, the authors reviewed an extensive state data set to determine the impact of surgeon volume on outcome after carotid endarterectomy (CEA), lower extremity bypass grafting (LEAB), and abdominal aortic aneurysm (AAA). A 4% decrease in

[152] (Ali Ayyildiz, Akgul, Yucel, & Germiyanoglou, 2009, p. 366)

adverse outcomes was associated with the surgeons who had a higher volume of surgical cases[153]. Interestingly enough, they have concluded that volume was not associated with better outcomes, although a reduction in adverse outcomes, training, and advanced certification was associated with better outcomes. In addition, Showstack et al. (1987) analyzed discharge abstracts for 18986 CABG operations at 77 hospitals in California in 1983, using multiple regression techniques, and found that higher-volume hospitals have lower in-hospital mortality rates; these hospitals also had shorter average postoperative lengths of stay[154].

Similarly, Archampong et al. (2010) conducted a study to clarify the relationship between the surgeon caseload and patient outcomes. They found that "un-adjusted meta-analysis showed a statistically significant benefit in favor of high-volume surgeons for 30-day postoperative mortality[155]". Chowdhury et al. (2007) also confirmed that high-volume surgeons had significantly better patient outcomes[156]. Birkmeyer et al. (2002) stated that "Dramatic differences in mortality between very-low volume and very-high volume hospitals were observed for pancreatic resection and esophagectomy"[157].

The effect of volume on patient outcomes was evident in the combined surgery-types linear regressions where surgery volume had a positive effect in decreasing the duration of surgery by 2.60 minutes, reduce the number of clinical visits by .13, reduce the length of hospitalization stay by .18, and, finally, by reducing mortality onset to 0. On the other hand, when separating surgery types, we found that surgery volume did not affect any of the dependable variables in neurosurgery, as the case number and size were too small compared to the other two specialties studied. However, due to sample size in cardiac surgery and surgical oncology, we found that surgery volume had a positive impact in decreasing the

153 (Pearce, Parker, Feinglass, Ujiki, & Manheim, 1999, p. 768)
154 (Showstack et al., 1987, p. 785)
155 (Archampong, Borowski, & Dickinson, 2010, p. 341)
156 (Chowdhury, Dagash, & Pierro, 2007, p. 145)
157 (Birkmeyer et al., 2002, p. 1130)

duration of surgery by 3.986 and .796 min., respectively, and no effect on the other dependable variables[158].

Therefore, it is safe to conclude that this paper is aligned with the literature that states that volume and training do affect patient outcomes. This is evident in the paper written by Pearce et al. (1999).

Chapter 5. Conclusion

5.1 Concluding Remarks

Throughout this paper, it was evident that the location of training systems does affect patients' outcomes. This study compared Saudi surgeons who completed their postgraduate surgical training in Saudi Arabia and Saudi surgeons who completed their training in Canada. The study showed that the Saudi Canadian-trained surgeon had better patient outcomes than those trained in Saudi Arabia in Cardiac surgery in both regression analyses. The first analysis did not account for the hospital as a confounding variable, and the second analysis accounted for the hospital as a confounding variable. The bivariate and multivariate analyses in the first section of the analysis did not account for the organization as a confounding variable. The results accounted for the origin of the board and postoperative complications, showed that Saudi surgeons trained in Canada had fewer postoperative complications than Saudi surgeons who were trained nationally, furthermore, to verify whether other factors will impact patient outcomes, based on the training location; we statistically examined patient outcomes against the origin of the board, the amount of experience they gained after board certification, and, finally, whether volume impacted patient outcomes based on the origin of the board. The second analysis was conducted to understand the effect of the organization (Hospital) on patient outcomes, the second set of analyses and showed that the hospital had no impact on patient outcomes regarding the dependent variables considered in the study.

[158] The number of clinical visits, length of hospitalization in days, morbidity grade, and morbidity onset.

However, in one of the dependent factors, postoperative complication, the Saudi Canadian trained surgeon had fewer postoperative complications than the Saudi trained surgeon with a P-value of .001; they also performed better in Cardiac surgery and urgent cases with a P-value of .008. Finally, Canadian-trained Saudi surgeons were associated with a fewer number of comorbidities with a p-value of .048. The organization did not affect the other independent variables such as mortality rates, readmission to the operating room, and general ward within 30 days; interestingly, the board also within this analysis showed no effect on patient outcomes.

By examining these three factors in this study, it was found that the Saudi Canadian-trained surgeon had fewer adverse events in Cardiac surgery, urgent cases, and fewer comorbidities in both types of analysis. Thus, the fact is that there is statistical evidence for the hypothesis that training location does have a positive effect on patient outcomes in Cardiac surgery.

It is worth mentioning that, as shown, this is a retrospective study focusing on specific indicators, such as 30-day readmission rates, readmission within 30 days to the operating room, postoperative complications, and postoperative clinic visits, etc. However, further studies that measure the quality of postgraduate medical education and create a graduate medical-health-training matrix to measure the outcomes of postgraduate medical training programs are required. This postgraduate medical- and surgical-quality matrix will provide a complete picture of how training programs affect the quality of patient care due to its capability of measuring the quality of training throughout the residency period in any medical or surgical specialty.

In 2008, in their article, Birkmeyer et al.; wrote, “Blueprint for New American College of Surgeons: National Surgical Quality Improvement Program.” It focused on strategies that enhance measurement, translated into improvement at the local level, using proposed ACS-NSQIP mechanisms[159]. Carefully examining similar articles will pave the way for SCFHS to create Surgical Performance improvement plans based on outcome measurements. This will create a comprehensive training excellence initiative that focuses not only on surgical outcomes but also on enhancing the training process itself.

5.2 Research Limitations

The quality of evidence available in the medical records was low, which impacted the type of surgeries chosen for this thesis. For instance, within Neosurgy (VP-shunt & shunt revision), we were limited to this specific surgery within the Neurosurgery specialty for the reasons mentioned above. This is also the case with cardiac surgery and surgical oncology, where the quality evidence of medical records determined the specific type of surgery included in this thesis.

Further, the research available specifically links postgraduate surgical training to patient outcomes focused on one specific aspect of the training process or another, rather than considering all environmental and process-related training aspects. These aspects in the literature also looked at university-based training versus non-university-based teaching hospitals, having a subspecialty versus general training. However, to my knowledge, examining the outcome quality of Canadian training institutions as a group with the Saudi training institutions does not exist. This made it difficult to compare to other studies, and the comparison done in the literature review was based on specific aspects only. Further, there are possible limitations associated with the sampling approach as all available samples with complete and valid medical records were included.

The complexity and number of variables and confounders can bias any association between medical training programs and clinical outcomes. Another issue that arose during the literature review is that, when considering a point in time for aftercare follow-up associated

[159] (Birkmeyer et al., 2008, p. 781)

with surgeries, nearly all of the literature focused on specific surgeries; there were no general guidelines for what should be considered when looking at various types of surgeries that differ from the ones stated in the literature.

Further, the inability to control the clinical variables that might negatively impact the results is another challenge in this paper, as is the inability to conduct on-site audits, other than the medical-record file review, in this study. Patient satisfaction rates with postoperative outcomes were not studied, and in-depth analysis for hospital characteristics was not conducted. All three hospitals were teaching training centers under the umbrella of the Ministry of Health; they had identical manpower credentialing and facility resources to conduct the operations chosen in this study. There is a possibility that there may be other organizational factors that were not considered in the study due to the lack of information or simply data was not reliable enough to consider. Therefore, other hospital factors were not considered. Another bias could be the selective reporting of positive patient outcomes in the literature that was reviewed for this paper; this reporting covered a specific aspect of patient outcomes concerning a specific indicator only and did not address the non-clinical aspects, such as patient teachings, patient-to-physician ratio, physician-to-surgeon ratio, etc.

Currently, the Saudi Commission for Health Specialties collects specific training KPIs; however, they are not comprehensive enough to be considered an outcome besides annual pass rates of residents in high-stakes exams such as the Saudi board. However, the effects of these training processes are measured when associating them with patient outcomes in the years that follow the certification. Furthermore, although the national training system has adopted the CanMEDS, it is undetermined how this Canadian framework had affected the required process, outcome, and structural elements that would affect the training journey.

5.3 Implication for research & Further Actions

To my knowledge, this paper will be the first of its kind to examine the empirical link between training systems in two different locations (Canada, Saudi Arabia) and patient outcomes. This study focused on surgical specialties, specifically neurosurgery, cardiac surgery, and surgical oncology. This study can be generalizable to other specialties to understand the impact of training program systems in two different countries on patient outcomes. Having said that, to generalize this, one would first control for all the confounding variables that may not have been covered in this paper due to lack of information. Further, a national database for patient outcomes that link their outcome with the board certification is warranted to ensure that patient data are reliable and valid when conducting similar studies. This will help MOH assess the efficacy of scholarships to a particular country over the other as this center will directly link patient outcomes with board certification origin such as European Boards, Saudi Board, North American boards, and any other approved postgraduate healthcare training program that the Saudi commission classifies and approved for registration. This center will directly feed into the newly introduced model of care (MoC)[160], addressing four of its components directly as Provider reform, Governance development, Financing reforms, and workforce development. In addition, the creation of this center will positively impact decision-making, such as which specialties we would continue to send abroad? It will also assist in shaping the Training governance process and refinancing local programs in areas where the Saudi Board outperforms international boards when carefully examining patient outcomes.

It would be interesting to look at different countries' training programs and patient outcomes; this would allow for creating an international postgraduate outcome research body

[160] The model of care was introduced in the Preface. It is part of the Ministry of Health Transformation strategy. (https://www.moh.gov.sa/en/Ministry/vro/Documents/Healthcare-Transformation-Strategy.pdf)

that will build on one another and initiate performance improvement projects in postgraduate medical- and surgical training programs.

Research is warranted in assessing training programs' outcomes throughout the residency life cycle by creating a postgraduate surgical- and medical-quality matrix. Each year, this matrix will measure essential elements in the training process, such as resident satisfaction, trainer satisfaction, e-log systems, induction for residents to the program, induction for the program director, the passing rate of residents from one year to another, etc. In addition, research must include the training governance aspect, as this will show whether policies, procedures, and bylaws are updated to meet the current need of healthcare manpower planning.

This paper will hopefully positively impact the national training policy within the Kingdom of Saudi Arabia, where in the future, Donabedian's three-component approach should be carefully considered. First, training centers should be given autonomy and the funds needed to provide a customized training process depending on the type of programs they are accredited to train in, the quality of residents they receive, the overhead available, and national need for a specific specialty. Second, the training process should be evaluated regularly through continuous evaluations of the training programs and their associated elements. Finally, training outcomes would be the final component in Donabedian's approach; however, the outcome should encompass resident pass rates and a well-rounded training quality key performance indicator that would act as a 360 evaluation of the training process.

Conflict of Interest Statement

I declare no personal, financial or political interest, which could influence the findings submitted in this paper.

Appendices

Appendix 1: National Surgical Quality Improvement Program Thesis-Related Variables (Khuri, et al., The patient safety in surgury study: background, design, and patient populations, 2007, p. 1092)	
Category	Variable Name
Preoperative Variables	Demographic Gender Race Age General health status Height Weight Current smoker
Operative Variables	Current procedural terminology code of primary operation Current procedural terminology codes of secondary operations Postgraduate year level of surgeon Emergency Wound class Anesthesia type Operation time Anesthesia time Work relative value units Red blood cells transfused Transfer status Operative date Inpatient/outpatient operation Postoperative diagnosis Specialty code of surgeon
Postoperative Variables	30-day mortality 30-day overall morbidity Return to operating room Hospital length of stay Postoperative length of hospital stay
Cardiac Events	Cardiac arrest Myocardial infarction Central nervous system events Cerebrovascular accident Coma Peripheral nerve injury Respiratory events Pneumonia Unplanned intubation Pulmonary embolism Failure to wean
Other Events	Graft Failure Deep vein thrombosis Systematic sepsis Bleeding

Appendix 2: A General List of Independent & Dependent Common Variables

Independent Variables for all Surgeries	General Dependent Variables for all Surgeries
Location of training	Postoperative length of stay
Structure of care (hospital, equipment, supplies)	Postoperative morbidity
	Postoperative mortality
Postgraduate surgeon qualifications	Unplanned return to operating room within 30 days
Gender	Unplanned readmission within 30 days
Age	Hemorrhage
Patient comorbidities	Uncontrolled pain
Duration of surgery	Structure damage
Type of surgery	VTE
	Infection
	Respiratory
	Gastroenterology
	Renal
	Grade of complications
	Number of clinic visits
	Wound infection
	Bleeding
	Other

Appendix 3: Data Collection Form

Patient Demographic and Clinical Characteristics:

MRN#:	Age:	Gender: □ Male □ Female

Comorbidities (Specify):
Cardiac:
____
Neurological:
____
Respiratory:
____
Diabetic and Endocrine:
____
GI:
____
Renal:
____
Malignancy:
____
Others:
____

Past Surgical History (Specify):
____
____
____
____
____
____
____
____
____

Surgeon Demographics:

Age (at Time of Surgery):	Specialty:	Gender: □ Male □ Female
Years of Experience (Board Certification):	Surgery Volume:	Board: □ Saudi Arabia □ Canada

Outcomes:

Type of Surgery: □ Elective □ Urgent	What is the surgery?: ___________
Morbidity: ___________	Morbidity Rate: ___________
Morbidity Type: Hemorrhage: ___________ Uncontrolled pain: ___________ Damage to adjacent structures: ___________ VTE: □ DVT □ PE Infection: ___________	Organs Specific: Cardiac: ___________ Neurological: ___________ Respiratory: ___________ Diabetic and Endocrine: ___________ GI: ___________ Renal: ___________ Malignancy: ___________ Others: ___________
Morbidity Onset: ___________ □ Intraoperative □ Postoperative	Morbidity grade (Except Death): □ Grade I □ Grade II □ Grade III □ Grade IV □ Grade VI
Readmission Within 30 Days: Operation Room: □ Yes □ No General Wards: □ Yes □ No	Readmission Rate:
Death: □ Yes □ No	Death Rate:
Length of Stay in Hospital:	

Appendix 4: Classification of surgical complications (Dindo, Demartines, & Clavien, Classification of surgical complications : A new proposal with evaluation in cohort of 6336 patients and results of a survey, 2004, p. 206)	
Grade	Description
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions Allowed therapeutic regimens are drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside.
Grade II	Requiring pharmacological treatment with drugs other than such allowed for Grade I complications. Blood transfusions and total parenteral nutrition are also included.
Grade III	Requiring surgical, endoscopic, or radiological intervention
Grade IIIa	Intervention not under general anesthesia
Grade IIIb	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications) * requiring IC/ICU Management
Grade IVa	Single organ dysfunction (including dialysis)
Grade IVb	Multi-organ dysfunction
Grade V	Death of a patient
Suffix "d"	If the patient suffers from a complication at the time of discharge (see examples in table 2), the suffix "d" (for "disability") is added to the respective grade of complication. This label indicates the need for a follow-up to fully evaluate the complication.
CNS: Central Nervous System; IC: Intermediate Care; ICU: Intensive Care Unit	

Appendix 5: Clinical Examples of Complication Grades

(Dindo, Demartines, & Clavien, Classification of surgical complications : A new proposal with evaluation in cohort of 6336 patients and results of a survey, 2004, p. 207)

Grades	Organ System	**Examples**
Grade I	Cardiac Respiratory Neurological Gastrointestinal Renal Other	**Atrial fibrillation converting after correction of K+ - level** **Atelectasis requiring physiotherapy** **Transient confusion not requiring therapy** **Non-infectious diarrhea** **Transient elevation of serum creatinine** **Wound infection treated by opening of the wound at the bedside**
Grade II	Cardiac Respiratory Neurological Gastrointestinal Renal Other	**Tachyarrhythmia requiring β-receptor antagonists for heart-rate control** **Pneumonia treated with antibiotics on the ward** **TIA requiring treatment with anticoagulants** **Infectious diarrhea requiring antibiotics** **Urinary tract infection requiring antibiotics** **Same as for I, but followed by treatment with antibiotics because of additional phlegmonous infection**
Grade IIIa	Cardiac Neurological Gastrointestinal Renal Other	**Bradyarrhythmia requiring pacemaker implantation in local anesthesia** **See grade IV** **Biloma after liver resection requiring percutaneous drainage** **Stenosis of the ureter after kidney transplantation treated by stenting** **Closure of dehiscent non-infected wound in the O.R. under local anesthesia**
Grade IIIb	Cardiac Respiratory Neurological Gastrointestinal Renal Other	**Cardiac tamponade after thoracic surgery requiring fenestration** **Bronchopleural fistulas after thoracic surgery requiring surgical closure** **See Grade IV** **Anastomotic leakage after descendorectostomy requiring relaparotomy** **Stenosis of the ureter after kidney transplantation treated by surgery** **Wound infection leading to eventration of small bowel**
Grade IVa	Cardiac Respiratory Neurological Gastrointestinal Renal	**Heart failure leading to low-output syndrome** **Lung failure requiring intubation** **Ischemic stroke/brain hemorrhage** **Necrotizing pancreatitis** **Renal insufficiency requiring dialysis**
Grade IVb	Cardiac Respiratory Neurological Gastrointestinal Renal	**Same as for IVa but in combination with renal failure** **Same as for IVa but in combination with renal failure** **Same as for IVa but in combination with hemodynamic instability** **Ischemic stroke/brain hemorrhage with respiratory failure** **Same as for IVa but in combination with hemodynamic instability**
Suffix "d"	Cardiac Respiratory Gastrointestinal Neurological Renal Other	**Cardiac insufficiency after myocardial infraction (IVa-d)** **Dyspnea after pneumonectomy for severe bleeding after chest tube placement (IIIb-d)** **Residual fecal incontinence after abscess following descendorectostomy with surgical evacuation (IIIb-d)** **Stroke with sensorimotor hemisyndrome (IVa-d)** **Residual renal insufficiency after sepsis with multi-organ dysfunction (IVb-d)** **Hoarseness after thyroid surgery (I-d)**

TIA = Transient Ischemic Attack; O.R. = Operating Room

Appendix 6: CBAHI Letter of Accreditation for the Three Hospitals Included in This Paper

Kingdom of Saudi Arabia
Saudi Health Council
Saudi Central Board for Accreditation
of Healthcare Institutions

CBAHI

المملكة العربية السعودية
المجلس الصحي السعودي
المركز السعودي لاعتماد المنشآت الصحية

1st May 2019

Ms. Amal Alamoudi
Riyadh, Kingdom of Saudi Arabia

Subject: Status of Hospital Accreditation

Dear Ms. Amal Alamoudi,

On behalf of the Saudi Central Board for Accreditation of Healthcare Institutions (CBAHI), we are pleased to respond to your kind request about the status of the below hospitals:

King Fahad Medical city
King Saud medical City
King Khalid university hospital

We would like to inform you that all the above listed hospitals/medical cities are all CBAHI accredited and you can check on the below link the updated status which is updated monthly

https://portal.cbahi.gov.sa/english/StatusAccreditation/hospitals

We appreciate your effort in communicating CBAHI for getting accurate and updated information.

Sincerely,

Dr. Hamad AlSalhi

Assistant to Director General for Research and Development, CBAHI

UAN 92 00 12512 | Fax +966 11 245 5627 | P.O Box 75722 | Riyadh 12264 - 2415 | Zip Code 11588 | Email cbahi@cbahi.gov.sa | www.cbahi.gov.sa

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Paper# 2: Incremental Cost-Effectiveness Analysis of Training Saudi Surgeons Nationally vs. Training Them in Canada

Abstract

Background

Saudi Arabia has been sending postgraduate surgical and medical residents to Canada since 1978 to complete their residency in various training programs throughout Canada with an estimated training cost of $1.3 million Canadian (equivalent to 4,875,000 SAR with an exchange rate of 3.75 SAR to CAD). At the same time, the local training through the Saudi Commission for Health Specialties costs CAD 475,000 (equivalent to 1,781,250.0 SAR with the exact exchange rate). Yet, the value relative to the cost incurred has not been measured. Therefore, the goal of this paper is to determine the cost-effectiveness of the former training programs and address postgraduate surgical training policies internally by answering the research question, "What is the Comparative cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada?"

Objective

To compare the cost of medical training in two different locations (Canada and Saudi Arabia) and investigate how the cost of these programs compares to the cost associated with postoperative adverse events.

Methods

Cost-effectiveness analysis is used to compare outcomes based on the number of surgical interventions to improve health[161]. Cost-effectiveness analysis is most suitable for this type of research because it would provide policymakers with a structured approach to gaining the most return on their investments. In this paper, the investment will be the scholarship provided, and the return expected would be the improved patient care outcome.

[161] (Gold, Siegal, Russell, & Weinstein, 1996).

Results/Discussion

From the cost-effectiveness analysis conducted in this paper, the Canadian-trained Saudi surgeon was more cost-effective in neurosurgery, with a mean initial cost of treatment of 23640 SAR, compared with the Saudi-trained Saudi surgeon with an initial mean cost of 49907 SAR. This information was highlighted by the results of a t-test that showed statistically more expensive with a value ($p<.0001$) for Saudi-trained surgeons. The opposite, however, was true in relation to cardiac surgery, with mean initial costs of treatment being higher when performed by Canadian-trained surgeons (SD (696) (2,610 SAR)) compared to those performed by surgeons trained in Saudi Arabia (SD 2,021.41(7,578 SAR)). Again, this difference was statistically significant following the examination of mean differences via a t-test ($p<.001$). Finally, the costs for oncology surgeries appear similar and indicate that there was little difference between Canadian-trained (SD 642.57 (2,411 SAR)) and Saudi-trained (SD 1,029.20 (3,859SAR)) surgery costs. A t-test indicated that this was indeed the case, with no significant differences in costs between groups being detected ($p=.775$). These results were then further examined within the context of the total costs of care, as calculated by adding the initial costs of surgery to the costs of any required follow-up care required. The differences described above in relation to the initial costs of surgery can be even more pronounced when factoring into the equation the monetary costs of follow-up or readmission. What is particularly interesting is how for surgeons trained in Canada, there is very little increase in the mean cost of neurosurgery from the initial surgery (M 5,080) equivalent to (19,050 SAR) to the mean costs when factoring in the follow-up costs (M 5,352 (20,070 SAR), SD 6,299.07 (23,622 SAR)). However, for those surgeons trained in Saudi Arabia, the costs from initial surgery rise more than twofold, from M = 5,352 (20,070 SAR) to M = 11,085 (41,569 SAR) (SD 13,288.93 (49,833 SAR)). Having said the above, when increasing the volume of operation, the total cost-effectiveness of training for the Canadian-trained surgeon is reduced dramatically under the assumption that the surgeon does over 1.77 operations per month, which is the point where the two training programs become equal in their cost-effectiveness. Ultimately, the provision of surgical training is fundamental to meeting the growing service user demand and in reducing demand-capacity gaps, which are key to maintaining patient safety and optimizing outcomes in contemporary practice and should thereby take precedence over the costs of surgeon training.

Conclusion

From the results and discussion, it was evident that conducting a cost-effectiveness analysis to compare two training programs in two different countries through carefully examining post-operative complications offered a structured approach to improve the return on resources invested in these training programs. Therefore, it is safe to conclude that the incremental benefits associated with the Canadian-trained surgery program outweigh its costs in neurosurgery. However, although there was a statistical significance in cost-effectiveness in the cardiac cases examined in favor of the Saudi trained system, this cost could be off-set by the emotional and mental distress that the patients and their families experience as a result of the increased likelihood of complications that were exhibited in Saudi trained surgeons. The variation in case distribution could have skewed the results in the cost-effectiveness analysis conducted within this paper. Except for neurosurgery, the remaining two specialties (cardiac and surgical oncology), the Saudi-trained surgeons had a noticeable higher volume in cases than the Candian-trained surgeons. Once the volume increase for the Canadian-trained surgeons to exceed the 1.77 operations per month, cost-effectiveness analysis favors the Canadian-trained surgeon over the Saudi-trained surgeon. This is evident in the total savings that increase as the volume of operations increases in one month; accumulating all the months together in one year yields a total cost of training savings that would amount to 9,904,512 Saudi riyals annually in reduction of post-operative complications for fifteen surgeries per month. This large amount can be reinvested in the Saudi training programs to increase the competencies required to match those of the Canadian system.

Keywords:
Cost-effectiveness analysis, postgraduate medical training cost, cost of postoperative complications, the effectiveness of postgraduate medical training.

Chapter 1. Introduction

1.1 Costs of Clinical Training in the Local and International Contexts

Postgraduate medical and surgical training is costly with an "annual global expenditure that exceeds £63 billion,[162]" which is equivalent to 304.51[163] billion Saudi Riyals. Since 1978, Saudi Arabia has been sending qualified postgraduate medical and surgical residents on scholarships to continue their residency in North America. As a result, Canada, for many years, has had an average of 1,200-2,400 residents enrolled in its various medical and surgical training programs with an average cost of $650,000[164] to $1.3 million CAN per medical resident, which is equivalent to 2,437,500 to 4,875,000 Saudi riyals over the average of five to seven years of residency for surgical specialties and an average of three to five years for medical specialties.

Saudi, as a country, had to look into developing a training system of its own to meet its growing healthcare sector demands. As a result, in 1992, a Royal decree was announced to establish the Saudi Commission for Healthcare Specialties (SCFHS) to address the increasing demand to have highly qualified medical and surgical consultants practicing in the field. The SCFHS, to date, has developed more than 140 residencies. This does not include fellowship, and diploma training programs, with an average cost of $475,000 CAN per resident, equivalent to 1,781,250 SAR. These programs are currently conducted in more than a thousand sponsoring institutions across Saudi Arabia and the Gulf Region[165].

The high cost associated with postgraduate training internationally and the inability to determine the value relative to the cost elevated the importance of investigating the training approaches and alternative methods to measure the efficiency and efficacy of these programs

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[162] (Walsh, Levin, Jaye, & Gazzard, 2013, p. 963)
[163] Using the current exchange rate of 4.83 SAR = 1 pound sterling
[164] The exchange rate at 3.75 fixed
[165] Please note that there is a difference in cost over a seven-year between Canadian-trained Saudi surgeons and Saudi-trained Saudi Surgeon, equivalent to (SAR) 2,615,250. If we looked at the monthly difference in cost between the two countries, it would equal (SAR) 52,587,22 higher for the Canadian-trained Saudi surgeon..

in various training settings. Two main reasons drove the need to carefully examine training approaches: firstly, to ensure that the quality of graduate health medical training provided to residents meets the highest international standards in training. Secondly, to ensure the development of the healthcare workforce is systematically handled effectively to meet the current need of the healthcare market.

The Kingdom of Saudi Arabia is currently undergoing a significant transformation guided by the ambitious Vision 2030. Therefore, the mandate for reforming the health care system is now front and center. More specifically, this vision has a stated objective to "improve healthcare professional performance in the Kingdom to meet international standards[166] and to improve the quality and efficiency of health care services[167]." This means that there needs to be an enhancement of the overall value provided to all beneficiaries of the healthcare services through a constant improvement of the quality and efficiency of services through sufficient and adequate healthcare coverage that is sustainable for the overall population.

Realizing this and that no reform in healthcare can be complete without health care workforce training, the SCFHS has recently developed a far-reaching strategy. This strategy plans to: 1) Increase the training capacity of its graduate and medical programs to meet the increasing demands posed by the healthcare workforce gap; 2) Ensure that with this capacity, increase training quality will not be negatively impacted; and 3) Advance the standards of training to meet international standards and benchmarks.

This strategy highlighted the importance of carefully examining the cost-effectiveness approaches to international training programs and informing local Saudi policies regarding funding to support medical and surgical resident training. In turn, such information would have implications as to whether medical and surgical residents should be provided with

[166] (Vision 2030, 2018)
[167] (Vision 2030, 2018, p. 14)

overseas training. However, diverse clinical experiences and training in countries with leading surgeons are likely to prove invaluable for future patient care.

1.2 Cost-Effectiveness Analysis (CEA): Literature Review

Cost-effectiveness analysis refers to "the evaluation of two or more alternative approaches or interventions according to their costs and their effects in producing a certain outcome[168]". Another definition that fits in the context of this paper is that "Cost-effectiveness analysis refers to the evaluation of two or more alternative educational approaches or interventions according to their cost and their effects in producing a certain outcome"[169].

A literature review was conducted to understand the cost and cost-effectiveness analysis. In the commentary written by O'Malley et al., the authors stated that distinguishing between cost analysis and CEA is essential for making clear decisions about value. They have defined cost analysis as "the cost per unit of output, where the costs are the value of all inputs that the program uses"[170]. They also have defined CEA as "the cost per unit of health outcome"[171], where, according to this commentary, the fewer dollars needed to achieve an outcome, the more effective it was. When trying to use this idea within the context of this paper, we already know that training surgeons nationally through the Saudi commission costs less than training them in Canada, but what we do not know is how effective both training programs are. The purpose here is to identify which training location produces better patient health outcomes. This, in turn, will affect the training/scholarship policies within the Kingdom of Saudi Arabia.

To my knowledge, Saudi Arabia does not have a national database that measures patient outcomes based on training location or any national database that is outcome focused.

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[168] (Walsh, 2016, p. 265)
[169] (Walsh, Levin, Jaye, & Gazzard, 2013, p. 962)
[170] (O'Malley, Marseille, & Weaver, 2013, p. 2).
[171] (O'Malley, Marseille, & Weaver, 2013, p. 3)

Further, we do not know the cost offset[172] associated with training in one location over the other.

According to Clarke et al. conducting a cost analysis usually involves three stages: 1) Identifying resources; 2) Measuring these resources; 3) Valuing them, i.e., "apply unit of cost to each resource category" (p. 120). Following the above, this paper has identified the resources required as monetary and non-monetary, and the way to measure these resources would be through measuring the quality of care outcome that would be apparent from the chart review using indicators such as unplanned readmission rates and postoperative complication rates within 30 days, unplanned readmission to OR within 30 days, clinical visits associated with the specified operation. The difficulty that Clarke et al. mentioned in the stages may be in the third stage, which is the valuation aspect, which requires assigning a monetary value to all the impacts. One way this issue could be addressed is to look at the opportunity[173] costs that society as a whole endures. Due to the nature of this paper, valuing the differences in outcomes would be more suitable than opportunity costs for this paper. The benefits that we could be considering are faster recovery postoperatively and the ability to continue with their healthy lives quicker.

Another cost that could be considered would be the forgone health of society members in choosing to be treated by a specific consultant trained in either of the locations (Canada & Saudi); this is a common practice in private healthcare providers, but not applicable in the governmental hospitals that were chosen for this study. For the consultants, the costs may be the location of training itself, i.e., those trained in Canada would have more exposure to cases. Therefore, higher volume and more experience with minimal pay (cost of

[172] Cost offset "is a term used to describe interventions that save money independently of their health benefit." (Kaplan & Groessl, 2002, p. 483)
[173] Opportunity costs are not addressed in this paper as there is insufficient information about costs associated with the willingness to pay for a medical service, the costs associated with various postoperative complications other than those mentioned in this study. Incomplete costs of postoperative complications for surgical oncology complications. Finally, costs associated with trainers are included in their monthly salaries. It is unknown the amount of time devoted to teaching and whether facilities acquired technological teaching platforms to improve training, which has costs associated with it.

living comfortably, within one's own culture, family, and standard of living), and those who were trained in Saudi would highly depend on the facility, lesser volume, therefore, lesser experience and reasonably higher pay and its long-term effect on one's career. For those involved in the training program, their cost would be the time spent training these residents, as they could be working privately and making much more monthly income than they currently do due to minimizing clinical time to teach.

Economic evaluation methods such as cost-benefit analysis and cost-effectiveness analysis are designed to maximize healthcare gains as available resources are scarce. S.D. Pinkerton et al. stated that cost-effectiveness analysis "ignores the inherent value that society places on human life, and thereby avoids the difficulties associated with efforts to place a unitary value on the whole individual human experience.[174]" As we will see later in this paper, cost-effectiveness analysis measures the effectiveness of outcomes rather than putting a dollar amount on life. Further, this method can address questions of productive efficiency where a specified good or service is being produced at the lowest possible cost[175]. One of the advantages of using this method is that it is "a method to determine which program accomplishes the given objective at a minimum cost[176]". Further, CEA "offers decision-makers a structured, rational approach with which to improve the return on resources expended[177]". Therefore, it was determined that using cost-effectiveness analysis for this paper was most suitable to avoid the ethical dilemma of associating costs with lives saved. Although, the value of life within the context of this paper is not a subject matter that will be examined, but rather the number of readmissions due to postoperative complications that are prevented based on the surgeries performed by surgeons who were trained in Canada and surgeons who were trained in Saudi Arabia.

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[174] (Pinkerton, Johnson-Masotti, Derse, & Layde, 2002, p. 74).
[175] (Gray, Clarke, Wolstenholme, & Wordsworth, 2011, p. 11).
[176] (Shepard & Thomson, 1979, p. 536).
[177] (Neumann, 2004, p. 308)

Using cost-effectiveness analysis as a method for this paper is considered an added source of information about the quality of care outcome, specifically the non-mortality outcomes such as unplanned readmission rates to the hospital and the operating room based on the location of training for the Saudi postgraduate surgical residents. The difference in the quality of care outcomes based on patient files that directly associates the location of the training system (Canada vs. Saudi Arabia) has been proven to exist through the quantitative multivariant regression analysis that was conducted in the paper titled “Saudi Arabia vs. Canada, is there a difference in the quality of patient surgical outcomes based on postgraduate surgical training location?” Suggesting that the Canadian-trained surgeon had fewer adverse events postoperatively than the Saudi-trained surgeons in three medical cities (namely, King Fahad Medical City, King Saud Medical City, and King Khaled University Hospital) in central Riyadh, Saudi Arabia. The medical cities were considered one model of the Saudi health care system due to the uniformity of their systems and distribution of study samples between these medical cities. The involved medical cities are major governmental medical cities that serve the public. All three hospitals included in this thesis are Joint Commission International-accredited and follow the same applicable quality standards of practice. The three cities were considered to match the surgical specialties included in the study. Three types of surgery specialty were selected, namely, neurosurgeries, cardiac surgeries, and surgical oncology. This thesis included ventriculoperitoneal (VP) shunts insertion and revision from neurosurgery specialty, coronary artery bypass grafting (CABG) from cardiac surgery, mastectomy, and colectomy from surgical oncology specialty.

It was essential to consider the broader literature regarding cost-effective analyses of the former types of surgical procedures to gain insight into the various costs and factors to consider in this research. For example, in a recent cost-effectiveness analysis of neurosurgical shunt surgery for patients with idiopathic normal pressure hydrocephalus, Kameda *et* *al.* (2017) found that the incremental cost-effectiveness ratio of VP shunts after one year of surgical implantation ranged between $29,934 and $40,742. In addition, at the end of the second postoperative year, the long-term insurance costs reduced considerably due to improvements or resolution of symptoms due to VP shunt-managed hydrocephalus. Thus, a positive investment return was observed after only 18 months of surgery. Notably, excess expenditure in such surgery was primarily attributed to complications and the need for VP revisions. However, the rate of complications in the first year was only 4%, which was lower than other evidence[178]. Although most healthcare is provided through government funding in Saudi Arabia, a large proportion of patients in Canada utilize health insurance. Thus, investment costs are an important factor to consider or reflect upon in the cost-effective analyses performed herein[179]. However, the cost-effectiveness of neurosurgery can also differ by the indication for VP shunting wherein an evaluation of patients with various causes of hydrocephalus, Lim *et al.* (2018) showed that the cost of surgery exceeded that reported by Kameda *et al.* (2017) by more than $36,000 ($76,620), although VP shunts were more cost-effective than endoscopic ventriculostomies ($126,394).

Similar variation has been observed within coronary artery bypass grafting surgery, where Ariyaratne *et al.* (2018) found that the incremental cost-effectiveness ratio was $55,255. Still, this figure varied depending upon the type of stents deployed: bare metal ($25,815), all types of drug-eluting ($56,861), second-generation drug-eluting ($42,925), and third-generation drug-eluting ($88,535) stents. Moreover, the incremental costs also increased in patients with a higher cardiovascular risk, ranging from £30,432 ($39,244.04) for those with a prior myocardial infarction to £62,299 ($80,338.61) for those with chronic renal disease. Such costs were based on a mean follow-up of 2.7 years. Still, given the

[178] (Toma *et al.*, 2013)
[179] (Soril *et al.*, 2017)

protracted risk of recurrent cardiovascular disease among the cohort, as well as the risk of delayed stent failure, the overall cost-effectiveness may have been under-estimated. Indeed, research evaluating the cost-effectiveness of post-coronary artery bypass grafting at five years post-operation revealed that the total costs were $100,522, which was $18,732 more than primary percutaneous coronary intervention[180]. In oncological surgery, research has shown that the cost-effectiveness of mastectomy also differs depending upon patients' risk profiles and, in effect, the indications for radical surgery. For example, Schrauder *et al.* (2019) found that the cost-effectiveness of bilateral mastectomy surgery was negative for executing hospitals with losses of up to $4,471 per patient. However, such risk-reducing surgery is routine for its prevention of cancer in those with BRCA mutations.

In contrast, Keskey *et al.* (2017) showed that unilateral mastectomy for patients with breast cancer totaled $1,234 per patient, less than contralateral prophylactic mastectomy, and provided a quality-adjusted life year benefit, suggesting that breast surgery is minimally cost-effective. Still, the justification is evident given the clinical advantages. Such variances in cost-effectiveness are also shared within colorectal surgery for cancers of the colon and rectum and, overall, highlight the complex array of clinical and non-clinical factors that influence calculations of cost[181].

1.3 Rationale Statement, Research Question and Objectives

This paper will examine the cost-effectiveness analysis of postgraduate surgical training to answer its main **research question**, “What is the incremental cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada?” The **objective** here is to compare the cost of surgical training in two different locations (Canada and Saudi Arabia) and investigate how the cost of these programs compares to the cost associated with

[180] (Stroupe *et al.*, 2006)
[181] (Alsowaina *et al.*, 2019, Abdolahi *et al.*, 2018)

postoperative adverse events. The goal is to determine the efficiency of resource allocation concerning external funding of these programs and address postgraduate surgical training policies internally. Kaplan and Groessl, with regards to using the cost-effectiveness analysis, stated, "that the purpose of the analysis is to identify decisions that will maximize the amount of total health gained for the expenditure of these resources[182]."

1.4 Summary of Approach and Decision Tree

Since resources are scarce, this paper will mainly look into the incremental cost-effectiveness of both training systems based on patients' outcomes; the purpose here is to evaluate comparative training location outcomes and identify which location would maximize the total health gained within the three specialties included in this paper.

Using a simplified decision tree (figure1) that would lay the groundwork for findings and answer the **research question** as stated previously is: "What is the Comparative cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada?" The hypothesis is that the expected net benefit of external training programs outweighs their cost. The first step in creating this decision tree was to create a simplified cost-effectiveness analysis scenario: a healthcare policymaker is faced with the decision to train a certain number of graduating seniors this year from medical school and would like to be trained as surgeons. We will assume that residents have an equal opportunity to be trained locally and internationally. To simplify the assigning of monetary values, we will also assume that the residents are married with two children and that the exchange rate is fixed at 3.75 Saudi riyals per Canadian dollar. The training period in both countries is seven years, followed by a board exam for these residents to be certified as consultants. Training them locally will cost CAD 475,000 (1,781,250 million SAR), and training them in Canada would cost CAD 1.3 million (4,875,000 million SAR).

[182] (Kaplan & Groessl, 2002, p. 483)

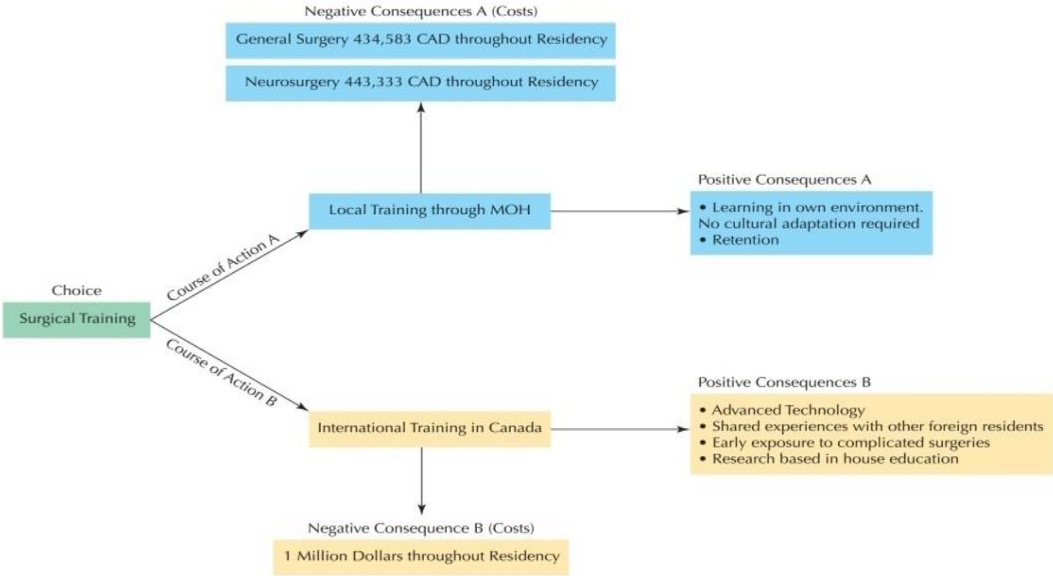

Figure 1: Simplified decision tree.

1.5 Research Outline

"In economic evaluation, costs are calculated by quantifying the different types of resources used in producing a particular good or service and then multiplying these amounts by their respective unit costs[183]". In this paper, the costs that are taken into consideration are the costs associated with training physicians domestically or in Canada. These would include measures of the effectiveness between the two locations. In addition, monetary costs included in this study were the cost incurred as a result of a postoperative complication based on the three surgeries neurosurgeries, cardiac surgeries, and surgical oncology.

The cost here can be understood as the value of resources involved in providing surgical residents with the monetary means during their training period. This cost will include tuition fees and any stipends given to surgeons annually; these costs are all-inclusive of training fees (tuition fees), travel, stipends, as mentioned earlier. Boardman et al. stated that

[183] (Gray, Clarke, Wolstenholme, & Wordsworth, 2011, p. 119).

cost-effectiveness analysis involves computing ratios and using these ratios to make policy decisions that foster efficiency, which can be measured in lives saved using the following formula[184]

$$CE_{ij} = C_i – C_j / E_i – E_j \quad (1.1)$$

Where there are two policies *i* and *j*, in this paper, we will assume that the cost of training surgeons in Canada is *i* and national training policy is *j*, and E would represent, according to Boardman et al., the number of effectiveness units produced by its alternative. Furthermore, they stated, “The simplest application of the formula occurs when a single policy *i* is being assessed as an addition to the status quo, *j*, and both the cost and effectiveness of *i* can be expressed as increments to the status quo[185]”. In this paper, the status quo would be training the resident surgeons through the Saudi commission for healthcare specialties. The alternative would be training them in Canada through the Royal College of Physicians and Surgeons Canada, therefore using their concept, the equations should be $C_i = C+C_j$ (1.2) and $E_i = E + E_j$ (1.3) and the cost-effectiveness ratio C/E[186].

To understand the effectiveness (E), a Viscusi type methodology will be used, although in his paper “The Value of Life,” his issue was not “the value of life itself but rather the value of small risks to life,” were for him “the risk-money trade-offs provide an appropriate measure of deterrence in that it indicates the individual’s private valuation of small changes in the risk[187]”.

This paper attempts to understand the logic of how Saudi healthcare policymakers decide to open scholarships for foreign training and on what basis?

In the first paper of this thesis titled “*Saudi vs. Canada, is there a difference in the quality of patient outcomes based on the location of the training?*” it was determined that location of

[184] (Boardman A. E., Greenberg, Vinning, & Weimer, 2011, p. 465)
[185] (Boardman A. E., Greenberg, Vinning, & Weimer, 2011, p. 465)
[186] (Boardman A. E., Greenberg, Vinning, & Weimer, 2011, p. 465)
[187] (Viscusi, 2005, p. 3).

training affects patient outcomes, where Canadian trained surgeons had fewer postoperative adverse events including the unplanned return to the operating room and general ward within the first 30 days of the initial operation. So now the decision is whether to train them locally or continue sending them to Canada for training? Azimi & Welch confirmed that choosing the cheaper alternative may not provide the best outcomes when it is selected and that cost-effectiveness analyses “are more likely to support strategies that require additional expenditure than the low-cost alternative[188]”.

1.6 Potential issues

Cost-effectiveness analysis has many benefits when used as a method in making postgraduate medical and surgical training decisions, “when used correctly, they guide our educational decision making and enable us to choose an approach to maximize effectiveness[189]”. However, as with any method, it is by far not considered flawless by skeptics. For example, Weintraub & Cohen argued that the first level of uncertainty stems from sampling error alone, where the cost-effectiveness analysis is only as valid as the sample chosen[190]. To avoid this dilemma in this paper, choosing three different sub-specialties within the surgical department gives this paper more ground in understanding the variation in training and how it affects patient outcome when linking it to training location; it will also highlight the effectiveness of both training programs.

Although cost-effectiveness analysis promises the increase of the return on investment for society as a whole[191], much of the literature review about this particular method unanimously agreed that one of the major obstacles for cost-effectiveness analysis is its inability to measure the total social net benefit. Boardman et al. stated, “Analysts may recognize that a particular effectiveness measure does not capture all the social benefits of

[188] (Azimi & Welch, 1998, p. 664)
[189] (Walsh, Levin, Jaye, & Gazzard, 2013, p. 963)
[190] (Weintraub & Cohen, 2009)
[191] (Neumann, 2004, p. 308)

each alternative, and some of these other social benefits are difficult to monetize[192]". Raftery also stated, "Difficulties in measuring effectiveness in ways that represent those of society were at the center of the panel's deliberations" (1999, p. 362).

Another potential issue stems from the fact that cost-effectiveness analysis contains a series of assumptions that may not be measurable[193]. For example, in this paper, we cannot precisely measure the effect of training location systems on patient outcomes in monetary values. This method is chosen to inform health policy decision-makers whether there is a difference in the quality of patient outcomes based on location but does not measure or attempt to examine or address the equity issue when it comes to patient outcomes. Further, "current CEA practice often fails to identify existing misallocation of resources by focusing on the evaluation of new technologies or strategies[194]".

In the article written by Shepard & Thomson, they indicated that one of the noticeable practical issues with this method is the lack or insufficiency of adequate data, and this, in turn, complicates and reduces the accuracy of the results obtained by this particular method, as time is of essence mainly when decisions are needed in critical and important situations (1979, p. 541).

In the context of measuring the outcomes of two postgraduate training programs in two different locations and their effect on patient outcomes, "cost-effectiveness cannot be used to compare interventions with different intended outcomes[195]". Further, according to Walsh et al. (2013), this method cannot be used to compare interventions that do not have "common measures of effectiveness that can be used to assess them[196]".

Applying cost-effectiveness analysis as a method to determine the efficacy of a particular training program through measuring patient outcomes is relatively new, as there

[192] (Boardman A. E., Greenberg, Vinning, & Weimer, 2011, p. 464)
[193] (Weintraub & Cohen, 2009, p. 55)
[194] (WHO, 2003, p. 4)
[195] (Walsh, Levin, Jaye, & Gazzard, 2013, p. 964)
[196] (Walsh, Levin, Jaye, & Gazzard, 2013, p. 964)

were a limited number of studies that tackled this issue and used this particular method to examine the effects of the location of training on patient outcome. In addition, during the literature review, this method was primarily used to evaluate outcomes of specific surgical procedures and interventions as well as a certain type of administered medications. Therefore, if this method is used correctly, it will elucidate the correlation between patient outcome and training location.

Chapter 2. Methods

2.1 Study design and setting

A cross-sectional study was conducted on patient complication costs for invasive surgical operations in three medical cities (namely, King Fahad Medical City, King Saud Medical City, and King Khalid University Hospital) in central Riyadh, Saudi Arabia. The medical cities were considered one model of the Saudi health care system due to the uniformity of standards and practices and distribution of study samples between these medical cities. The involved medical cities are major governmental medical cities that serve the public and are all Joint Commission International-accredited and Central Board for Accreditation of Healthcare Institutions and follow the same applicable quality standards of practice. The three cities were considered to match the surgical specialties included in the study. All operations included in this study were performed by Saudi consultants who completed their residency training in Canada and Saudi consultants who completed their residency training in Saudi Arabia. The time span for the operations selected was between January 2012 to December 2017.

2.2 Subjects and Sampling

This study included various[197] postoperative complications for patients who underwent surgical operations selected and stratified by the surgeon residency board, Saudi vs. Canadian. Three types of surgery specialty were selected, namely, neurosurgeries, cardiac surgeries, and surgical oncology. In addition, we included ventriculoperitoneal (VP) shunts insertion and revision from neurosurgery specialty, coronary artery bypass grafting (CABG) from cardiac surgery, and mastectomy and colectomy from surgical oncology specialty. All cost information was taken from MOH's Actuarial & Costing department in the main headquarters for research purposes only.

2.3 Data Analysis

A linear and logistic regression of patient's outcomes were conducted to understand the effect of the location of residency training on patient outcomes on the dependable variables such as duration of surgery, the number of clinical visits, length of hospitalization (days), and finally, morbidity and mortality grades (Table 9 below). A cost-effectiveness analysis was used as a method to analyze the results based on obtaining the average salaries for the surgeons in the mentioned specialties above, cost of each surgery in Saudi riyal and cost of hospitalization per day also for the selected three surgeries, and finally, cost of various other complications associated with the surgeries. All costs are shown in tables (1-6). Other relevant tables were obtained from the paper titled "*Saudi Arabia vs. Canada, is there a difference in Quality of patient surgical outcomes based on postgraduate surgical training location*?[198]"

[197] Only complications that we could find costs associated with them were included in this study
[198] (AlAmoudi, 2019, pp. 13-29)

2.4 Ethical Considerations

Prior to study conduct, institutional review boards approvals of all three hospitals were obtained, as well as the Carleton University CURB Protocol[199].

Table 1: Average residency cost per country

Medical residency country	The average cost of residency in 7 yrs. In (SAR)	The average cost of residency per 1 month in (SAR)
Saudi	1,505,750 SAR	17,925.60 SAR
Canada	4,121,000 SAR	70,512.82 SAR

Table 2: Average pay per specialty for both categories[200]

Specialty	Average pay per month	Average pay per year
Cardiac surgery	65,000 SAR	780,000 SAR
Neurosurgery	81,104 SAR	973,248 SAR
Surgical oncology	59,000 SAR	708,000 SAR

Table 3: Cost of operations per category

Operation name	cost
Neurosurgery — Shunt	52,000 SAR
Neurosurgery — Shunt Revision	58,500 SAR
Cardiac surgery — CBAG	91,000 SAR
Surgical oncology — Breast cancer	39,000 SAR
Surgical Oncology — Colon Cancer	26,000 SAR

Table 4: WHO — Hospital costs in the year 2005[201] for Saudi Arabia per hospital level

HOSPITAL COSTS			
Cost per bed day by hospital-level*			
	Int $ 2005	LCU[202] 2005[203]	
Primary	95.88	359.55 SAR	
Secondary	125.08	469.05 SAR	
Tertiary	170.85	640.686 SAR	
Cost per outpatient visit by hospital-level*			
	Int $ 2005	LCU 2005	
Primary	35.55	133.31 SAR	
Secondary	50.43	189.11 SAR	
Tertiary	74.60	279.75 SAR	
HEALTH CENTRE COSTS			
Cost per visit at health centre by population coverage for a 20-minute visit**			
	Int $ 2005	LCU 2005	
50%	35.07	131.5 SAR	
80%	35.07	131.5 SAR	
95%	43.45	163 SAR	

[199] CURB Protocol # 108561
[200] There is no difference in pay between the Canadian trained and the Saudi trained consultants, both have at least three years of experience as per SCFHS classification requirements to become full consultants.
[201] (WHO, Choosing Interventions that are Cost Effective (WHO-CHOICE), 2000)
[202] LCU: Local Currency Units
[203] Conversion rate at 3.75 SAR/1 US dollar

Table 5: Length of hospitalization in a tertiary hospital per bed per surgery

Type of surgery	Average Length of Hospitalization in days	Cost per day in SAR	Total Cost in SAR
Neurosurgery — VP Shunt	4 days	640.646	2,562.584
Neurosurgery — VP Shunt Revision	4 days	640.646	2,562.584
Cardiac Surgery — CBAG	14 Days	640.646	8,969.044
Surgical oncology — Breast cancer	7 days	640.646	4,484.522
Surgical Oncology — Colon cancer	7 days	640.646	4,484.522

Table 6 shows various postoperative complications in the chosen specialties

Table 6: Cost of all complications as per MOH cost coding in cardiac surgery, neurosurgery, and surgical oncology available data.

DRG	Long Description	DRG Name	**Cost SAR**
F03B	Cardiac Valve Procedures W CPB Pump W Invasive Cardiac Investigation	CRDC VALV PR+PMP+INV INVES-CCC	**94,597**
F04B	Cardiac Valve Procedures W CPB Pump W/O Invasive Cardiac Investigation	CRD VLV PR+PMP-INV INVES-CCC	**87,839**
F05B	Coronary Bypass W Invasive Cardiac Investigation	CRNRY BYPSS+INV INVES-REOP-CCC	**90,759**
F06A	Coronary Bypass W/O Invasive Cardiac Investigation	CRNRY BYPSS-INV INVS+REOP/CSCC	**108,897**
F06B	Coronary Bypass W/O Invasive Cardiac Investigation	CRNRY BYPSS-INV INVS-REOP-CSCC	**83,996**
F41A	Circulatory Disorders W AMI W Invasive Cardiac Investigative Procedures	CRC DSRD+AMI+INVA INVE PR+CSCC	**38,181**
F41B	Circulatory Disorders W AMI W Invasive Cardiac Investigative Procedures	CRC DSRD+AMI+INVA INVE PR-CSCC	**18,934**
F42A	Circulatory Disorders W/O AMI W Invasive Cardiac Investigative Procedures	CRC DSRD-AMI+IC IN PR +CSCC	**28,954**
F42B	Circulatory Disorders W/O AMI W Invasive Cardiac Investigative Procedures	CRC DSRD-AMI+IC IN PR -CSCC	**20,886**
F42C	Circulatory Disorders W/O AMI W Invasive Cardiac Investigative Procedures	CRC DSRD-AMI+IC IN PR SD	**19,312**
F43Z	Circulatory System Diagnosis W Non-Invasive Ventilation	CIRC SYS DIAG W NIV	**80,295**
F60A	Circulatory Disorders W AMI W/O Invasive Cardiac Investigative Procedures	CRC DSRD+AMI-INVA INVE PR+CCC	**76,370**
F60B	Circulatory Disorders W AMI W/O Invasive Cardiac Investigative Procedures	CRC DSRD+AMI-INVA INVE PR-CCC	**27,155**
F61B	Infective Endocarditis	INFECTIVE ENDOCARDITIS -CCC	**64,867**
F62A	Heart Failure and Shock	HEART FAILURE & SHOCK + CCC	**59,102**
F62B	Heart Failure and Shock	HEART FAILURE & SHOCK – CCC	**38,402**
F74Z	Chest Pain	CHEST PAIN	**12,533**
G48A	Colonoscopy	COLONOSCOPY +CSCC	**57,228**
G48B	Colonoscopy	COLONOSCOPY - CSCC	**26,840**
G48C	Colonoscopy	COLONOSCOPY, SD	**22,553**

Chapter 3. Results

3.1 Overview

To provide a comprehensive overview as possible, based upon the data collected in this study, this reporting of results will comprise dual analysis methods. These dual approaches will include several cost-effectiveness calculations, including an estimation of the mean cost of operations, net effectiveness costs, and comparative effectiveness ratios alongside reporting of inferential statistical tests regarding cost-related treatment outcomes.

3.2 Cost-effectiveness of Surgery

This sub-section will provide an overview of the cost-effectiveness of surgery as a separate entity and compare this between medics trained within the Kingdom of Saudi Arabia and those trained within Canada. To do this, the mean costs of operations shall be compared, as shall inferential equation modelling of surgery duration and length of hospitalization.

The equation for a mean cost of operations (total cost/number of operations) is reported using Int$ 2000 as a means of measurement and indicated the following. First to be discussed is the cost of operations when just taking the initial hospitalization into account. Of the n=376 operations recorded that were conducted by those trained in Canada, the mean cost was 2,362.39 (8,858.9 SAR). This is compared to the mean costs of the n=692 recorded operations by those trained in Saudi Arabia of 2,094.97 (7,856.13 SAR). This equates to Canadian trained surgeons' operations being 1.13 times the costs of Saudi trained surgeons[204]. Table 7 below provides details of these figures.

[204] Costs relate only to days spent in hospital

Table 7: Costs of treatment (initial admission only)

Training location (n)	Total costs in Int$ 2005[205]	Mean costs (Standard deviation)[206]	Effectiveness ratio compared to other location
Canada (376)	888,258.28 (3,330,968.55) SAR	2,362.39 = (8,858.9 SAR) (3,702.44) = (13,884.15 SAR)	1.13
Saudi Arabia (692)	449,719.18 (1,686,446.92) SAR	2,094.97 = (7,856.13 SAR) (5,364.70) = (20,117.625 SAR)	0.88

Next to be discussed is the mean cost of operations when considering the costs related to the need for post-discharge visits for follow up care. Of the n=376 operations recorded that were conducted by those trained in Canada, the mean cost was 2,845.50 (10,670.6 SAR), compared to the mean cost of 2,281.21 (8,554.53 SAR) for operations (n=692) conducted by those trained in Saudi Arabia. A t-test indicated that the difference in means between groups was statistically significant (p=.041) and therefore indicated that Saudi Arabian trained surgeons' costs of surgery were significantly less than those of surgeons trained in Canada. The comparative cost ratio calculated from these means indicates that Canadian trained surgeons' operations and post-operative care being 1.25[207] Times the costs of Saudi trained surgeons. Table 8 provides additional details.

Table 8: Costs of treatment (initial admission plus outpatient care)

Training location (n)	Total costs in Int$ 2005[208]	Mean costs (Standard deviation)[209]	Effectiveness ratio compared to other location
Canada (376)	1,069,907.11 (401,239.162) SAR	2,845.50 = (10,670.6 SAR) (3,635.63) = (13,858.6 SAR)	1.25
Saudi Arabia (692)	1,578,600.02 (5,919,750.08) SAR	2,281.21 = (8,554.53 SAR) (5,337.34) = (20,015 SAR)	0.80

[205] Conversion rate 1US dollar = 3,75 SAR
[206] Conversion rate 1US dollar = 3,75 SAR
[207] Days spent in hospital plus costs for follow up appointments.
[208] Conversion rate 1US dollar = 3,75 SAR
[209] Conversion rate 1US dollar = 3,75 SAR

In addition to these mean cost of operation calculations, one of the core means of examining differences in cost-effectiveness between Canadian and Saudi Arabian trained doctors is via an examination of patient outcomes following surgery. A linear regression analysis was conducted to examine predictors of surgery duration based upon predictor variables, which included both doctor-related characteristics, area of surgery, and patient characteristics. A significant regression equation was found ($F = 16.82$, $p<.001$), with an R^2 of 0.18. Patients predicted duration of surgery, measured in minutes, was equal to 499.96 - 2.60 (surgery volume) - 386.23 (neurosurgery) - 183.93 (cardiac surgery) + 147.57 (gender). Whilst the above variables in this equation were all significant predictors with a p-value of <.001, the board from which doctors qualified (Canadian or Saudi Arabian) was not a predictive factor (p=.510)[210]

[210] Table 9

Table 9: Linear Regression Analyses of Patients' Outcomes (Duration of Surgery, Number of Clinic Visits, Length of Hospitalization, Morbidity Grade, Morbidity Onset) for Saudi-Board-Certified Surgeons versus Canadian-Board-Certified Surgeons.

	Duration of Surgery (min.)		**Number of Clinic Visits**		**Length of Hospitalization (days)**		**Morbidity Grade**		**Morbidity Onset**	
	B	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**	**B**	**P-Value**
(Constant)	499.96	.000	3.58	.009	2.64	.696	0.45	.015	0.45	.001
Board	15.85	.510	5.61	.000	-17.70	.000	-0.25	.004	-0.22	.001
Years of Experience	0.28	.866	0.09	.033	1.26	.000	0.00	.915	0.00	.923
Surgery Volume	-2.60	.000	-0.13	.000	-0.18	.007	0.00	.228	0.00	.020
Neurosurgery	-386.23	.000	-2.25	.089	43.23	.000	0.30	.094	0.20	.130
Cardiac Surgery	-183.93	.000	6.79	.000	-1.74	.635	0.23	.026	0.15	.047
Oncological Surgery	7.63	.800	-1.00	.213	8.78	.027	0.37	.001	0.28	.000
Gender (Patient)	-3.42	.884	0.60	.319	-5.81	.055	-0.09	.294	-0.08	.196
Age of Patient (yrs.)	-0.84	.248	0.02	.248	0.17	.073	-0.01	.027	0.00	.116
Number of Comorbidities	-6.03	.512	0.25	.300	-2.29	.050	0.15	.000	0.08	.001
Number of Previous Surgeries	0.01	.999	-1.23	.001	6.39	.000	0.01	.863	0.01	.712
Gender (Physician)	147.57	.001	5.71	.000	9.51	.078	-0.17	.263	-0.07	.557
F	16.82		31.96		24.82		9.11		8.24	
P-Value	<0.001		<0.001		<0.001		<0.001		<0.001	
R^2	0.18		0.29		0.27		0.10		0.09	

** Significant P-Value

Duration of Surgery (min.) = 499.96 + 15.85 (Board) + 0.28 (Years of experience) -2.60 (Surgery Volume) - 386.23 (Neurosurgery) -183.93 (Cardiac surgery) +7.63 (Surgery) -3.42 (Gender of the patient) -0.84 (Age of the patient) -6.03 (Number of Comorbidities) +0.01 (Number of previous surgeries) + 147.57 (Gender of the Doctor)

Number of Clinic Visits = 3.58 + 5.61 (Board) + 0.09 (Years of experience) - 0.13 (Surgery Volume) - 2.25 (Neurosurgery) - 6.79 (Cardiac surgery) -1.00 (Surgery) + 0.60 (Gender of the patient) -0.02 (Age of the patient) + 0.25 (Number of Comorbidities) -1.23 (Number of previous surgeries) + 5.71 (Gender of the Doctor)

Length of hospitalization (days) = 2.64 -17.70 (Board) + 1.26 (Years of experience) - 0.18 (Surgery Volume + 43.23 (Neurosurgery) -1.74 (Cardiac surgery) + 8.78 (Surgery) -5.81 (Gender of the patient) + 0.17 (Age of the patient) -2.29 (Number of Comorbidities) +6.39 (Number of previous surgeries) + 9.51 (Gender of the Doctor)

Morbidity Grade = 0.45 - 0.25 (Board) + 0.30 (Neurosurgery) + 0.23 (Cardiac surgery) + 0.37 (Surgery) - 0.09 (Gender of the patient) - 0.01 (Age of the patient) + 0.15 (Number of Comorbidities) +0.01 (Number of previous surgeries) + 147.57 (Gender of the Doctor)

Morbidity Onset = 0.45 - 0.22 (Board) + 0.20 (Neurosurgery) + 0.15 (Cardiac surgery) + 0.28 (Surgery) - 0.08 (Gender of the patient) +0.08 (Number of Comorbidities) + 0.01 (Number of previous surgeries) - 0.07 (Gender of the Doctor)

(For Categorical variable: Board: 0 = Saudi, 1 = Canadian. Neurosurgery: 0 = Other, 1 = Neurosurgery. Cardiac surgery: 0 = Other, 1 = Cardiac surgery / Surgery: 0 = Elective, 1 = Urgent

3.3 Examining costs by surgery specialty

Because the board's location where doctors qualified was related to significant differences in surgery costs, combined with the effectiveness ratio indicating that Saudi-trained surgeons had more positive effectiveness ratios than Canadian surgeons, more exploration was needed. As a part of the post-hoc analysis of the above results, it was therefore decided to examine if the above results held true when considering the differing surgery specialties under examination: neurosurgery, cardiac surgery, and oncology surgery. This section will, therefore, provide an overview of this analysis and will be able to provide evidence that will either support or partially refute that outlined in the previous section with regards to the differing costs of care between board locations for surgeons.

Firstly, it is essential to note the differing ratios of surgical care provided by these groups of surgeons. Those trained in Canada were responsible for n=376 operations, for which data was collected for this current study. This was broken down by n=100 (26.6%) operations being performed by neurosurgeons, n=137 (36.4%) of operations being performed by cardiac surgeons, and n=139 (37.0%) of operations being performed by oncology surgeons. This can be contrasted with the figures of Saudi Arabia-trained surgeons, who were responsible for n=692 operations within the data collection period of this current study. Of these 692 operations, just n=69 (10.0%) were performed by neurosurgeons, while a much more significant proportion of operations were performed by cardiac surgeons: n=358 (51.7%). Oncology surgeons permed the remainder of the n=265 (38.3%) procedures. These figures indicate that the spread of specialties was fairly even for those trained in Canada; however, this is not the case for surgeons whose certification board was in Saudi Arabia; they were far less likely to specialize in neurosurgery than they were to work within cardiac- or oncology-related disciplines. It is beyond the scope of this study to examine why this is the case, but the future investigation may wish to address this.

Regarding the differing costs across these specialties and between the location of board certification, Figure 2 below highlights the mean costs of treatment for initial admissions only across these factors. This figure provides an insight that expands upon the above knowledge.

This indicates that when performing neurosurgery, the mean initial costs of treatment are higher for Saudi-trained surgeons with a mean cost of (5352 (20,070SAR) than for Canadian-trained surgeons' mean costs of 5080 (19,050 SAR). If we look at the standard deviation mean cost for the Saudi-trained neurosurgeon. We will find that for 69 neurosurgeries, it was ((6299) (23,621 SAR), while the standards deviation mean cost for the Canadian-trained Saudi surgeon for 100 surgeries was (13288) (49,830 SAR), a difference in the standard deviation mean cost of 26,209 SAR more for the Saudi-trained neurosurgeons. A t-test indicated a statistically significant difference, highlighting that neurosurgeons trained in Saudi Arabia were statistically more expensive than those trained in Canada ($p<.001$). This is perhaps reflective of the greater propensity described above for Canadian surgeons to go into neurosurgery, compared to the minority of Saudi-trained surgeons who do so; perhaps the increased training in this field enable Canadian-trained neurosurgeons to be more efficient in their practice — although it should be noted that it is beyond the remit of this study to examine why these costs may be different. The opposite, however, was confirmed in relation to cardiac surgery, with mean initial costs of treatment being higher when performed by Canadian-trained surgeons $1,928 (7,230 SAR) compared to those performed by surgeons trained in Saudi Arabia $1,289 (4,834 SAR), with a standards deviation in monetary value that is equivalent to ($696) (2,610 SAR). In comparison, the Canadian-trained Saudi surgeon had a standard deviation in the monetary value of ($2,021) (7,578 SAR) with a difference of –4,968 SAR for the Saudi-trained cardiac surgeon.

Again, this difference was statistically significant following the examination of mean differences via a t-test ($p<.001$). This again may reflect the increased likelihood of Saudi-trained surgeons entering cardiac surgery as a specialty — indicating perhaps a greater specialty in this form of surgery. Again, however, this is just speculative and beyond the scope of this study. Finally, the costs for oncology surgeries appear similar to the graph below. They indicate little difference between Canadian-trained surgical oncologists' $833 (3,124 SAR) and Saudi-trained surgical oncologist's $857 (3,214 SAR) costs. A t-test showed that this was indeed the case, with no significant differences in costs between groups being detected ($p=.775$). Table 10 below provides the details of the costs compared by training hard location across disciplines.

Table 10: Costs of care compared by training board and surgical specialty

	Canada board mean costs (SD)	*Saudi Arabia board mean costs (SD)*	*Statistical significance between Canada and Saudi Arabia values*
Initial costs			
Neuro	5080 (19,050 SAR) (13288) (49,830 SAR) (n= 100)[211]	5352 (20,070SAR) (6299) (23,621 SAR) (n= 69)	<.001
Cardiac	1928 (7,230 SAR) (2021) (7,578 SAR) (n= 137)	1289 (4,834 SAR) (696) (2,610 SAR) (n= 358)	<.001
Oncology	833 (3,124 SAR) (1029) (3,859SAR) (n= 139)	857 (3,214 SAR) (643) (2,411 SAR) (n= 265)	0.775
Total costs			

[211] These are the number of cases that were completed by the Canadian trained Saudi Surgeon and Saudi Trained Saudi Surgeon.

Neuro	5352 ((20,070 SAR) (6299) ((23,621 SAR)	11085 (41,569 SAR) (13289) (49,834 SAR)	<.001
Cardiac	2075 (7,781 SAR) (2021) (7,579 SAR)	1475 (5,163 SAR) (2021) (7,579 SAR)	<.001
Oncology	1800 (6,750 SAR) (1008) (3,780 SAR)	1071 (4,016 SAR) (1032) (3,870 SAR)	<.001

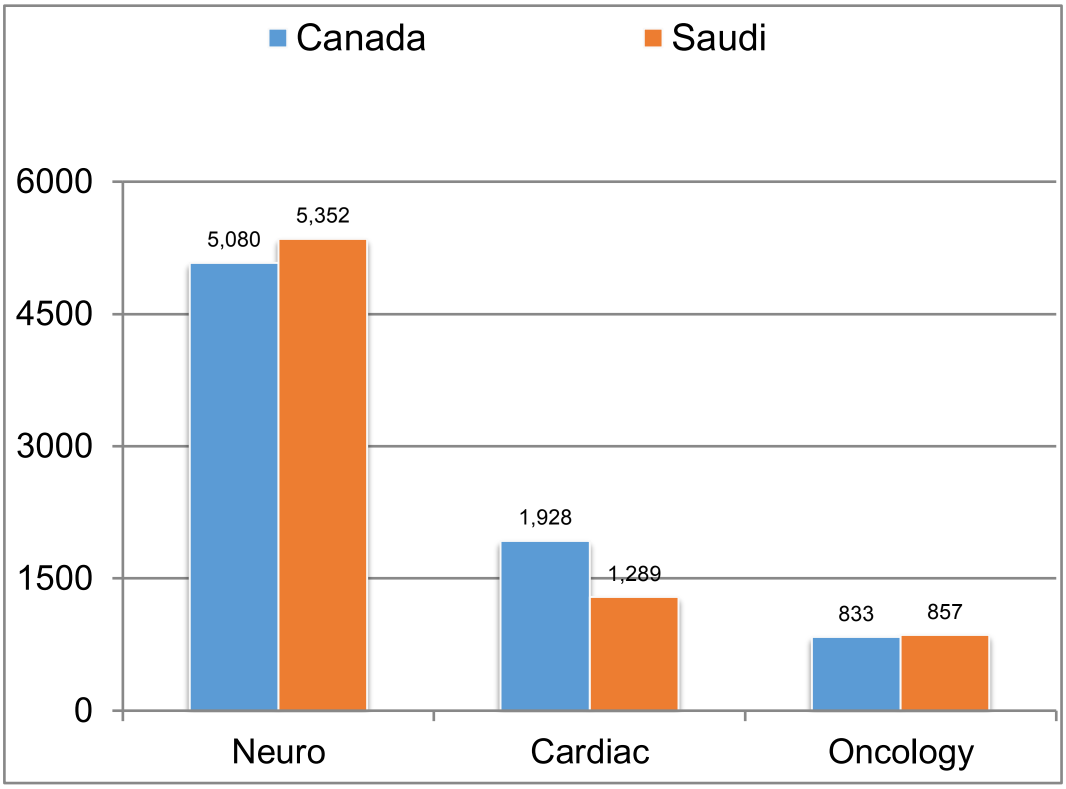

Figure 2: Comparing initial costs of treatment across surgery specialties.

To further compare the costs, an examination within the context of the total costs of care, as calculated by adding the initial costs of surgery to the costs of any required follow up care required. The differences that were described above in relation to the initial costs of surgery can be seen to be even more pronounced when factoring into the equation the monetary costs of follow up or readmission. Figure 3 shows that the total costs of Neurosurgery was for the Canadian-trained Saudi Surgeon $5,352 USD equivalent to 20,070 SAR, while for the same surgery it was $11,085 USD equivalent to 41,568.75 SAR, a difference of cost savings of 30,483.75 SAR in favour of the Canadian-trained Saudi surgeon. In cardiac surgery, the total costs of treatment were $2,075 USD equivalent to 7,781.25 SAR for the Canadian-trained Saudi surgeon, in comparison with $1,475 USD equivalent to 5,531.25 SAR for the Saudi-trained cardiac surgeon, a difference of cost savings of 2,250 in favour of the Saudi cardiac-training system. Surgical oncology when considering the total costs of treatment was higher for the Canadian-trained surgical oncologist where it was $1,800 USD equivalent to 6,750 SAR and was $1,071 USD equivalent to 4,016.25 SAR for the Saudi trained surgical oncologist, with a difference of 2,733.75 SAR in favour of the Saudi surgical oncology training program.

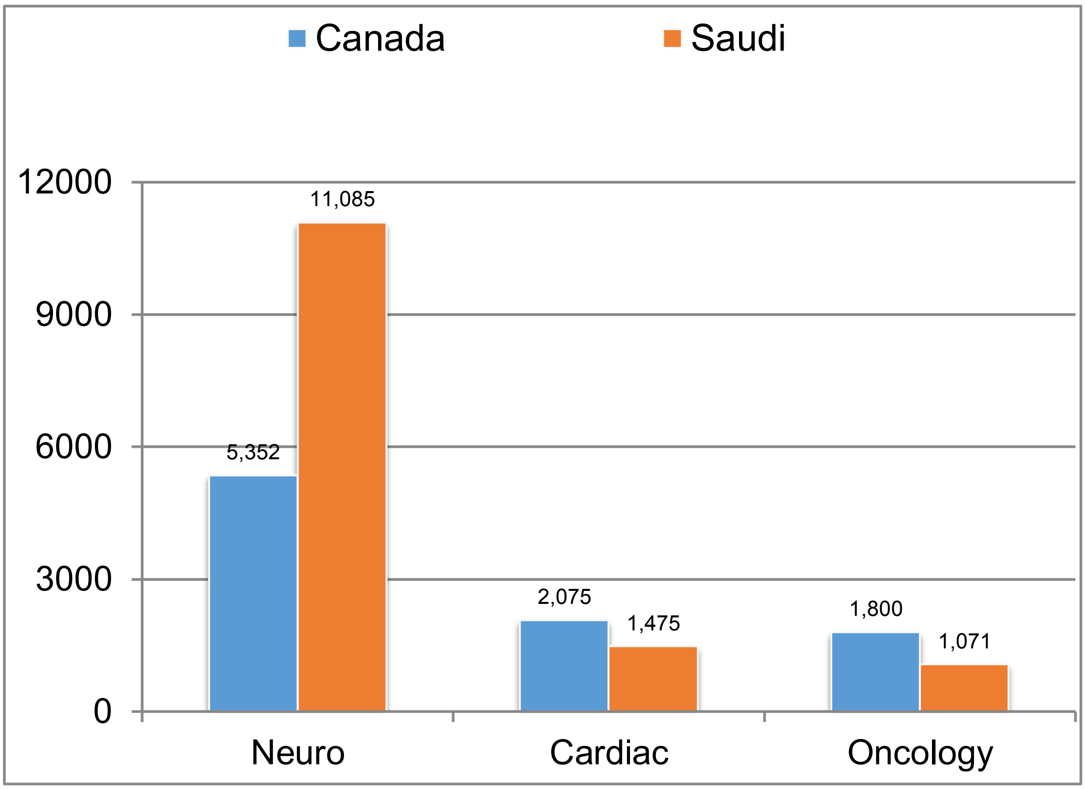

Figure 3: Comparing total costs of treatment across surgery specialties.

This indicates that there are more complications experienced within the field of neurosurgery for those surgeons trained in Saudi Arabia, which represents a significant addition to the costs of care. A t-test was conducted to examine the differences in total treatment costs, and this affirmed that the differences between Saudi and Canadian trained surgeons were indeed statistically significant (p=.001). It should, however, be noted that the number of surgeons who were trained in Saudi Arabia and who perform neurosurgery is the smallest group within this study (n=69) and so the overall impact on broader health service costs could be questioned. However, when one considers that the total treatment costs of the n=69 neurosurgeries performed by Saudi-trained surgeons were around 1.4 times the cost (sum = 764,913 (2,868,423 SAR)) of the n=100 neurosurgeries performed by Canadian trained surgeons (sum = 535,256 (2,007,210 SAR)), the issue can be seen in more context and indicates that when it comes to neurosurgery, it is much more cost-effective to utilize Canadian trained surgeons. These results indicate that there is considerable difference in the way that Saudi- and Canadian-trained neurosurgeons approach their surgeries which may reflect differing standards of training in this specific discipline, which are less pronounced in the other two surgical fields.

However, the same could not be said for either the field of cardiac surgery or oncology surgery. In these cases, Saudi-trained surgeons can be seen to be more effective in terms of the costs of surgery than their Canadian-trained counterparts. With regards to cardiac surgery, the lack of any significant increase in costs following the surgery itself maintained the *status quo* described in the previous subsection regarding the more expensive Canadian-trained surgeons (SD 2,021.41 (7,580 SAR)) compared to Saudi-trained surgeons (SD 2,021.03 (7,579 SAR)). Indeed, a t-test indicated that the difference in mean total costs, as highlighted above in figure 3, was statistically significant ($p<.001$). With regards to oncology cases, the opposite of what could be viewed in neurosurgery was true, with the post-surgery complication related costs being higher in cases where Canadian-trained surgeons practiced (SD 1,008.22 (3,781 SAR)) than where Saudi-trained surgeons did (SD 1,031.89 (3,869 SAR)). This led to a statistically significant difference to be detected following a t-test ($p<.001$), in which Saudi-trained surgeons were significantly cheaper when it came to oncology surgeries.

In summary of this section, therefore, the post hoc decision to examine the differing costs via surgery specialty has yielded a deeper level of insight into the initial findings that stated that costs of treatment were higher for Canadian trained surgeons on average compared to Saudi Arabian trained surgeons. This section has shown that this may be down to the differing specialty mix within these groups of surgeons, with Canadian trained staff being more likely to be involved with the much more expensive neurosurgery operations than Saudi trained surgeons. It is also of note, that when it comes to these expensive operations, Saudi trained surgeons are related to a much greater expense when it comes to post-treatment complications. However, with the more frequent, but less expensive operations such as cardiac and oncology procedures, this is not the case, and Saudi-trained surgeons seem to perform better — or at least in a less expensive manner than their Canadian counterparts.

3.4 Relating cost-effectiveness to treatment outcomes

The location of training where residents qualified from was predictive within regression equation models, which examined all other outcomes of interest. For example, a linear regression analysis was conducted to examine predictors of the number of clinic visits post-surgery based upon the same set of predictor variables[212]. Again, a significant regression equation was found ($F = 31.96$, $p<.001$), with and R^2 of 0.29. This model, therefore, accounted for more variance than examining the duration of surgery as an outcome. Patients predicted the number of visits was equal to 3.58 + 5.61 (board) +0.09 (years of experience) - .13 (surgery volume) + 6.79 (cardiac surgery - 1.23 (number of previous surgeries).

Similarly, another important treatment outcome, length of hospitalization, as measured in days, could be predicted via a regression equation model, and a significant equation was developed as a result ($F = 24.82$, $p<.001$) with an R^2 of 0.27. As with the previous model, the predictor variables, therefore, accounted for over a quarter of the variance in this model, and again the board qualified from was a significant predictor within this model. Patients predicted length of hospitalization was equal to 2.64 -17.70 (board)

[212] Table 9 above

+1.26 (years of experience) -.18 (surgery volume) + 43.23 (neuro) -2.29 (number of co-morbidities) + 6.39 (number of previous surgeries).

In terms of examining levels of cost-effectiveness and comparing these between Saudi Arabian and Canadian trained doctors, the above models provide a useful overview. To examine this in greater detail, cost-effectiveness comparisons between Canadian and Saudi Arabian trained surgeons can also be made by factoring in the overall costs of surgery as outlined in the previous sub-section, alongside the average costs of surgical complications and the average cost of a month's training within either Canada or Saudi Arabia. Modelling this equation, the following outcomes were found, which supported the findings outlined previously: namely, when examining issues on purely a costings basis, the costs of Canadian based training were considerably higher (mean = 27,096.39) equivalent to (101,611.5 SAR) based on 376 surgeries than were the costs of Saudi Arabian based training (mean = 20,779.00) equivalent to (77,921.25 SAR) based on 692 surgeries; in this case, the cost ratio of Canadian-based training was 1.30 times that of Saudi Arabian training. This can be attributed to the far higher costs per month of training in Canada (2.74 times higher), which potentially skewed these ratios.

Table 11: Net cost-effectiveness of the treatment (costs of care, complications, training)

Training location (n)	*Total costs in Int$ 2000*	*Mean costs (Standard deviation)*	*Effectiveness ratio compared to other location*
Canada (376)	10,215,338.99 (38,307,521.0 SAR)	27,096.39 (101,611.5 SAR) (3,633.75) (13,626.56 SAR)	1.30
Saudi Arabia (692)	14,379,070.70 (53,921,515.1 SAR)	20,779.00 (77,921.25 SAR) (5,337.34) (20,015 SAR)	0.77

However, another factor to consider is the impact of the volume of surgeries performed by surgeons trained in different parts of the work. For those surgeons who perform just one operation per month, for example, it is not cost-effective for these surgeons to be trained in Canada, with the number of operations being offset by the total cost of training in Canada, minus the total cost of training in Saudi Arabia. As table 12 below shows, the cost-effectiveness becomes equal at a stage of 1.77 operations per month and then becomes increasingly more cost-effective as the output of operations per month is scaled upwards. This indicates that the training in Canada becomes a cost-effective process if these surgeons have a substantial surgical output when qualified and can be clearly seen in figure 4 below.

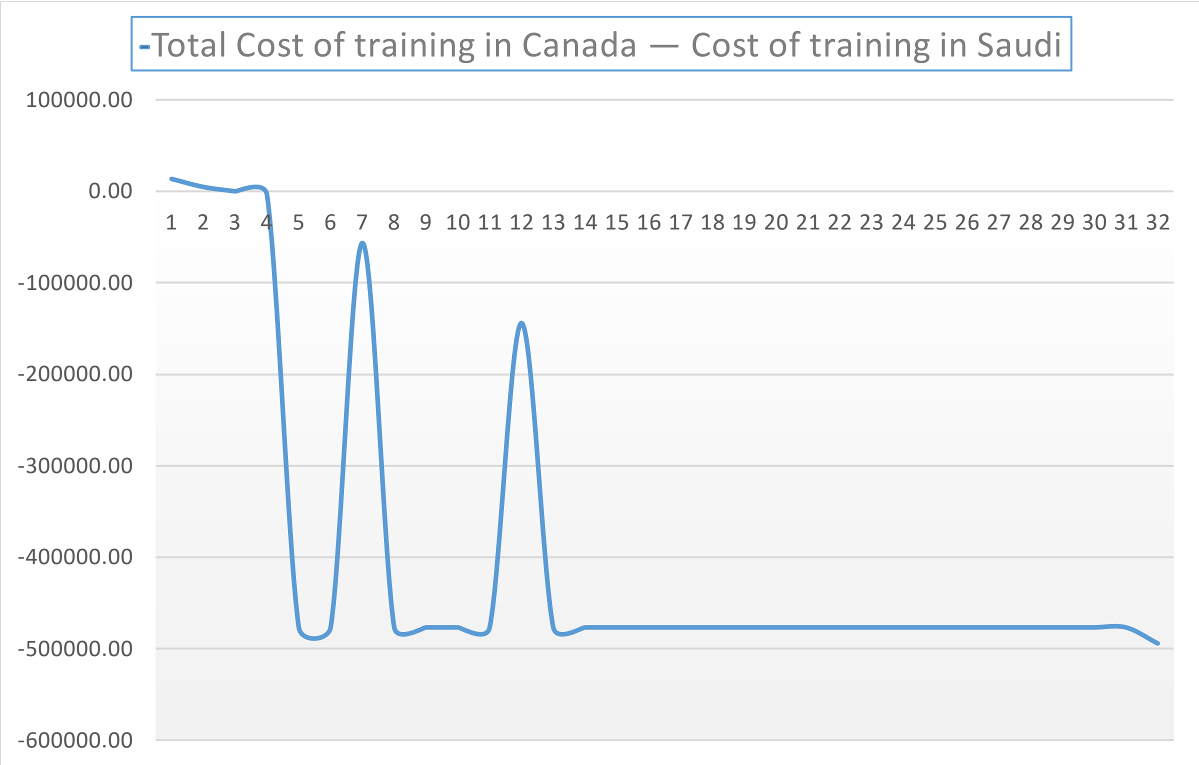

Figure 4: Total costs comparisons reduce dramatically as surgical output increases[213].

Also, just as the previously mentioned linear regression models confirmed, that there are significant differences in patient outcomes across locations of board qualification, which was a significant predictor of a range of differing outcomes. When considering the value of cost-effectiveness of training in Canada, therefore, it is also important to consider the average costs of operation and costs of complications to produce values of net effectiveness and effectiveness ratios. Again, as with pure issues of cost as outlined above, the issue of cost-

[213] For detailed total cost of training as per number of operations per month kindly see table 12

effectiveness when factoring these elements could also be expanded and used upon the surgical output of the individuals involved. Again, the tipping point from being more cost-effective to train in Saudi Arabia to be more cost-effective to train in Canada is located at the rate of 1.77 operations per month[214], at which the effectiveness ratio is 50% apiece. This ratio increases in favour of Canadian trained surgeons as the number of operations per month increases. The net effectiveness in terms of costs for each countries training can be compared via Figure 5 below.

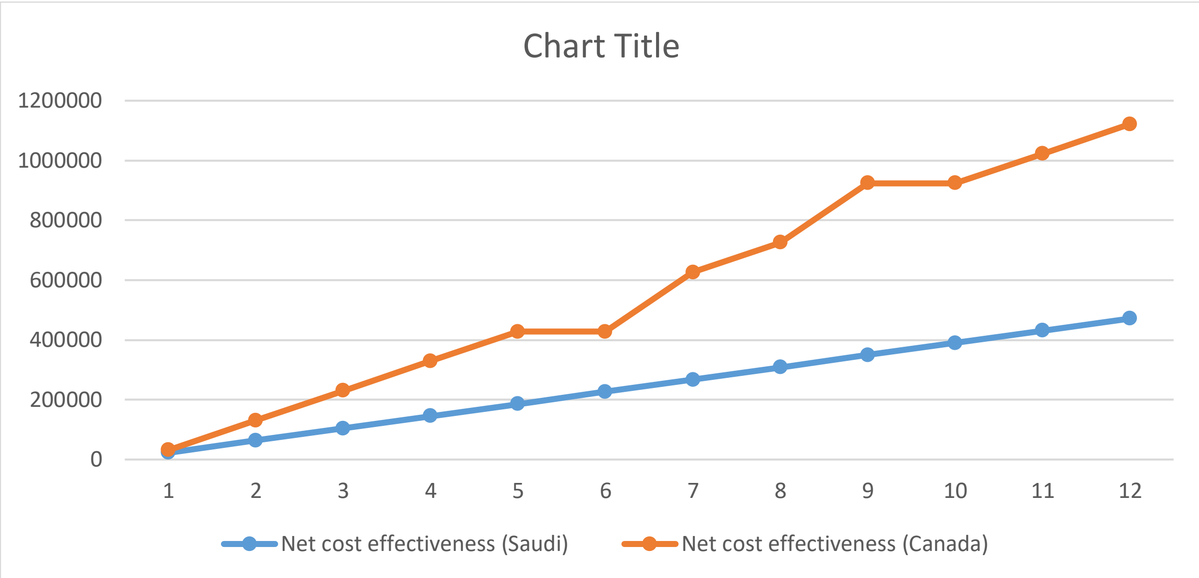

Figure 5: Net cost-effectiveness favours Canada as number of operations per month increases[215] in SAR.

[214] Table 12

[215] For detailed total cost of training as per number of operations per month kindly see table 12

Table 12: Total cost of training (Canada – Saudi)

	T.C		
# Of Opr.	Saudi	Canada	Total Cost of training in Canada - training in Saudi
1	48040.10	61548.56	13508.46
1.5	62893.39	67647.39	4753.99
1.77	70959.27	70959.27	0.00
2	77746.69	73746.22	-4000.47
3	879824.53	403083.10	-476741.43
4	879824.53	403083.10	-476741.43
5	166866.45	110339.21	-56527.24
6	879824.53	403083.10	-476741.43
7	879824.53	403083.10	-476741.43
8	879824.53	403083.10	-476741.43
9	879824.53	403083.10	-476741.43
10	315399.38	171327.52	-144071.86
11	879824.53	403083.10	-476741.43
12	879824.53	403083.10	-476741.43
13	879824.53	403083.10	-476741.43
14	879824.53	403083.10	-476741.43
15	879824.53	403083.10	-476741.43
16	879824.53	403083.10	-476741.43
17	879824.53	403083.10	-476741.43
18	879824.53	403083.10	-476741.43
19	879824.53	403083.10	-476741.43
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25	879824.53	403083.10	-476741.43
26	879824.53	403083.10	-476741.43
27	879824.53	403083.10	-476741.43
28	879824.53	403083.10	-476741.43
29	879824.53	403083.10	-476741.43
30	909531.12	415280.76	-494250.35

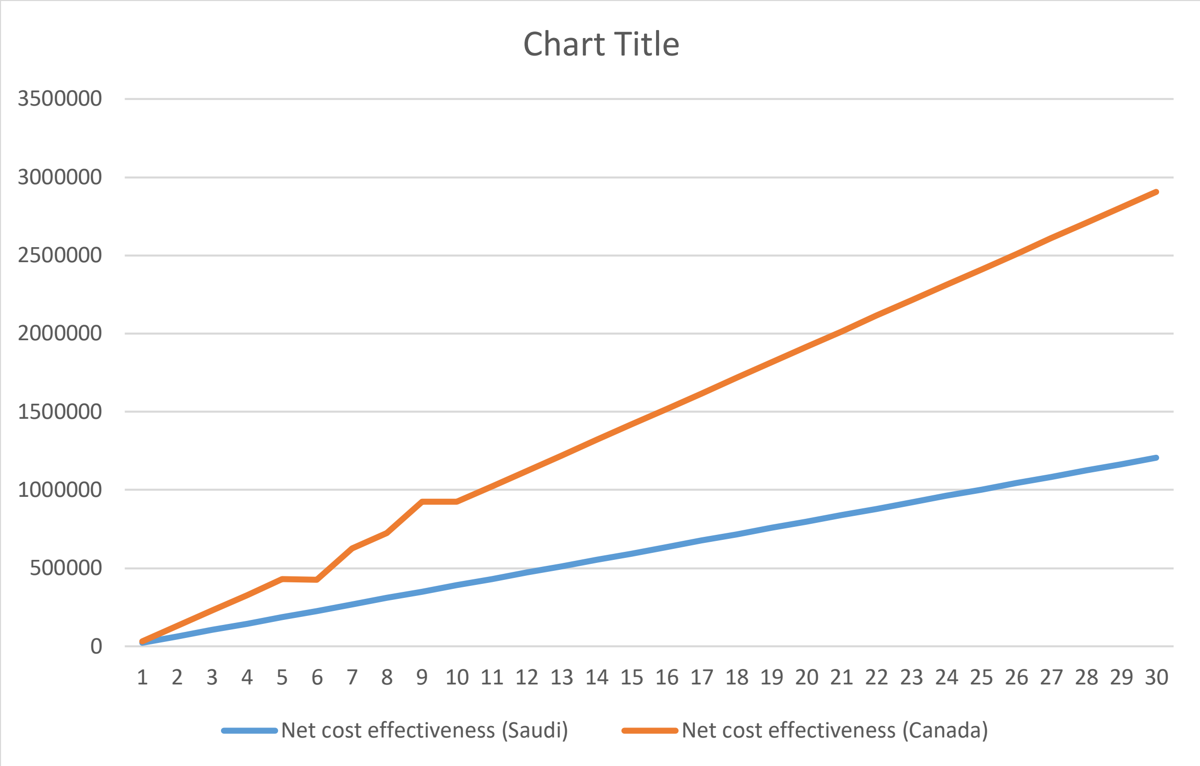

Figure 6: Net cost-effectiveness favours Canada as number of operations per month increases (30 operations)

While the above figure supports the use of Canadian training as means of producing cost-effective surgeries, this assumption is based on surgeons being able to perform a considerable number of operations every month. It would be important therefore at some stage in the future for there to be an analysis conducted — which could easily be achieved from audit data — as to the average number of operations performed per month of these staff members. This could then inform a broader overview with regards to real terms savings from this initiative. At this stage, however, there is no data that suggests how many surgeries per month are performed by these medics, and hence the true level of cost-effectiveness remains elusive.

When it comes to considering the cost-effectiveness, we can also examine the costs of complications themselves. For example, the odds ratio[216] of .349 (Beta = -1.054) that was previously detected regarding the level of complications between board-certified groups of surgeons indicates that the likelihood of Canadian trained surgeons to be associated with

[216] Table 12

surgical complications was about 65% less than Saudi trained surgeons. Considering that complications related to Saudi surgeons' cost, on average, 11,140.40 Int$ (41,776.5 SAR), and those complications related to Canadian surgeons cost, on average, 4,234.14 Int$ (15,878 SAR), this represents a reduced cost of complication of 6,906.26 Int$ (25,898.4 SAR) per complication, for Canadian over Saudi Arabian trained surgeons. Although data regarding the exact number of complications that resulted in not available, we can infer that for every 100 operations that were performed by Saudi Arabian trained surgeons that resulted in a complication, this would result in a cost of 1,114,040 Int$ (4,17,7650 SAR). By comparison, if performed by Canadian trained staff (with a reduced chance of complication, therefore, and a reduced cost per complication), the cost would equate to 147,771 Int$ (554,141.2 SAR). Although these figures are based upon several assumptions, and actual data regarding the frequency and complexity of the complications are needed, this represents an insight into how the costs of Canadian trained surgeons can be redeemed over time and made into an extremely cost-effective process.

Another way to look at the cost effectiveness of surgeons based on location of training was to estimate the costs of surgery, as performed by a Canadian-trained surgeon, and compared to the costs of surgery performed by Saudi-trained surgeons.

This sub-section will outline some of the procedures that were enacted to examine this aspect of the study. The first step of this process was to estimate the differences in training processes with the seven year of cost of Canadian residency training totalling $1,098,933.33 US (equivalent to 4,120,999.00 SAR), compared with to $404,533.33 US (equivalent to 1,516,999.99 SAR) for a Saudi based training, with a difference in training cost between the two countries of $+697,400 US (equivalent to 2615,258 SAR)

The following step within this process was to estimate the costs of surgery, as performed by a Canadian-trained surgeon, and compared to the costs of survey as performed by Saudi-trained surgeons.

These costs were calculated by combining mean operating costs, post-surgery hospital care costs, and estimated costs of complications. The estimated cost of complications were themselves calculated by multiplying the mean costs of complications with the probability of complications occurring. This can be simplified into the following:

total costs = cost of surgery + cost of post-surgery hospital stay + (cost of complications x probability of complications)

This process was applied to those surgeons in cardiac, neuro, and oncology specialties as well as to total surgeries within the dataset (i.e., not broken down by surgical specialty), and the results are outlined below.

First to be discussed are neurosurgeons. The analysis indicated that when factoring into account mean costs of operations, hospital stays, and complications, surgeries performed by Canadian-trained surgeons were on average 1,578.26 Int$ (equivalent to 5,918.47 SAR) less expensive than those performed by Saudi-trained surgeons. However, it is of note that this is the only specialism in which Canadian-trained surgeons performed surgeries in a more cost-effective manner than their Saudi-trained counterparts. For example, examination of the above formula indicated that in cardiac surgery, Saudi Arabian trained surgeons were 383.78 Int$ (equivalent to 1,439.17 SAR) less expensive per surgery than those who had trained in Canada. These results were supported — although to a lesser extent when examining the costs of oncology surgery, in which Saudi Arabian trained surgeons were 13.32 Int$ (equivalent to 49.95 SAR) less expensive than those who had received their training in Canada.

The above results re-iterate that there is no cost-effective argument that can be made — on a purely financial level — for surgeons to be trained in Canada rather than Saudi Arabia unless they are to go onto specialize in neurosurgery. At this point it is of note that these estimates cannot consider the more intangible aspects of effectiveness; for example, the lived experience of patients and the distress caused to them and their families as a result of the increased likelihood of complications that was exhibited in Saudi-trained surgeons. In addition, the evaluated surgical procedures are often due to diseases or conditions associated with high morbidity and seldom premature mortality and thus, the losses in occupational productivity and the subsequent costs to society were not possible to ascertain[217]. However, on a purely financial level, the argument from this data highlights that neurosurgery represents the sole field in which the Canadian residency scheme can be financially supported.

The final part of the cost effectiveness analysis will examine the point at which Canadian training becomes cost effective. This has only been conducted for neurosurgeons, because as noted above, those from other specialties are less expensive per operation when surgeons are trained in Saudi Arabia. At an average cost of neurosurgeries being 1,578.26 Int$ (equivalent to 591,843.75 SAR) less expensive when performed by Canadian trained surgeons, it can be estimated that for every 100 neurosurgeries performed by these staff, 157,825 Int$ (equivalent to 591,843.75 SAR) is saved compared to 100 neurosurgeries performed by Saudi-trained surgeons. Because the training of these surgeons cost $697,400 (equivalent to 2,615,250 SAR) more, it would take 422 operations to be conducted for savings to start being made. However, the above numbers demonstrate, upon reaching this threshold, the cost effectiveness for Canadian-trained Saudi surgeons continues at a rate of $157,825 US (equivalent to 591,843.75 SAR) per 100 operations

In conclusion, this set of results provides a set of findings which lays bare the complex nature of training surgeons abroad; whereas there is good evidence to indicate that in neurosurgery, this is related to decreased costs, the evidence also does not support the economics of this approach of those not working in this clinical field. This is an important

[217] (Sambamoorthi *et al.*, 2015)

distinction to make therefore that this system may not able appropriate or cost effective for all surgeons, but within this specific specialty, it may be an important and cost-effective thing to do. Further, one needs to always consider the psychological stress that patients and their families endure when knowing that there is a higher complication rate for neurosurgeries that are performed by the Saudi trained neurosurgeon, in comparison to the Canadian-trained neurosurgeon. This adds a greater value on the Canadian neurosurgery program, that outweighs the cost of its training. In the other two specialties, it was shown that the Saudi training system for cardiac and surgical oncology was in its favour, but the cost savings can be easily offset by the emotional and psychological distress that the patients and their familied endure.

It is important to consider all elements when looking into policy decisions based on cost- effectiveness, as on the outset in two of the three specialties favoured the Saudi training system, it did not consider the non-measurables such as mental, psychological and emotional distress that patients and their families may endure when knowing that the overall complication rate is higher for the Saudi-trained surgeon, than their counterparty who had an overall lower complication rate in all of the three specialties included in this study. Other non-measurable costs included the socioeconomic effects of chronic disease and related surgical morbidity or symptom relief or disease resolution, as well as the costs associated with professional development and revalidation procedures for surgeons in training.

Table 13: Logistic Regression Analyses of Patients' Outcomes (Complications) for Canadian-Board-Certified Surgeons Versus Saudi-Board-Certified Surgeons[219]

		B	Odds Ratio[218]	95% CI for Odds Ratio		P-Value
				Lower	Upper	
Board	**Canadian**	-1.054	0.349	0.210	0.580	< 0.001*
	Saudi$	1.000				
Years of Experience		0.006	1.006	0.975	1.038	0.696
Surgery Volume		-0.010	0.990	0.979	1.001	0.083
Type of Surgery	**Neuro**	0.820	2.270	0.864	5.966	0.096
	Cardiac	0.777	2.174	1.271	3.720	0.004*
	Oncology$	1.000				
Surgery	**Elective$**	1.000				
	Urgent	0.617	1.853	1.125	3.053	0.015*
Gender of the Patient	**Female**	-0.460	0.632	0.402	0.993	0.046*
	Male$	1.000				
Age of the Patient (Yrs.)		-0.008	0.993	0.979	1.006	0.289
Number of Comorbidities		0.250	1.285	1.088	1.517	0.003*
Number of Previous Surgeries		0.030	1.030	0.805	1.319	0.813
Gender of the Physician	**Female**	-0.478	0.620	0.247	1.560	0.310
	Male$	1.000				
Constant		-1.382	0.251			0.006*
* Significant P-Value $ Used as a Reference.						

[218] The odds ratio … approximates how much more likely (or unlikely) it is for the outcome to be present among those with x= 1 than among those with x= 0. (Hellevik, 2009, p. 66)

[219] Logit (pi) = Ln(Odds) = -1.382 - 1.054 (Board) + 0.006 (Years of experience) - 0.010 (Surgery Volume) + 0.820 (Type of Surgery - Neuro) + 0.777 (Type of Surgery - Cardiac) + 0.617 (Surgery) - 0.460 (Gender of the patient) - 0.008 (Age of the patient)+ 0.250 (Number of Co-morbidities) + 0.030 (Number of previous surgeries) - 0.478 (Gender of the Doctor)
(For Categorical variable / Board: 0 = Saudi, 1 = Canadian / Type of Surgery: 0 = Oncology, 1 = Neurosurgery, 1 = Cardiac surgery / Surgery: 0 = Elective, 1= Urgent / Gender: 0 = Male, 1 = Female)

3.5 Summary

In summary, therefore, the above outlining of the results of these analyses have highlighted several salient points. Firstly, when it comes to important outcomes post-surgery, such as the time needed in the hospital afterward, such as the number of visits needed, and such as morbidity, whether the surgeon was trained in Canada or Saudi Arabia was highly predictive across these outcomes. Second, this section has shown how the location of this training can also be linked to long-term cost savings, depending upon the productivity and volume of output of individual surgeons. However, taken on a patient-by-patient basis, the cost-effectiveness equations used indicated that Saudi-trained surgeons were more cost-effective, mainly due to savings made across the course of training. This should be tempered with the knowledge that for expensive and complicated neurosurgeries, the Canadian-trained surgeons demonstrate a reduced set of costs both for the initial surgery itself and for the longer term when considering complications that require readmission, for example. This situation was mirrored by the opposite being the case when it came to the less expensive but more common cardiac surgery and surgical oncology cases, where the cost differences are negligible in surgical oncology cases. Saudi-trained surgeons represented less of an expense than their Canadian-trained counterparts. This, therefore, represents a varied set of findings, the implications of which will be discussed in a subsequent section. Finally, this analysis has also shown how more detailed data relating to the actual output of surgeons would be valuable in further elucidating the true cost-effectiveness of the Canadian training program for the health service in Saudi Arabia.

Chapter 4. Discussion

The costs associated with postgraduate surgical training are complex to quantify as many factors are related to these quantifications. Likewise, assessing the effectiveness of postgraduate surgical training in this paper has also proven to be a complicated process due to the variability of factors that needs to be considered when calculating the value generated from the effectiveness of one surgical training program vs. the other.

This paper aims to determine the incremental cost-effectiveness of training Saudi surgeons in Canada vs. training them locally through the SCFHS. This dilemma is addressed through answering its main research questions "*What is the incremental cost-effectiveness of training Saudi surgeons nationally vs. training them in Canada*?"

The effect of the location of training postgraduate Saudi surgeons on patient outcomes was determined through the paper titled "*Saudi Arabia vs. Canada, is there a difference in the quality of patient surgical outcomes based on postgraduate surgical training location*?" Where Saudi surgeons trained in Canada had fewer adverse events than the Saudi surgeon trained in Saudi Arabia in Cardiac surgery, this was evident in the chosen indicators such as readmission to the operating room and the general ward within the first 30 days of the initial procedure.

To my knowledge, examining the cost-effectiveness of two training programs and the incremental value it adds has not been studied before, especially in Saudi Arabia, nearly all the literature reviews conducted for this paper were merely a systematic review of a specified context. Therefore, the findings in this paper could be generalizable in the future for further studies comparing training programs in two different countries.

From the results section calculations and tables, it is safe to conclude that training postgraduate surgical residents in Canada, although 2.7 times higher than the cost of training them locally through the Saudi commission for health specialties, is much more cost-effective when the volume of surgeries increase per month in the long run. Furthermore, the effective ratio increase for the Canadian-trained surgeon as the number of operations increases; it was also evident that the possibility of readmission to the operating room and the general ward within the first 30 days of the initial operation is lower for the Canadian-trained surgeon than the Saudi.

It is worth mentioning that the short-term results favor the Saudi training as it shows that it delivers more value per SAR spent in training. Still, with the increasing demand to increase the number of the healthcare workforce to meet the current national needs for healthcare services, this option is clearly not enough.

Volume as an efficiency indicator has been studied before. In the paper titled "Relationships between volume, efficiency, and quality in surgery — a delicate balance from managerial perspectives" by Kraus et al., they looked at the volume-based learning and volume-outcome relationships in surgery. In the first area, they have stated that "volume-quality links appears to be heavily based on learning and infrastructure features to access to knowledge and high-end technical support[220]". The authors continued by stating that there is insufficient accurate data of existing administrative processes[221]. This statement also seemed to be proven in this study. The factors that were considered are costs associated with training Saudi surgeons in one site vs. the other but did not look into administrative training procedures that gave the Saudi Canadian trained a lead advantage when looking at the value generated from the effectiveness of the training program itself.

In the latter, the authors stated, "the strength of any association between volume and outcome was procedure-specific[222]". This is also true in the realm of this paper as three specific surgeries were determined early on, and the outcomes, specifically readmission to

[220] (Kraus, Buchler, & Herfarth, 2005, p. 1238)
[221] (Kraus, Buchler, & Herfarth, 2005, p. 1238)
[222](Kraus, Buchler, & Herfarth, 2005, p. 1238)

the operation room and the general ward within the first 30 days, were examined to show that the Canadian-trained Saudi surgeons are more cost-effective than the Saudi-trained surgeons. This is heavily dependent on increasing the volume of surgeries per month in the three surgeries (*Ventriculoperitoneal (VP) shunts insertion and revision from neurosurgery specialty, coronary artery bypass grafting (CABG) from cardiac surgery, and mastectomy and colectomy from surgical oncology specialty).*

The volume within this study played a role in skewing the effectiveness ratios. Table 8 showed that the cost of treatment for the initial treatment plus outpatient care for the Saudi board trained surgeons was less than the Canadian board trained surgeons as their effectiveness ratios were 0.08 and 1.25, respectively. Therefore, it was determined to look at each specialty on its own to understand the actual cost-effectiveness of training Saudi surgeons in one location versus the other. The Saudi surgeons who were trained in Canada had a total number of 376 operations, which was the data collected for the current study, and the Saudi surgeons who were trained in Saudi Arabia had a total number of 692 operations. Of these numbers, it was found that within neurosurgery, the Canadian-trained Saudi surgeons had 100 cases and the Saudi-trained surgeons had 69 cases; although the number of cases for the Saudi-trained surgeon was much lower than the Canadian-trained Saudi surgeons, there was a statistical difference in costs of care compared by training board and surgical specialty with a P-value of <.001 and SD (5080 (19,050 SAR) for the Canadian trained Saudi surgeons versus SD (5352 (20,070SAR) for the Saudi-trained neurosurgeons. Further, the mean initial costs of treatment are higher for Saudi-trained surgeons than for Canadian-trained surgeons with an SD13,288.93(49,833.48 SAR) and (SD 6,299,07 (2,362,151.25 SAR)) respectively. Therefore, indicating that it is much more cost-effective to train Saudi surgeons in Canada for that specialty. Also, it was found that the average cost of neurosurgeries being 1,578.26 Int$ (equivalent to 591,843.75 SAR) less expensive when performed by Canadian trained surgeons, it can be estimated that for every 100 neurosurgeries performed by these staff, 157,825 Int$ (equivalent to 591,843.75 SAR) is saved compared to 100 neurosurgeries performed by Saudi-trained surgeons. Because the training of these surgeons cost $697,400 (equal to 2,615,250 SAR) more, it would take 422 operations to be conducted for savings to start being made. However, the above numbers demonstrate that the cost-effectiveness for Canadian-trained Saudi surgeons continues at a rate of $157,825 US (equivalent to 591,843.75 SAR) per 100 operations upon reaching this threshold.

On the other hand, when looking at the other two specialties, cardiac and surgical oncology, where in cardiac surgeries, the mean initial costs of treatment were higher for the Canadian-trained surgeons (SD 695.81(2,609.28 SAR)) compared to those performed by surgeons trained in Saudi Arabia (SD 2,021.41(7,580.28 SAR)). This could result from the volume distribution, where Saudi-trained surgeons have a much higher patient volume than the Canadian-trained Saudi surgeon (n = 265, n = 137), respectively. Finally, the costs for oncology surgeries appear similar and indicate that there was little difference between Canadian-trained (SD 642.57(2,409.63 SAR)) and Saudi-trained (SD 1,029.20(3,859.5 SAR)) surgery costs.

As mentioned previously, the increase in volume, regardless of the type of surgery, has shown to favor the Canadian postgraduate surgical training; this was clear in the savings that increased monthly in proportional with the volume increase.

Many studies have focused on competency-based training and evidence-based healthcare, but none looked at the effectiveness of these approaches to reduce cost. This paper's cost-effectiveness analysis helped establish the net cost-effectiveness of the two training programs (Canada & Saudi Arabia), specifically when postoperative surgical complications both in the long and short term. This was evident in Figure 2, where it was found through the calculations conducted that in the long term, with the increased number of surgical volumes to 30 surgeries per month to have a $625,000 US in savings monthly in favor of the Canadian trained surgeon, which is equivalent to 2,343,750.00 SAR. However, in the short term, it was more cost-effective to train surgical residents locally in Saudi Arabia when their output is less than one operation per month, as both surgeon categories (Canada trained vs. Saudi trained) become equal at 1.77 operations per month. Further, when considering the outcomes from the logistic regression analysis[223], it was suggested that the Canadian-trained surgeons have 65% less postoperative complications than the Saudi-trained surgeon, with a reduced cost per complication of 6,906.26 Int$ (25,898 SAR).

In addition, it has been shown in studies like the one conducted by Birkmeyer et al. that mortality rates decreased as volume increased in 14 types of procedures mentioned in their study[224]. This was also shown through the calculations conducted in this study that increased surgery volume has a positive effect on incremental costs of training programs and lower postoperative complications as skills are improving gradually through practice. The volume is also associated with improved quality of patient health care status as fewer clinical visits postoperatively and fewer postoperative readmissions to the operating room and the general ward within the first 30 days of the initial operations. This is also true in the realm of this study, as improved healthcare outcomes mean that the Canadian-trained surgeon provides an improved service quality.

Although the concept *of Cost offset*[225] is not included in the analysis, it is important to mention. *According* to Kaplan and Groessl, cost offset is “a term used to describe interventions that save money independently of their health benefit[226].” This paper has shown that the Canadian training system in neurosurgery is much more cost-effective than the Saudi

[223] Table12
[224] (Birkmeyer et al., 2002, p. 1128)
[225] Kaplan & Groessl indicated that cost-offset is not recommended as the primary goal because it shifts focus away from whether the intervention improves health. Yet, it may be present with cost-benefit or cost-effectiveness. (p.483)
[226] (Kaplan & Groessl, 2002, p. 483)

training system. Yet, the results in cardiac surgery suggest that the Saudi training system appeared to be much more cost-effective. However, the results did not include all the health benefits or lack-of such as the mental health and emotional distress caused to patients and their families due to the increased likelihood of complications exhibited in Saudi trained surgeons. Therefore, the local training program's savings will be discounted in theory when considering the emotional and mental distress that the patient and their families may experience. The third specialty (surgical oncology) analyzed showed no statistical differences between the two locations.

The Saudi training system could benefit from the existence of Canadian-trained surgeons currently practicing in governmental hospitals. Increasing the volume of surgeries that the Saudi consultants could assist in performing alongside a Canadian-trained Saudi surgeon would positively impact knowledge transfer and improve Saudi surgeons' skills. Creating a blended mix of knowledge and experience transfer would also benefit the Saudi surgeons; this means that for every operation conducted, a Saudi-trained surgeon would accompany a Canadian-trained surgeon to transfer knowledge and skills acquired through the Canadian surgical residency programs. Measuring the monetary value of improved performance would help understand incremental value gained when conducting a cost-effectiveness analysis based on this blended mix of a training system.

Training policy adjustments are required to look at the cost-effectiveness benchmarks for incremental values generated from a certain training program locally and internationally. For example, this study, through its cost-effectiveness analysis results, indicates that in the long run, it is more cost-effective to continue sending surgical; residents to Canada to increase the level of knowledge and skills acquired and the ease of transferring this knowledge to the appropriate context. Further, training policy should address solutions to residents who could not secure residency seats in the Canadian surgical program and look at alternatives to increase the number of fellowship scholarships to Canada after reaching an international agreement with the Royal College of Surgeons in Canada.

Saudi Arabia is currently creating a cost center for all diseases and postoperative and medical interventions. This will have a significant impact on cost-effectiveness analysis on various disease-related outcomes, which will help to guide training policymakers to look at the incremental value gained from other international training programs worldwide.

The country is moving toward privatizing all healthcare services. Therefore, it should closely learn from the private sector about resource allocation and return on investment in postoperative complications for surgeons who have trained abroad and use them as models for further improvement in the current training system. This would include the total revision of the existing institutional and program accreditation processes and standards and a complete close examination of the current trainers' qualifications and their appropriateness to train residents.

Chapter 5. Conclusion

5.1 Concluding Remarks

From the results and discussion, it was evident that conducting a cost-effectiveness analysis to compare two training programs in two different countries through carefully examining post-operative complications offered a structured approach to improve the return on resources invested in these training programs. Therefore, it is safe to conclude that the incremental benefits associated with the Canadian-trained surgery program outweigh its costs in neurosurgery. However, although there was a statistical significance in cost-effectiveness in the cardiac cases examined in favor of the Saudi trained system, this cost could be off-set by the emotional and mental distress that the patients and their families experience as a result of an increased likelihood of complications that were exhibited in Saudi-trained surgeons. In addition, the variation in case distribution could have skewed the results in the cost-effectiveness analysis conducted previously, where except for neurosurgery, the remaining two specialties (cardiology and surgical oncology), the Saudi-trained surgeons had a noticeable higher volume in cases than the Candian-trained surgeons. Once the volume increase for the Canadian-trained surgeons to exceed the 1.77 operations per month, cost-effectiveness analysis favors the Canadian-trained surgeon over the Saudi-trained surgeon. This is evident in the total savings that increase as the volume of operations increases in one month; accumulating all the months together in one-year yields a total cost of training savings that would amount to 28,125,000.00 SAR annually. This large amount can be reinvested in the Saudi training programs to increase the competencies required to match those of the Canadian system.

5.2 Research Limitations

In this study, most of the medical interventions do not have costs associated with them; Saudi Arabia, through the Ministry of Health, just started creating cost codes for surgeries and post-operative complications associated with it. Further, there are no-cost codes associated with inpatients' length of stay.

Lack of data was a significant obstacle while conducting this research, as governmental hospitals don't have cost codes for procedure or complications, this became an issue when trying to find inpatient costs per day in a given hospital or a post-operative complication other than unplanned readmission to the operating room or the general ward within the first 30-day post-operation. Further, costs in surgical oncology complications were unavailable except for the known return to the operating room and the general ward within the first 30 days of the initial operations. Therefore, it is necessary to look at the added costs postoperatively, such as chemotherapy prior to an oncology surgical procedure such as breast cancer should be considered to determine the cost-effectiveness accurately.

Factors such as health adjusted life years were not calculated, and there is insufficient information to calculate the quality-adjusted life years and its positive impact of the health gain as a result of a positive surgical procedure and the disability-adjusted life year and its impact of health loss as a negative surgical procedure outcome. Further, there was no indication in any literature review of the costs that society is willing to pay for improved health.

Finally, there were no studies to my knowledge that studied the cost-effectiveness of two training programs in two locations. Therefore, the ability to benchmark with other research and to look at cost-effectiveness thresholds were not feasible.

5.3 Implications for Further Research and Policy

To my knowledge, this paper would be the first of its kind to calculate the cost-effectiveness of two training programs in two different locations, specifically Saudi Arabia and Canada. This study focused on postoperative complications such as readmission to the general ward and the operating room within the first 30 days of the initial surgery. Using the costs of the mentioned postoperative complications to measure the effectiveness of the training programs, it was found that it is more cost-effective in the long run to continue sending surgical residents on scholarships to Canada. However, the opportunity costs were unable to be determined, as mentioned, because of the severe lack of data. Indeed, the analysis of secondary or pre-existing data pertaining to surgery costs across both settings was a fundamental limitation of this research as the segmental costs of treatment may have been outdated and either under or over-estimated. However, conducting a more rigorous analysis of cost-effectiveness would require considerably more research time, resources, and costs and may even be unfeasible in the current context of the COVID-19 pandemic, which is adversely affecting researchers' ability to generate credible primary evidence to inform current and

future practice[227]. Despite this, future research could build upon the evidence generated in this study by seeking to ascertain or calculate the current surgery costs in the Canadian and Saudi contexts and re-exploring the comparative cost-effectiveness of neurosurgery, cardiac surgery, and oncological surgery using methods reported by previous researchers[228].
It would be interesting to determine the effectiveness of different training settings worldwide and the incremental value gained from the return on investment when examining health outcomes.

Saudi Arabia through the ministry of health, should invest financially in research that addresses the current knowledge gap in postgraduate medical training and it is long-term cost-effectiveness for society. The continuous measurement of educational outcomes and the incremental values generated from the costs associated with the training process as a whole should be carefully examined; this would include looking at the current center and program accreditation and determine whether it is internationally compatible with what is available or not. Studies such as this paper would have a beneficial impact on training decisions made by the training and academic affairs within the MOH and medical cities. More studies using additional economic evaluations and methodologies to determine the effectiveness of training and the possible return on investments of these training programs using primary data if available is warranted for future research.

The three-tiered system that the Saudi healthcare system currently has should look into the inclusion of the private system and examining the effect of the Canadian trained surgeon vs. the Saudi trained surgeon since both have private clinics and are required to manage efficiently according to the resources available. This will help understand the cost that society is willing to pay for one unit of improved health outcomes. Further, it will help understand efficiency aspects that could not be addressed in a governmental health institution

[227](Tuttle, 2020)
[228] (Abdolahi *et al.*, 2018, Ariyaratne *et al.*, 2018, Kameda *et al.*, 2017).

due to the lack of accurate cost codes for services and supplies. In the current context, the implications for clinical managers with access to funding allocators and related decision-making are somewhat clear. In this regard, the cost-effectiveness of surgery conducted in Canada and Saudi Arabia vary but is by no means excessive enough to warrant cessation of critical surgical procedures that are known to spare morbidity and lives. Thus, clinical managers should seek to optimize cost-savings through other means, such as operational efficiency and patient throughput, which have been known to exaggerate the costs of hospital care and more comprehensive costs related to social care provision[229].

Conflict of interest statement

I declare no personal, financial, or political interest, which could influence the findings submitted in this paper.

[229] (The Chartis Group, 2007)

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Appendices

Appendix 1: Cost-effectiveness calculations.

Equation name	Calculation method
Average cost of operations	Total cost of operations / total number of operations
Average cost of complications	(Average total #complications x %of it occurring) + (possibility of admission x average stay in the hospital x cost of hospital admission)
Net Effective cost	cost of operation – average cost of complication – cost of training in one month – readmission to OR within 30 days x cost of operation
Effective ratio	Total benefit for each country/ total benefit for both countries
%Of complication occurrence	Total number of complications / total number of operations
Average cost of training	Cost of training in 1 month / (7yrs*12)
%Readmission to G.W with in 30days	Total number of patients readmitted to the GW / total number of operations
%Readmission to OR within 30days	Total number of patients admitted to OR within 30days / total number of operations

Paper# 3:Quality Improvement Model for Postgraduate Surgical and Medical Training in Saudi Arabia

Abstract

Background

Delivering high-quality care by physicians is determined by the quality of training within the facilities they complete their residency. Residents should be trained in settings that provide them with an optimal experience during their journey in acquiring their medical or surgical board. To assess the quality of training within Saudi Arabia, a multi-institutional mixed-method approach was administered. It was found that training programs require performance improvement initiatives to improve their ability to deliver the training process to enable residents to provide healthcare optimally and consistently. This paper presents a quality improvement initiative that the Saudi Commission for Health Specialties could adopt to elevate the quality of residents' competencies required to deliver safe care.

Medical residency programs are designed to equip residents with skills and knowledge to provide high-quality care. These programs take into consideration educational as well as clinical aspects to provide trainees with suitable competencies, which can be defined as "[t]he array of abilities across multiple domains or aspects of [in this case] physician performance in a certain context[230]". Since there is a direct association between professional competencies and residents' ability to deliver high-quality care due to the quality of training they receive during their residency, it is vital to take into account program directors' and residents' perspectives on current postgraduate medical and surgical training programs and to consider the policy implications for postgraduate medical and surgical training in the context of particular medical systems within the Kingdom of Saudi Arabia. Furthermore, the quality of training that the residents receive during their residency period highly affects their ability to perform competently in the future. The type of rotations that are

[230] (Frank et al., 2010, p. 641).

required, the allocated time for operation room training, the research necessary, the teaching hours that they receive, the coaching that they require from senior residents, and their ability to accurately document patient symptoms and their diagnoses are all essential elements that both program directors and residents need to address. Therefore, it is important to know their perspectives on the current training process to improve it and eventually provide residents with a training system that meets and exceeds their expectations and professional standards.

Objective

The objectives of this paper are twofold, first, to explore and understand the views of residents regarding the Saudi postgraduate medical training program; and second, to generate consensus on how to move forward and revise training programs to optimize residents learning and development.

The first objective is addressed by conducting surveys among residents and program directors to understand the barriers and facilitators to professional learning and development. The Executive Department of Training distributed the surveys within SCFHS for legal reasons, and the results were shared to create questions for focus groups for both residents and program directors. The second objective was addressed using an exploratory qualitative approach that elicited the most critical issues in the current training system. Further, this research complied with the quality performance improvement framework proposed to the Saudi Commission for Health Specialties to generate locally relevant and informative findings to stimulate training program improvements.

Methods

A multi-institutional, mixed-methods study was conducted to answer the main research question, "What are the perspectives of program directors and residents on the current Saudi surgical training system, and how can it be improved?"

Results

Governance of the training process was highlighted as the most crucial aspect that needs to be improved within the postgraduate medical and surgical program throughout the three methods used within this paper. The importance of conducting qualitative research (satisfaction surveys, focus groups) prior to the Delphi survey is to identify the most important aspects and themes that the residents and program directors consider essential elements that they would like to improve.

The Delphi survey is a sequential process through which opinions are collected anonymously from participants[231]; it also allows participants to be selected based on characteristics. Throughout the three rounds that were administered in this section of the methodology. The participants were fed back their responses based on the highest weights to determine the most important aspect of the training process that both residents and program directors considered. Within the three-round resident Delphi survey, residents have given the high importance of having a systematized training process by having clear policies and procedures that lay the law of the land for programs to follow and that this process needs to be transparent. They also required that their trainers devote a sufficient amount of time and instruction during teaching, an element that should be clearly stated in training policies and procedures as defined by the clinical site.

The program director Delphi survey, in its final round, showed that the well-being of residents was in ensuring that they had sufficient time of support given to them by their

[231] (Keeley et al., 2016, p. 2)

trainers. They further indicated that the training facility needs to have the appropriate infrastructure and leadership to support the training process's delivery adequately. Finally, they indicated that the faculty must maintain a culture of supervision such that residents feel safe and supported when requiring assistance in delivering patient care.

From the results mentioned in the final round of the Delphi survey, it is apparent that Saudi Commission for Health Specialties is required to look into improving the training processes and experiences for residents within the hosting training institutions that they accredit for all stakeholders involved in the training journey.

Having clear policies and procedures that govern the training process within institutions will eliminate the noted variation in training delivery methodology between trainers. Further, clear descriptions of what is required from trainers and what is expected from them when delivering the training process would help trainers understand their required responsibilities. Having this focused understanding of what residents and program directors deem to be important elements to have in the training program elicits the need for adopting quality training standards that training institutions could use as a self-assessment tool and report back the results to SCFHS. This elevated the need to have an improvement framework that encompasses various aspects of the training process.

Conclusion

There is a current need to look deeply into the structure and support elements of the training process. There was a unanimous call for having clear policies and procedures in training programs, sufficient institutional support for residents and program directors to gain and provide a seamless training process. The proposed quality framework[232] in this paper encompasses standards that deal directly with the two issues mentioned within the context of this paper and have a broader scope to cover other areas in the training system. Examining

[232] I have proposed a quality framework "Excellence by Design"at the end of this paper to present best practices in postgraduate health training.

the effect of these standards on improving the outcome of training programs will be an area that should be examined once these standards have been approved and adopted by SCFHS.

Keywords

Training quality, quality in postgraduate health training programs, quality improvement, quality standards.

Chapter 1. Introduction

1.1 Overview of the Problem

Medical residency programs are designed to equip residents with skills and knowledge to provide high-quality care. These programs consider educational and clinical aspects to provide trainees with the competencies necessary to deliver high-quality patient care[233]. In other words, such competencies can be defined as "an array of abilities across multiple domains or aspects of [in this case] physician performance in a certain context[234]". Since there is a direct association between competencies and residents' broader ability to perform high-quality care with the type of training they receive during their residency, it is vital to consider program directors' and residents' perspectives on current postgraduate medical and surgical training programs and to consider the policy implications for postgraduate medical and surgical training in the context of particular medical systems within the Kingdom of Saudi Arabia[235]. For example, in a recent systematic review of qualitative and quantitative evidence, Garzonis (2015) explored the traits and skills of various healthcare staff upon patient outcomes. Through an evaluation of 24 studies, they found that effective communication, diagnostic capability, and referral were the primary competencies associated with desirable outcomes[236]. The impact of clinician competencies upon patient outcomes has also been reflected across evidence showing that improvements to care experiences and outcomes consistently demand improvements to practitioner education, training, and professional development, suggesting that practice with outdated knowledge and/or skills may be associated with compromises to patient safety, static (non-improving) outcomes and even patient harm[237]. There has even been research showing that the education and training of physicians in cultural competency–delivery care in accordance with principles designed to optimize care experiences and outcomes is associated with improvements of clinically

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233 (Frank et al., 2010, p. 641).
234 (Frank, et al., 2010, p. 641).
235 (Combes 2012 & Mosadeghrad 2014)
236 (Garzonis et.al., 2015)
237 (Beech 2019 & Action for Global Health 2011)

important and patient valued outcomes[238]. Such approaches have also been associated with improvements in care experiences and outcomes among difficult-to-access population groups, such as Black and Minority Ethnic persons and those with mental health disorders, which have been previously challenging to resolve[239].

In Saudi Arabia, there has been limited evidence seeking to explore the relationship between a clinician or other health worker competence with patient outcomes, and the research that does exist is unable to infer a direct causal association between the former variables due to the nature of the designs used[240]. A recent systematic review of the quality of care provided in large teaching hospitals in Saudi Arabia based on eight studies revealed that the main problems with care quality were due to insufficient measures to protect patient safety, as well as deficits in clinician leadership, communication, and the provision of person-centered care. Although such problems were attributed to clinician and health worker incompetence, much of the variance was associated with organizational cultures that failed to prioritize patient safety and wellbeing[241]. Thus, there is a scarcity of evidence revealing the nature of the relationship between physician competence and care quality, both locally and internationally.

Physician competencies form a fundamental part of the broad range of factors influencing care quality in accordance with the conceptual framework for the quality of patient care. Additional factors include accessibility, acceptability, availability, timeliness, privacy, affordability, confidentiality, appropriateness, responsiveness, accuracy, accountability, reliability, continuity, equity, facilities, and comprehensiveness. These must be viewed or observed along with specific organizational practices to ensure patient safety and/or reduce morbidity, quality of life impairment, or mortality[242]. The importance of

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[238] (Lie 2011).
[239] (Govere 2016)
[240] (Mohamed 2015 & Samy 2016).
[241] (Aljuaid 2015).
[242] (Mosadeghrad 2012).

physicians acquiring a diverse set of clinical competencies cannot be undermined as these are fundamental to meeting the complex needs of patient populations. Furthermore, all age groups are observing rapid growth worldwide[243]. Although this thesis examined the technical competencies primarily, physicians' specific technical and interpersonal competencies are necessary for physicians operating within contemporary contexts. This thesis also highlighted the skills required to master roles such as leadership skills, multi-disciplinary and inter-disciplinary team are working, communication, health management, palliative care skills, policy and regulation, time management, conflict resolution, human factors, performance feedback, reflection, emotional intelligence, person-centeredness, and shared-decision making[244].

Such competency expectations have been in place since the emergence of evidence-based practice recommendations published by the US Institute of Medicine (Crossing the Quality Chasm). However, evidence shows that the uptake and utilization of competencies designed to improve care quality are insufficient[245]. The acquisition of the interpersonal competencies will provide a holistic set of skills that would allow for an easy transition of roles for practitioners.

The quality of training that the residents receive during their residency period highly affects their ability to perform competently in the future[246]. The type of rotations that are required, the allocated time for operation room training, the research necessary, the teaching hours that they receive, the coaching that they require from senior residents, and their ability to accurately document patient symptoms and their diagnosis are all very important elements that both program directors and residents need to address[247]. Therefore, it is important to

[243] (Manning 2017).
[244] (Combes 2012).
[245] (Institute of Medicine 2003).
[246] (Back 2019).
[247] (Malender 2020 & Alqahtani 2020).

know their perspectives on the current training process to improve it and eventually provide residents with a training system that meets and exceeds their expectations.

For this research, a policy can be defined as "the process of making organizational or system decisions by considering a number of options and their potential effects[248]". To look into the policy implications in the Saudi context taken up by this thesis, first, we must understand how training and licensing are conducted in Saudi Arabia. The first two papers of this thesis have already addressed the difference in patient outcomes for the Saudi surgeons who trained in Canada through the Royal College of Physicians and Surgeons Canada versus Saudi surgeons who trained locally through the Saudi Commission for Health Specialties and the cost-effectiveness aspect of their training. In effect, physicians who had been trained in Canada were associated with fewer postoperative complications and a lower number of comorbidities and performed better in cardiac surgery than their counterparts; this analysis was consistent in both regressions' tables 11 and 31 in paper one. However, when considering the organization as a confounding variable, it was found that the board of certification and the organization of service provision did not affect the dependent variables such as mortality rates and readmission rates within 30 days to the operating room or the general ward.

Furthermore, paper two indicated that monthly Canadian-trained surgeons save the country around 9,904,512 Saudi riyals annually in reducing postoperative complications under the assumption that fifteen surgeries per month are conducted by surgeons trained in Canada. Further, this paper also showed that beyond the point of 1.77 surgeries where both training locations surgeons are equal, the Canadian trained surgeons have a higher cost-effectiveness value[249]. Therefore, a postgraduate medical and surgical training quality improvement reform is needed to improve the current national training policy.

[248] (Taber, et al., 2010, p. 688)
[249] (AlAmoudi, 2020)

In Saudi Arabia, healthcare is currently provided to all local citizens across the 13 regions and 20 constituent health directorates without any personal cost by the Ministry of Health, although a private health system does exist and supports service provision where locals have sufficient personal funds at their disposal[250]. However, with the majority of citizens having little disposable income and lacking health insurance, there is marked dependence upon government healthcare to address the diverse and complex needs of the population[251] While population growth and increases in life expectancy are accounting for demand increases that are straining the current system, the Ministry of Health also supports care for those immigrating into the region for religious activities – the most notable being Ramadan and Hajj pilgrimage – that attracts millions of people from across the globe[252]. University hospitals that represent the principal setting for resident training and development receive financial support from the government, although the allocation of funds and resources to support optimal physician competence have not kept up with the increasing time constraints and complexity of patient populations, which has called into question the suitability of care provision in addressing the needs of service users[253]. In response to patient outcomes that have failed to remain in line with that of other countries and often remaining static despite advances in and access to more effective therapies, the local health system has increasingly adopted and revised their cultures in congruence with that of western populations, to improve patient safety and outcomes[254]. In this regard, the majority of health cultures within Saudi Arabia have been centered around paternalistic models of care, which are authoritative, directive and thus, fail to comply with many of the principles associated

[250] (Walston 2008).
[251] (Rahman 2020).
[252] (Walston 2008).
[253] (Walston 2008).
[254] (Walston 2008 & Alswat 2017).

with desirable outcomes in modern contexts, such as person-centered care and shared decision making[255].

In Saudi Arabia, the national body responsible for training and assessment of residents' skills and competencies – also contributing to the former issue, is the Saudi Commission for Health Specialties (SCFHS); this organization is equivalent to five licensing bodies in Canada (Royal College of Physicians and Surgeons, Canadian Nurses Association, Medical Council of Canada, Canadian Accreditation Council, and The National Dental Examining Board of Canada). SCFHS was established by royal decree No. M/2 dated 1992 and is given the "responsibility of supervising and evaluating training programs, as well as setting controls and standards for the practice of health professions[256]". It has 18 branches distributed across the country's region to cover the wide geographic distribution of residents and training centers.

Having a bird' eye view of the main functions that the Saudi Commission for Health Specialties (SCFHS) conducts and understanding its role in monitoring and improving training programs. This familiarity with the main functions of SCFHS will help answer the following **Research Question**: What are the perspectives of the program directors and the residents of the current Saudi surgical training system, and how can it be improved?

It was found that there is a difference in patient outcomes based on the board certification training location in Paper 1 of this thesis; the Canadian-trained Saudi surgeons had better postoperative outcomes than the locally trained Saudi surgeons in Cardiac surgery. It was also determined from Paper 2 of this thesis that the Canadian-trained Saudi surgeons save the country approximately 825,376 Saudi Riyals monthly[257], which is equivalent to 9,904,512

[255] (Khalil 2018).
[256] (SCFHS, n.d., p. 2)
[257] (AlAmoudi, 2020)

annually[258], in postoperative complications assuming fifteen operations are conducted per month.

As previously noted, clinician competencies account for some variances in the relationship between resident training and patient outcomes. However, many factors contribute to the majority of the variance, such as organizational cultures that fail to prioritize patient safety and quality improvement strategies[259]. Therefore, addressing postgraduate medical and surgical training programs to improve their outcome became evident, multi-domain minimal quality standards to improve the training system. Thus, this part of the thesis addresses outcomes such as broadening physicians' competencies as a performance improvement initiative.

1.2 Literature review of Subject Area

Searching for literature relevant to the construct of interest was undertaken by searching electronic databases using applicable search terms. The databases selected for searching comprised MEDLINE and EMBASE. These are known to house many health studies in the order of millions and have been found to provide sufficient coverage of articles specific to defined review questions or problems[260]. However, as some journals publishing research specific to the Saudi setting are not always indexed to MEDLINE or EMBASE, two additional databases were searched: Scopus and Web of Science[261]. Finally, as additional means to ensuring the identification, retrieval, and evaluation of all relevant evidence, an open search of Google Scholar was undertaken. In addition, the citations of all reviewed studies were screened, which are methods commonly employed to minimize the risk of review reporting-type bias[262].

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[258] (AlAmoudi, 2020)
[259] (Aljuaid 2015).
[260] (Bramer 2018).
[261] (Pollock 2018).
[262] (Thakre 2013).

A total of fifteen hundred articles on quality indicators in postgraduate medical and surgical training were reviewed throughout this thesis. A smaller proportion of these articles were evaluated in this literature review section, which was identified using title/abstract and full-text screening processes. All eligible articles were subject to the primary inclusion criterion – all studies reported data relevant to the population, exposure, and context of interest to the review question. In addition, papers that dealt with terms such as training, outcomes, quality indicators, competency-based education, quality and training, training effectiveness, postgraduate medical and surgical training trainers, and related nomenclature were reviewed based on the inclusion criteria of English-language research, free full text that can be obtained through the Carleton University electronic library or the world wide web; all other studies that did not meet the three mentioned criteria were excluded. In this literature review, articles that matched the inclusion criteria were included.

The common conclusion in the included literature reviewed is that there is an urgent need to create competency-based postgraduate training programs, where health professionals' competency is defined as "the ability of a health professional that can be observed, it encompasses various components such as knowledge, skills, values, and attitudes[263]". The high cost of postgraduate training elevates the importance of looking deeply at training criteria and measuring the efficiency and efficacy of training programs across training different settings. The need for examining training criteria is done for two main reasons: first, to ensure that the quality of postgraduate training that is provided to residents meets the highest international standards; second, to ensure the development of the healthcare workforce is effectively and systematically handled to meet the current needs of the healthcare market. This outcome-based thinking is essential to "ensure that the right skills are acquired at the right time, right place, and in the most effective mode[264]".

[263] (Shah, Desai, Jorwekar, Badyal, & Singh, 2016).
[264] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 9).

According to a RAND Corporation working paper, the quality of postgraduate medical training has gained high priority within the Organization for Economic Co-operation and Development, "with current efforts aimed at improving the evidence-based on skills acquired in higher education[265]". Yet all the studies reviewed in that working paper "were unable to document evidence of the progress of this effort[266]". The study also mentioned that efforts to develop measurements to evaluate the quality of medical education and training currently being delivered are nonexistent, and "the need to establish a sound system of quality governance was reaffirmed[267]". In medical training, competency can be complex to describe as it tends to represent an amalgamation of traits, skills, and qualities of a sufficient level that promote, seek to deliver, or are associated with the essence of clinical and ethical practice – to benefit patients, do no harm and uphold human rights[268]. In general terms, knowledge is necessary for clinicians to make informed decisions about care as a cognitively accessible bank of information is required to understand and weigh up the benefits and risks of care providers or the prescribing of specific treatments[269]. Effective decision-making also demands rigor in inpatient history-taking and clinical examination, which require effective communication skills, knowledge of health and disease states, and skills in assessing multiple organ systems[270]. Other authors describe competency as an ability to apply knowledge, utilize clinical skills, build interpersonal relationships, collaborate with other professionals, support decision making, and practice ethically as a composite of means to benefitting others[271]. Notably, aptitude refers to the natural ability of persons to perform a specific task. Indeed, clinicians with high aptitude levels are often perceived to be highly competent practitioners.

[265] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 10).
[266] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 11).
[267] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 1).
[268] (Fukada, M, 2018).
[269] (Fukada, M, 2018).
[270] (Carr, 2004).
[271] (Fukada, M, 2018).

Developing and refining the traits, qualities, and skills associated with desirable patient outcomes arise naturally and tend not to demand intensive education or training[272].
With the increasing demand to increase the size of the healthcare workforce globally, Saudi Arabia, like many other countries, has refocused its efforts to look more seriously into quality standards for training and education for postgraduate medical training. The high importance of this matter has become a part of the country's national transformation program (NTP) 2020 vision "to increase training and development both locally and internationally[273]". Nolte et al. (2011) mentioned that "there is an increasing interest to learn about international experiences in the use of indicators to measure quality in education and training of healthcare workforce, in particular, the extent to which quality metrics were used to assess issues excellence of training[274]". Yet, according to Radford et al. (2015), "the current adequacy of surgical training remains a topic of debate given concerns surrounding the prioritization of service provision over training[275]".

Saudi Commission for Health Specialties (SCFHS) has aligned its new vision to "improve healthcare professional performance in the Kingdom to meet international standards[276]" with the country's 2030 vision to improve the quality of services provided. Accordingly, SCFHS has adopted as one of its central mandates to develop and monitor postgraduate medical training indicators, making it among the few countries globally[277] assessing the quality of postgraduate medical education and training programs and centers within the country. International standards predominantly refer to the expectations demanded of practitioners, which usually comprise several professional and ethical qualities defined by medical body organizations, such as the General Medical Council in the U.K. and

[272] (Blackmur 2016).
[273] http://vision2030.gov.sa/sites/default/files/NTP_En.pdf.
[274] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 1).
[275] (Radford P., Derbyshire, Shalhoub, & Fitzgerald, 2015, p. 214)
[276] (SCFHS, n.d.).
[277] Countries such as Canada, France, Switzerland, the Netherlands, and the U.K.

the Federation of State Medical Boards in the United States[278]. As an example of the overarching expectation upon physicians, the General Medical Council expect 'good doctors' or competent doctors to prioritize patients wellbeing, maintaining competence to practice by keeping knowledge and skills up to date and in line with the latest research evidence, taking action when patient safety is compromised or is at risk of compromise, developing and maintaining good relations with patients and colleagues and maintaining trust in oneself and the medical profession by acting with integrity and ethical values[279].

The SCFHS also acknowledges that ensuring the quality of training outcomes in postgraduate medical training requires not only ministerial accreditation of individual programs or institutional criteria or standard board examinations; but rather a comprehensive system that encompasses quality aspects throughout the process. This process starts from matching residents to surgical and medical training programs throughout their residency and post-board graduation.

Therefore, a competency-based medical training system is required in Saudi Arabia to translate functional occupational roles into outcomes based on demonstrated performance[280]. This is needed to eliminate variations between training programs and produce professionals capable of safe and independent practice in their specialization area. Such an assessment, according to Leung (2002), "is based on a set of clearly defined outcomes so that all parties concerned, including assessors and trainees, can make reasonably objective judgments about whether or not each trainee has achieved them[281]". The essential elements of competency-based medical training consist of "functional analysis of the occupational roles, translation of these roles into outcomes and assessment of trainee's progress in these outcomes based on demonstrated performance[282]".

[278] (Fukada, 2018).
[279] (GMC 2013).
[280] (Leung, 2002, p. 693).
[281] (Leung, 2002, p. 693).
[282] (Leung, 2002, p. 693).

Required competencies can be identified in various ways, such as through surveys of examining committees, triangulating results from focus groups, or using international standards. The aim of creating a Competency-Based postgraduate Medical Training program (CBMT) is to "regularly assess performance outcomes as opposed to the traditional time-based model[283]".

Each competency is built on the previous skills acquired, and mastery and confidence levels are increased through the movement from one competency to the next[284]. The critical success of CBMT, according to Caccia et al. (2015), is the "appropriate assessment of the skills in the clinical setting[285]". CBMT requires successful demonstrations of the knowledge, skills, and attitude acquired throughout the specified rotation required to practice[286]. IOBST et al., 2010, indicated that "progression in training requires that the learner demonstrates competence at critical stages of development[287]". The demonstration of competencies is usually directly observed by the trainer through predetermined thresholds that are clearly explained to both trainers and trainees. This will allow learners to advance in the program at different rates based on their successful demonstration of the competencies required[288].

Developing a CBMT[289], which "consists of functional analysis of occupational roles, translation of these roles into outcomes, and assessment of trainees' progress based on their demonstrated performance of these outcomes," requires that we set clear Key Performance Indicators (KPIs) and use a framework such as the Kirkpatrick model, which would give us a clear picture on which stage of competency development we would need to improve. The Kirkpatrick model was developed in 1959 but has been revised several times. It is designed to explore and ascertain the impact of training through reference to four key levels: reaction,

[283] (Garofalo & Aggarwal, 2017, p. 534)
[284] (Caccia, Nakajima, Scheele, & Kent, 2015, p. 1105).
[285] (Caccia, Nakajima, Scheele, & Kent, 2015, p. 1110)
[286] (Iobst, et al., 2010, p. 652)
[287] (Iobst, et al., 2010, p. 652)
[288] (Iobst, et al., 2010, p. 653)
[289] (Leung, 2002, p. 693).

learning, behavior, and results[290]. More specifically, the reaction involves measuring how valuable training was to individuals in terms of acceptability, suitability, and attainment of engagement; learning focuses upon determining what individuals have learned and not learned, behavior, assist in understanding whether training can be applied to practice, and results focuses upon measuring specific outcomes that provide information about effectiveness in meaningful terms[291]. Indeed, the Kirkpatrick model is much like the audit cycle used in contemporary continuous quality improvement projects. Information and knowledge about an outcome are based on factual evidence that can be measured using specific methods and tools[292]. Notably, several studies have shown and utilized the Kirkpatrick model to be a feasible and reliable means to evaluate training effectiveness across various clinical contexts[293].

Therefore, developing a system that measures key performance indicators throughout the postgraduate surgical and medical training process is necessary. To do so, one would have to first understand the perspectives of both residents and program directors, narrow down a rather long list of areas to focus on, and measure them. According to Olle ten Cate (2017, p. 1), "Competency-based medical education can be characterized as having two distinct features: a focus on specific domains of competence, and relative independence of time in training[294], making it an individualized approach that is practically applicable in workplace training[295]". This would also require a developmental continuum throughout their training[296].

Knowing the strengths and weaknesses of the teaching system and the process is essential for strengthening the quality of training delivery, a view supported by Vaižgėlienė et al. (2017), who stated that "for successful development of CBME programs in practice, it is

[290] (Mind Tools 2020).
[291] (Mind Tools 2020).
[292] (Benjamin 2008).
[293] (Heydari, 2019 & Dorri, 2016).
[294] According to the author, each resident (learner) must be allowed the learning time they need to attain a specific learning goal.
[295] (Cate, 2017)
[296] (Dath and Iobast, 2010, p. 684)

essential that clinical supervisors have insight in their strengths and weaknesses of the teaching qualities that are essential for competency-based learning[297]". CBMT offers paths to redefine the residency model based on cultural and environmental requirements; however, it is imperative to recognize that faculty development will enhance their understanding of CBMT[298]. Dath and Iobst (2010) stated that clinicians with no formal training as educators have functioned as medical trainers in the same way they were taught. However, this approach is challenged by the introduction of CBMT, which requires specific skills to prepare physicians for practice[299]. Dath and Iobst (2010) also stated that "the implementation of CBME requires teachers and evaluators to gain a new understanding of the theory and practice of education, one that is different from that demanded of them by content- and time-based systems[300]". Further advantages include, according to Hawkins, et, al., (2015), "focus on outcomes and learner's achievement; requirements for multifaceted assessment that embraces formative and summative approaches; support and flexible, time-independent trajectory through the curriculum; and increased accountability to stakeholders with share set of expectations and common language for education, assessment and regulation[301]".

On the other hand, CBMT, according to Leung (2002), has been subject to many criticisms, such as the difficulty of showing that competencies actually cover the work roles and adequately represent the types of knowledge relevant to the competency in question. Further, the issue of alignment of workplace culture and intended learners' goals is underestimated[302], although "workplace assessment of competencies requires a reorganization of the clinical environment. The clinical environment must be aligned with the intended curriculum of the

[297] (Vaižgėlienė et al., 2017, p. 346)
[298] (Caccia, Nakajima, Scheele, & Kent, 2015).
[299] (Dath and Iobast, 2010, p. 683)
[300] (Dath and Iobast, 2010, p. 683)
[301] (Hawkins et al., 2015, p. 1086)
[302] (Caccia, Nakajima, Scheele, & Kent, 2015, p. 1110).

CBME program[303]". Finally, according to Hawkins et al. (2015), "inconsistencies in CBME definitions and frameworks remain a significant obstacle" to their effectiveness[304].

Nevertheless, implementing a CBMT framework in SCFHS surgical and medical programs leads to clinical improvement and better patient care, as the learner will continue to show development in training to move on to the next phase, once the condition of alignment of the clinical environment with the CBMT curricula is fulfilled[305]. Martin et al. (1998) used the CBMT framework to evaluate eight postgraduate residents during their first three months of training. They concluded that residents' skills rapidly improved and could be sustained in the clinical setting, and thus that this framework produces competent residents[306]. The CBMT framework in SCFHS has the advantage of evaluating residents by the abilities acquired, through showing competency in every milestone through their residency journey[307]. De-emphasizing fixed time-based training will produce flexible, learner-centered programs that will improve overall healthcare delivery and reform postgraduate medical training in Saudi Arabia. Saudi Commission for Health Specialties needs to achieve the flexibility required so that residents can fulfill the requirements needed to attain the knowledge and clinical skills for the competencies required. However, before we can reform, it is important to understand what current graduate medical training looks like and how it impacts it to identify the needed reform elements.

1.3 Graduate Medical Education (GME) Training

The early description for GME was provided by Flexner's (1910) report, elements of which are still valid today. According to Cook et al. (2010), "Flexner asserted that scientific inquiry and discovery, not past traditions, and practices, should point the way to the future in

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303 (Caccia, Nakajima, Scheele, & Kent, 2015, p. 1110)
304 (Hawkins et al., 2015, p. 1086)
305 (Iobst et al., 2010, p. 651).
306 (Martin et al., 1998, p. 313)
307 (Iobst et al., 2010, p. 652).

both medicine and medical education[308]". They also stated that "medical training is inflexible, excessively long, and not learner centered[309]". In addition, a book review by Julie Nyquist (2011), "A Call for Reform of Medical School and Residency," stated that "clinical education is overly focused on inpatient clinical experience. Further, the formal knowledge that residents acquire during residency is poorly linked to clinical experience and supervised by clinical faculty who have less time to teach[310]".

In recent years, the GME has undergone a paradigm shift to emphasize the importance of measuring the outcome of training system functions rather than taking a process-oriented approach[311]. According to Musick (2006), "this new emphasis on outcomes has many implications for how GME training program's function[312]". The importance of this paradigm shift is to measure the effectiveness of GME training processes that are currently in place. This can be conducted through outcome evaluations by "obtaining evidence showing the degree to which program purposes and objectives are or are not being attained, including achievement of appropriate skills and competencies by residents[313]".

Musick states that "evaluation models specific to GME programs have been nonexistent; there is simply no overarching theoretical base or consistent approach provided[314]". In the book Educating Physicians: A Call for Reform of Medical School and Residency, Cook et al. (2010) came up with four goals for medical education, rooted in Flexner's model: 1) standardization of learning outcomes and individualization of the learning process; 2) integration of formal knowledge and clinical experience; 3) development of habits of inquiry and innovation, and 4) focus on professional identity formation. Congruence of the outcomes

[308] (Cook, Irby, C. O'Brien, & Shulman, 2010, p. I)
[309] (Cook, Irby, C. O'Brien, & Shulman, 2010).
[310] (Nyquist, 2011)
[311] (Lauer, 2017, p. 1).
[312] (Musick, 2006, p. 759)
[313] (Musick, 2006, p. 760)
[314] (Musick, 2006, p. 760).

of this study with this model described by Flexner is noted in the discussion chapter of this report.

Quality improvement in the delivery of healthcare services has become a significant movement globally. In the United States, the Accreditation Council for Graduate Medical Education (ACGME) has incorporated quality standards through its CLER framework. Its purpose is “to evaluate, encourage, and promote improvements in delivering safe and high quality of care to patients. The CLER Program provides sites with three types of formative feedback: 1) an oral report at the end of the site visit; 2) a written narrative report summarizing the observations of the CLER Field Representative(s), and 3) reports that provide national aggregated and de-identified data displayed along a continuum of progress toward achieving optimal resident and fellow engagement in the CLER Focus Areas[315]”. Indicators usually used to assess medical, and surgical care outcomes include “terms of recovery and restoration of function and of survival[316]”. In a Dutch study, Akdemir et al. (2017) evaluated the quality of postgraduate medical education through accreditation as a quality assurance technique. Their conclusion called for a decentralization of the responsibilities of the accreditor and focusing on the quality of local program management within the training center [317].

Studies that have implemented outcome-based quality in the GME context have found that neglecting to study the ability of program directors to teach and measure competency in system-based practice, which “requires that residents and fellows demonstrate awareness and responsiveness to the larger context and system of healthcare, as well as the ability to call effectively on other resources in the system to provide optimal healthcare[318]” could lead to barriers to the success of outcome-based quality[319]. Nevertheless, providing training centers

[315] (Accreditation Council for Graduate Medical Education, 2019, p. 6)
[316] (Donabedian, 1966, pp. 692-693)
[317] (Akdemir, LOmbarts, Paternotte, Schreuder, & Scheele, 2017, p. 7).
[318] (University of Maryland School of Medicine, 2019)
[319] (Daniel, et al., 2009)

with autonomy through decentralization will provide flexible, resident-centered training outcomes. In Saudi Arabia, the Saudi Commission for Health Specialties (SCFHS), through its national excellence in training initiatives, has decentralized the training process and moved this function to the training centers to provide them with the autonomy needed to make the training journey resident-centered. The SCFHS assumed the regulatory role that included all support functions such as accreditation standards, admission standards, assessment standards, trainee well-being standards, and curriculum and faculty development frameworks. In addition, SCFHS developed shared training committees to support the training centers and provide remediations for issues that may arise through their shared training committee.

1.4 ACGME Gap Analysis

With the rapid changes mandated by Saudi Arabia's ambitious strategic plan for 2030 and the National Transformational Plan (NTP) 2020, SCFHS recognizes that changes and challenges in its ambit are approaching. These challenges must be understood across the whole training cycle, starting from accrediting centers and programs to train postgraduate surgical residents (as focused on here and other residents) and then continuing to the actual training and quality assurance. Although accreditation of centers and programs and improvement of that process is not the focus of this research, it significantly impacts the training process. Its improvement as accreditation in both institutional and programs plays a significant role in ensuring that the training environment is suitable enough to obtain the best training experience possible based on a well-designed program with a curriculum that enhances the knowledge and skills of participating residents.

A gap analysis[320] of the current state of postgraduate medical training in Saudi Arabia was conducted by ACGME-I[321] helped illuminate the current challenges SCFHS faces due to the NTP 2020 requirement to improve postgraduate medical and health quality training. The report identified the following gaps: In the accreditation standards and practice environment, there are inconsistencies in knowledge and understanding of the accreditation process and standards and the role of SCFHS. It was challenging to find a single clear source of information on the accreditation process. In addition, through interviews, there was variability in resident decisions regarding desires and motives to comply with accreditation expectations, as well as a lack of transparency and understanding in leadership and trainer and trainee professional standards. Further, there is an inadequate assessment and quality improvement system, with no qualitative assessment measures to improve training centers and programs. Lack of program directors, poor trainer development, and cases where program directors and trainers lacked information on the key dimensions of competency-based medical education and using CanMEDS were also found. Trainee feedback is inconsistently collected and does not affect the program quality in a meaningful way[322].

Regarding oversight of health professions' education and training environment, the rollout of new standards neither exists nor new training centers appears to understand it. Further, there is an inadequate focus on education, where trainers view trainees as helpers rather than learners in a passive learning environment. Further, there is huge variability among training centers, including understanding and commitment to training among quality of program directors, trainers, and leaders.

Integration of education and training is the third gap that ACGME-I indicated in their report (2019). They identified limited clinical services at some training institutions, which

[320] Please note that only aspects related to this thesis are included in the ACGME report.
[321] ACGME-I (Accreditation Council for Graduate Medical Education International, a branch of the ACGME that focuses on international partnerships to improve the training processes through collaborative agreements)
[322] (ACGME, 2019)

could place training centers and programs at a disadvantage because of the inadequate essential provision of healthcare services and training processes due to their inability to attract qualified consultants as trainers. In addition, there is a misdirected focus on the quality rather than the structure and quality of the training environment. “This potentially limits the education and training experience that affects successful learning, graduation, and Saudi Board pass rates[323]”. According to Radford et al. (2015), “Surgical trainees are not receiving sufficient experience[324]”.

For the performance improvement roadmaps accreditation element, ACGME-I recommended developing a robust communication plan that includes routine written communications to stakeholders on strategic, operational, and clinical standards. This plan should be supplemented by web-based training, face-to-face training, and in-person briefings to all training stakeholders to bridge the knowledge gap. Further, the need was identified for a single set of transparent standards easily accessible from a single source with examples of compliance to reduce variability in compliance decisions and create a single clear information point. A new model of formative assessment with new content is required to develop a robust learning environment. Key stakeholders should participate in developing and revising standards to ensure a common understanding of the process and its requirements.

To address training program gaps, ACGME-I recommended that there should be clear outcome statements that explain guidelines and steps leading toward competency; the CanMEDS competency-based framework should be integrated with curricula objectives and rotations, and the importance of rotations explained, and regular audits on the adequacy of the training center system should be regularly conducted to ensure adequate focus on training and to reduce the high variability in training delivery systems among training centers.

[323] (ACGME, 2019, p. 12)
[324] (Radford, Derbyshire, Shalhoub, & Fitzgerald, 2015, p. 214)

SCFHS, based on the ACGME-I report, requires a shift from a process-based accreditation standard to outcome-based accreditation. Which is a system that encompasses both institutional and program accreditation: "The programs should use resident performance and outcome assessment in its evaluation of the educational effectiveness of the residency programs[325]". As defined by the ACGME, outcome measurement entails "evidence showing the degree to which program purposes and objectives are or are being attained, including achievement of appropriate skills and competencies by students[326]".

One of the compelling questions that the ACGME asks is "how do programs demonstrate continuous improvement in its educational process?[327]". However, this important question lacks specificity. While implying focus upon measuring performance outcomes quantitatively, it would be imperative to consider the accounts and experiences of residents exposed to educational processes. This would provide more in-depth and meaningful information on how the approaches can be improved to benefit professional development. Therefore, this question will be addressed in this research through the various methodologies implemented to understand directors' and residents' views of the system and make performance improvement recommendations for the SCFHS.

1.5 STUDY OBJECTIVES

The objectives of this paper are twofold, first, to qualitatively make sense of and understand the range of views about the Saudi postgraduate medical training program among those involved in it; second, to generate best possible ways to implement recommendations for improvement?

The first objective is addressed through conducting surveys among residents and program directors, to obtain an understanding of the most important issues that they see in

[325] (Musick, 2006, p. 759)
[326] (Musick, 2006, p. 761)
[327] (Musick, 2006, p. 761)

their work. The surveys were distributed by the Executive Department of Training within SCFHS for legal reasons, and the results were shared to create questions for focus groups for both residents and program directors. The second objective will be addressed through the Delphi-survey that will narrow down the most important issues that needs to be addressed within the current training system. Further, the elements that arise from the Delphi survey will be addressed in the quality performance improvement framework that is proposed to the Saudi Commission for Health Specialties.

Chapter 2. Methods

2.1 Overview

In addition to the extensive literature review formerly described on postgraduate training across all fields of medical and surgical residency training programs, this thesis will depend on multi-institutional mixed methods to address the objectives above. For the first part, a general analysis of survey data from trainees[328] and program directors in medical postgraduate program surveys, obtained through the electronic survey engine SurveyMonkey, will be undertaken.

To address the second objective, the Delphi technique and focus groups were used to obtain convergence of opinions between physicians trained in Saudi Arabia and physicians trained in Canada about what Saudi postgraduate medical training programs need to improve in their fields or specified programs. Hsu and Sandford (2007) stated, “The Delphi technique is well suited as a method for consensus-building by using a series of questionnaires delivered using multiple iterations to collect data from a panel of selected subjects[329]”. Further, it was indicated in the article that the Delphi technique is used “to determine or

[328] I have attached trainee sample questions in Appendix 2.
[329] (Hsu & Sandford, 2007, p. 1).

develop a range of possible program alternatives, and to explore underlying assumptions or information leading to different judgments[330]".

The Delphi technique was developed at the RAND Corporation in the 1950s to provide a structured approach to surveys and to identify and rank critical components and matters for decision-makers to act[331]. Some of the benefits associated with this method are that "it is a valuable data-driven approach in exploratory studies where limited evidence exists on specific topics and questions[332]". The multiple iteration process helps develop consensus between all the participants on key issues and promotes problem-solving. It "reduces the effects of dominant individuals, which often is a concern when using group-based processes used to collect and synthesize data[333]". The fact that the feedback is controlled means it can reduce biases and produce a disciplined summary of prior of the Delphi survey conducted. Through this, process participants "are expected to become more problem-solving oriented, to offer their opinions more insightfully[334]". Thus, utilizing the principles of the Delphi method was highly conducive to addressing the research question as related evidence has been scarce and specific evidence is lacking.

This research uses the Delphi method to determine whether there are divergences between Saudi and Canadian surgical training programs in their specific training programs and highlight the main areas in the domestic training program that need to be addressed. A "ranking-type" Delphi survey is used to identify the most immediate factors contributing to the strengths and weaknesses of the domestic surgical training program[335].

A thematic approach will identify the major themes that impact postgraduate surgical training in Saudi Arabia. The identified themes from phase one obtained from the focus groups of

[330] (Hsu & Sandford, 2007, p. 1)
[331] (Schmidt R. C., 1997, p. 763)
[332] (Jaana, Tamim, Paré, & Teitelbaum, 2011, p. 830)
[333] (Hsu & Sandford, 2007, p. 2)
[334] (Hsu & Sandford, 2007, p. 2).
[335] (Schmidt, Lyytinen, Keil, & Clue, 2001, p. 6)

both residents and program directors were used as the basis of the Delphi survey. Consents for all three methods used in this paper were obtained; participating in the satisfaction surveys used implied consent, as was stated in the survey preamble. Participants signed consent forms during the focus groups. They were informed that they would also participate in a Delphi survey that would follow in the next few weeks after the interview. Therefore, their participation would be considered automatic consent. The data obtained from the surveys were analyzed *using the statistical program SPSS version 24.* Details are described in the following subsections.

2.2 Outline of the survey method

Survey research, according to Visser et al. (2019), "is a specific type of field of study that involves a collection of data from a sample of elements drawn from a well-defined population through the use of a questionnaire[336]".

Surveys vary in type. Cross-sectional surveys are "conducted to assess the frequency with which people perform certain behaviors or the number of people who hold particular attitudes or beliefs[337]". They offer the opportunity to examine the correlation between two variables and identify the difference between two subgroups, usually to test a causal hypothesis, as they enable the estimation of the causal impact of one variable on another[338]. Panel surveys gather "data collected from the same people at two or more points in time[339]". This method allows for two ways to test a causal hypothesis: whether individual level in an independent variable changes over a period of time and whether changes over time in an independent variable can be predicted[340]. Sustaining participation in this type of survey is an issue, however, which might affect the representativeness of the survey sample[341]. Another

[336] (Visser, Krosnick, & Lavrakas, 2019, p. 223).
[337] (Visser, Krosnick, & Lavrakas, 2019, p. 225)
[338] (Visser, Krosnick, & Lavrakas, 2019, p. 226).
[339] (Visser, Krosnick, & Lavrakas, 2019, p. 226).
[340] (Visser, Krosnick, & Lavrakas, 2019, p. 227).
[341] (Visser, Krosnick, & Lavrakas, 2019, p. 227).

issue is the reluctance to report opinions or behaviors that may appear inconsistent across waves. Other limitations of both survey types include the following: "First, surveys are expensive and time-consuming, second the impracticality of executing elaborate scripted scenarios for social science interactions[342]".

Survey research can employ quantitative or qualitative research strategies or both. For example, survey research could be based on large or small populations to obtain information describing behaviors and opinions. Sampling is used in survey research to obtain a sufficient number of responses from a subset of a considered representative population. Sampling samples from the responses will increase the likelihood that the responses accurately reflect the entire population. Accurate identification of a population of interest thus also contributes to the accuracy of the conclusion and is affected mainly by participant recruitment strategy[343].

Recently, online surveys have become more prevalent, reaching a wider number of people, sometimes facilitating the adoption of a particular population by making more of them accessible[344]. Another advantage relates to the topic's sensitivity: being anonymous encourages higher response rates to specific questions. The low cost, time benefits, absence of and social desirability bias and interviewer bias (and reduction of researcher bias in general), convenience, lower likelihood of giving socially desirable responses are some of the other advantages of online surveys[345]. In addition, online surveys are quite flexible in the types of formats they can be embedded in. One of the most commonly used formats is surveys embedded into emails, considered a strength according to Evans and Mathur 2005[346]. According to the same authors, the convenience that the online survey provides is another strength, where participants can answer the survey anywhere and anytime that is suitable for them. Further, they noted that the ease of entry and data analysis is relatively simple as the

342 (Visser, Krosnick, & Lavrakas, 2019, p. 224).
343 (Ponto, 2015, p. 169)
344 (Selm & Jankowski, 2006, p. 437)
345 (Selm & Jankowski, 2006, pp. 438-439).
346 (Evans & Mathur, 2005)

responses are automatically tabulated and analyzed. Costs associated with online surveys are reasonably low, which is an added advantage to online surveys.

Limitations of online surveys include low response rates, and although online surveys reach a larger number of participants, it does not necessarily mean that the response rate will be high! This was evident with the program director and resident satisfaction surveys that were distributed in this study. In addition, the subjectivity of responses may occur because surveys are based on personal opinions about a particular issue or topic[347]. Further, demotivation among respondents and low response rates are among the identified weaknesses with online surveys, where there are no formal ways to guarantee a total response rate from participants. Finally, the selection bias of questions to be answered by the participants is another issue that has been identified as one of the weaknesses. Further, there may be a general bias that the general population’s true opinion may not be represented through the opinions of those who chose to respond to the survey.

Since this thesis assesses both trainees’ points of view in postgraduate medical and surgical training programs and program directors, the surveys were sent to everyone who fell under a program director or resident category. Therefore, the selection bias issue is minimized because there was no sampling involved in this context. The fact that focus groups will supplement these surveys will allow participants to focus on the most pressing issues that arose from the initial survey process and explore these issues in-depth to understand their efficacy regarding the Training policy changes required and how these changes would be. As a result, a quality improvement framework will be proposed to the SCFHS. The other disadvantages mentioned above, such as low participation rate, can be overcome by setting a minimum 50% response rate acceptance criterion. The subjectivity of responses bias could be overcome by having straightforward questions and clear multiple-choice responses to be

[347] (Ritter & Sue, 2007, p. 7)

ranked; both questions and multiple choice answers are obtained. Prompting participants with reminder emails could help in motivating participants to respond to the surveys and increase the surveys responses to the acceptable 50% response rate.

The satisfaction surveys were created on September 25, 2018, published on October 1, 2018, and closed on August 4, 2019. The survey results were collected through the survey engine SurveyMonkey, which aggregated responses and made it easier to draw out thematic words that occurred repetitively.

For this qualitative phase, a cohort of program directors and residents was recruited using a purposive sampling technique based on the simple willingness to participate in this study and fill out the survey. However, it is a struggle to have the commitment from both program directors and residents to participate in survey-style qualitative studies. Therefore, the surveys designed for each group (PD, Residents) were sent to all to get as many responses as possible. This Purposive[348] sampling enabled the investigator to identify and interview subjects relevant to the research question and who would-be providers of sufficient information for each interview question[349]. However, purposive sampling is a selective process and is thereby subject to the limitation of selection bias as the investigator/recruiter may be prone to recruiting individuals with characteristics that may skew or bias the outcome direction and/or size towards one favored by the intentions of the research[350].
In contrast, random sampling is a more favorable recruitment method as it eliminates investigator subjectivity and tends to capture more representative samples of subjects. However, this approach was not feasible as the author considered selectivity imperative to addressing the research gap[351]. Notably, recruitment of subjects continued until the point of theoretical data saturation as this is a qualitative method used to enhance the validity and

[348] Purposive in the sense that the specific target group was selected and a while population.
[349] (Martinez-Mesa, 2016).
[350] (Martinez-Mesa, 2016).
[351] (Spieth, 2016).

dependability of findings by ensuring that information about the construct is not precluded due to premature termination of data collection[352].

The administered program director survey consisted of 53 questions was structured representing four main sections. The first section was demographics details of the program directors; this section has 14 questions exploring the personal information and the base of the participants' practice. The second section is the supervision and training, which contained 15 questions. The third section was educational content, and it has five questions. The fourth section is the support and resources section which has 19 questions. An online link was created for the survey and was sent to all program directors through emails, but only 464 out of 716 completed the survey.

The resident survey was created on September 25, 2018, published on October 1, 2018, and closed on August 4, 2019. The questionnaire consisted of six sections with questions distributed among them. Eight questions covered the demographic section; in the second section, 14 questions were asked about trainees' educational activities. Three questions in the third section regarding the program satisfaction/training program. Section four had eight questions regarding perception & personal experience. Finally, the fifth and sixth sections have 3 and 5 questions for research participation and satisfaction with SCHFS, respectively. Similar to the program director survey, an online link was created for the survey and was sent to all Residents through emails, but only 3,696 (27%) out of 13,688 completed the survey.

2.3 Outline of the Delphi method

The literature reviewed indicated that three iterations of data collection would be sufficient to obtain consensus. The process itself, as shown in Figure 1, is divided into three phases. "In the first phase, a brainstorming round is conducted to elicit as many items as

[352] (Noble, 2015).

possible from the panels"; the main research question is an open-ended question, which helps in obtaining as much information as possible about the items they think are relevant to the subject matter. Doing this makes it possible to provide all the participants with a common list of items[353]. Duplicates are eliminated, the remaining items are grouped and combined, and this list is sent out to participants to be verified and approved. In the second phase, a narrowing-down process is conducted to select the most critical items contributing to the program's effectiveness; those selected by most participants are retained, and the remaining items are sent out again for further narrowing-down. This helps reduce the number of items to a manageable size and highlights the most critical issues. In the third phase, from the list produced in the second phase, participants rank items according to importance, iteratively until consensus is reached about the most critical factors for the surgical training program. Regarding participant selection, this study uses two panels. The first panel comprises 13[354] Saudi consultants trained in Canada and currently working in the national Saudi healthcare system as program directors to identify critical elements of quality training programs. These subjects were also selected using a purposive sampling approach as given the small sample size. It was essential to include participants who provided rich accounts of information regarding the research question. The second panel is composed of 12 residents who are currently undergoing postgraduate residency programs. These subjects were selected based on their willingness to participate in the study. The participants' inclusion was based on the condition that they were undergoing residency training, were easily identifiable, and provided the most current accounts regarding the training program that was not subject to recall bias. "The majority of Delphi studies have used between 15–20 respondents." Each participant is given a two-week window to send in their responses for each round[355].

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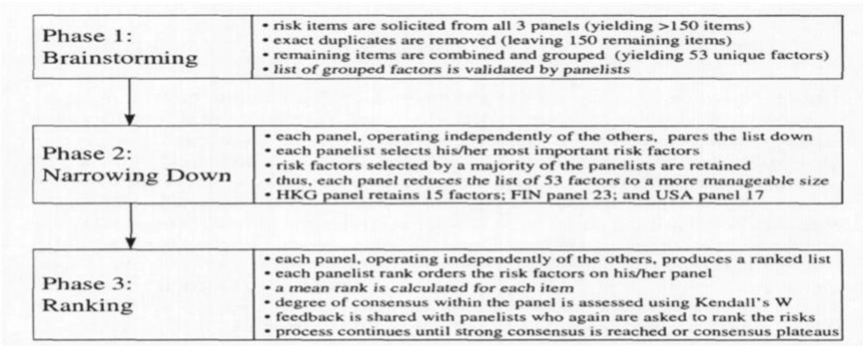
[353] (Schmidt, Lyytinen, Keil, & Clue, 2001, p. 12)
[354] This is the actual number that agreed to attend the focus groups that were conducted.
[355] (Hsu & Sandford, 2007, p. 4)

The responses are collected via e-mail; this will allow the participants to think thoroughly about their responses without the pressure of being physically in a confined area. Ethics approval from Carleton University[356] and King Saud Medical City, King Khalid University Hospital, and King Fahad Medical City was obtained before conducting this study.

Figure 1: Description of Delphi survey process (Schmidt, Lyytinen, Keil, & Clue, 2001, p. 13)



Drawing on rich data generated by this method, recommendations are generated for quality improvement directed at policies related to postgraduate surgical training programs in Saudi Arabia[357].

The satisfaction surveys that were distributed to program directors and residents formulated the basis of the focus groups questions and topics. It is important to point out that the focus group participants (program directors and residents) were not necessarily the same participants whose survey responses was reviewed and analyzed.

2.4 Participant sampling frame and recruitment

The focus group format included at least four participants from the following categories: program directors, senior residents, and junior residents. A letter for recruiting program directors and a letter to recruit residents were sent to the CEOs of the training

[356] Carleton Clearance Protocol #: 108561, King Saudi Medical Center IRB approval # H-01-R-053, King Khalid University Hospital IRB approval #E-17-2721, King Fahad Medical City IRB approval # H-01-R-012.
[357] Please see the discussion section.

institution and individual consent forms that all participants in the focus group signed. It was explained that there is a series of semi-structured questions that they would be asked, and they would need to answer as objectively as possible. The participants were randomly selected from a list provided by the Training and Academic Affairs executive directory within the SCFHS. The intent of obtaining a general list was to reduce bias and generate validity to their responses. There were two focus groups for program directors conducted in two different cities within the Kingdom (Riyadh and Taief). The program directors were randomly selected by the CEO of the accredited training institution, specifically King Faisal Hospital and research center in Riyadh, and Alhada Military Hospital in Taief, the specialties of the program directors, included medical and surgical programs to create a comprehensive view of how well the training process is delivered. There were also two focus groups for senior residents conducted, and they were from the same two cities and institutions mentioned above.

A final focus group that included junior residents was conducted in the Saudi Commission for Health Specialties (SCFHS), and it included 7 participants from various cities in the kingdom with specialties of medical and surgical nature. This final group was asked the same questions as the senior residents to ensure that the issues that arose from different focus groups were common, as the process of delivery and the requirements for residency training are predetermined by the SCFHS.

2.5 Data-gathering

Consent forms were distributed to all participants to ensure their acceptance of participation in the focus group. Their approval to record the sessions were obtained prior to starting the focus group. All sessions were digitally recorded and transcribed into Playscript-style Word documents[358]. The questions, depending on the targeted audience, covered specific themes, which are clearly outlined in Appendixes 5-10.

2.6 Analysis

This section will provide an overview of the processes involved in developing themes, which stemmed from the qualitative data gathered through focus groups.

Thematic analysis is, although widely used, an approach that can lack rigor and robustness if not conducted in a transparent manner[359]. Therefore, in alignment with the recommendations of Braun and Clarke (2006), before an explanation of the themes' content that stemmed from the analysis, an overview of the process involved in developing these themes is needed and will be the focus of this section.

Whereas the process of thematic analysis can differ depending on the nature of the raw data, the goals of the analysis and the size and composition of the research team involved in the work[360], the thematic analysis process that was used for this work was very much in line with the six steps outlined in Braun and Clarke's (2006) seminal text. Before discussing these steps, however, it is noteworthy that in line with the aims of this current study, the analysis of the experiences of residents and the analysis of the experiences of program directors were treated separately, and individual themes relating to each will be discussed in separate sections as a result. However, these themes will also be compared and contrasted with one another to gauge the difference in perspectives and experiences between these professional groups.

Developing themes took six specific stages, which were initiated once the digital recordings of the interviews or focus groups were transcribed into Playscript-style Word documents. First, a primarily inductive approach was sought to be adopted for the entirety of

[358] All transcripts are available upon request of the committee.
[359] (Braun & Clarke, 2006).
[360] (Vaismoradi, Turunen & Bondas, 2013)

the coding and theme analysis process, in line with recommendations made by Alhojailan (2012). With this in mind, the advice is given within the seminal work of Boyatzis (1998) on code development was heeded, and the question of what is interesting about this was used as a starting point for defining the codes from the raw data inductively.

The first stage of this process involved reading and re-reading the transcripts until a high degree of familiarization with the data was attained[361]. Throughout each of these readings, notes were made in response to Boyatzis' (1998) question about what is interesting about the data. In the final read-throughs of this initial process, any notes taken were shaped and categorized into initial codes seeking to broadly define what was of interest and how it manifested itself. This was then followed by the second phase of the thematic analysis process, which seeks to define these initial notes and examine if they could feasibly be clustered together into coherent codes. Again, in line with the aims of this work, this process was primarily data-driven as opposed to theory-driven, and the coding process itself was conducted both manually via the keeping of notes and mind-maps[362], and as the process progressed, via the use of Word and Excel programs to organize ideas on this in alignment with the data[363].

The third stage of theme development began once the transcripts had all been exhaustively reviewed and data had been initially coded and collated[364]. This saw a re-focusing away from lower-level codes and towards being able to group and cluster them into a set of meaningful themes. To achieve this, the previously developed and collated codes were analyzed and considered as to how they may interact with or complement other codes to conclude with an overarching theme[365]. Some initial codes were to go onto providing core themes in this process, while others represented sub-themes within broader themes. Still,

[361] (Guest, MacQueen & Namey, 2011)
[362] (Nowell, Norris, White & Moules, 2017)
[363] (Braun & Clarke, 2006).
[364] (Braun & Clarke, 2006).
[365] (Fereday & Muir-Cochrane, 2006)

more codes ended up being combined to form either a theme or sub-theme, while other codes were ultimately discarded once compared back to the data and being deemed as ultimately non-representative of the body of work as a whole. Like all others within the steps taken to analyze this set of data, this process is fully concordant with published recommendations as to how to conduct a rigorous thematic analysis (e.g., Terry, Hayfield, Clarke & Braun, 2017). Finally, step 4 began with a set of candidate themes as developed to this point and consisted of the refinement of these themes. This consisted of the themes being taken back and compared to the raw data; during this phase, it was evident that some candidate themes were not themes in that some insufficient data or data was too diverse to support them. As a result, these themes were re-worked and refined and either developed into new, better-suited themes or were dropped altogether from the subsequent analysis. The end of this phase was reached when a satisfactory thematic map of the data had been fully developed and checked in conjunction with the existing data.

After the thematic map of the data, the fifth phase of the thematic analysis commenced. This penultimate phase involved a further defining and refining of these themes[366]. This process aimed to ensure that each theme's essence could be credibly communicated in the final report[367]. This meant that as well as conveying the particular story for each theme, how they interacted with and related to other themes, and the original aims and objectives of this work could be clearly defined. By defining what each theme is about and what it is not about, the actual development of the data into themes within Braun and Clarke's (2006) process was complete. This led to the sixth step within the process, the actual production of the report. In alignment with the framework of analysis that was being used[368] and the seminal 1998 work of Boyatzis, this report was required to contain several

[366] (Braun & Clarke, 2006).
[367] (Boyatzis, 1998).
[368] (Braun & Clarke, 2006)

elements. Therefore, when outlining the themes, each theme is addressed individually but will also be compared, contrasted, and linked throughout the report. Each theme, too, will be provided with its own unique title, which seeks to encapsulate its essence, and within the discussion, numerous relevant extracts from the raw data will be used to support the narrative. This, therefore, will provide a comprehensive and cohesive overview of the data, which, as a result of the stringent and transparent processes outlined above, can be deemed to be reliably developed in a logical and scientifically robust manner.

Chapter 3. Results

3.1 Summary

This first part of this section presents the results of surveys assessing the perceptions of program directors and residents regarding postgraduate medical and surgical training programs in Saudi Arabia. Accumulating their perspectives allowed for robust development of a Delphi survey to converge on the most important aspects and themes that arose from the focus groups that were conducted earlier, highlighting the current postgraduate medical and surgical training processes within the Kingdom. The data for resident and program director satisfaction surveys were collected through an online survey engine (Survey Monkey) and entered into Microsoft Excel; respondents' data were rechecked for blank/empty or typographic error, then the file was exported to SPSS format for further management and analysis.

The data were analyzed using the statistical program SPSS version 24. A test will be considered significant if p-value < 0.05. All data were analyzed based on each KPI parameter and target. For the presentation of descriptive statistics, categorical data (gender, region distribution, qualification, etc.) was calculated as frequency (n) and percentages (%), while numerical data such as age and years of experience was presented as mean + standard deviation. Chi-square test was used to assess the effect of categorical variables like gender and country distribution upon the relationship between the dependent and independent variables to ascertain whether and how much variance these categorical confounders were accountable for in the analyses performed.

3.2 Program director survey and Results[369]

The Quality Indicators Committee (QIC) at the Saudi Commission for Health Specialties designed an interview questionnaire for program directors through key informant interviews and extensive focused group discussion. As mentioned previously, the questionnaire consisted of 53 questions was structured representing four main sections. The first section was demographics details of the program directors; this section has 14 questions exploring the personal information and the base of the participants' practice. Second section is the supervision and training, which contained 15 questions. The third section was educational content, and it has 5 questions. The fourth section is the support and resources section which has 19 questions.

An online link was created for the survey and was sent to all program directors, including the program directors of the three selected hospitals for this thesis, through emails but only 464 replied to the emails. Another 252 program directors were contacted, and an interview conducted through computer assisted telephonic interview (CATI) by SCFHS's personnel. The total number of responded program directors was 716 (65.2 %).

Saudi board graduation was the most common highest qualification for our program directors (58.4%), followed by graduation from different regional programs (15%), like Arab Board, Egyptian or Syrian Boards. Figure 2 describes the distribution of the primary qualification among program directors. The option "other" included Australian board, Pakistani, South African, etc.

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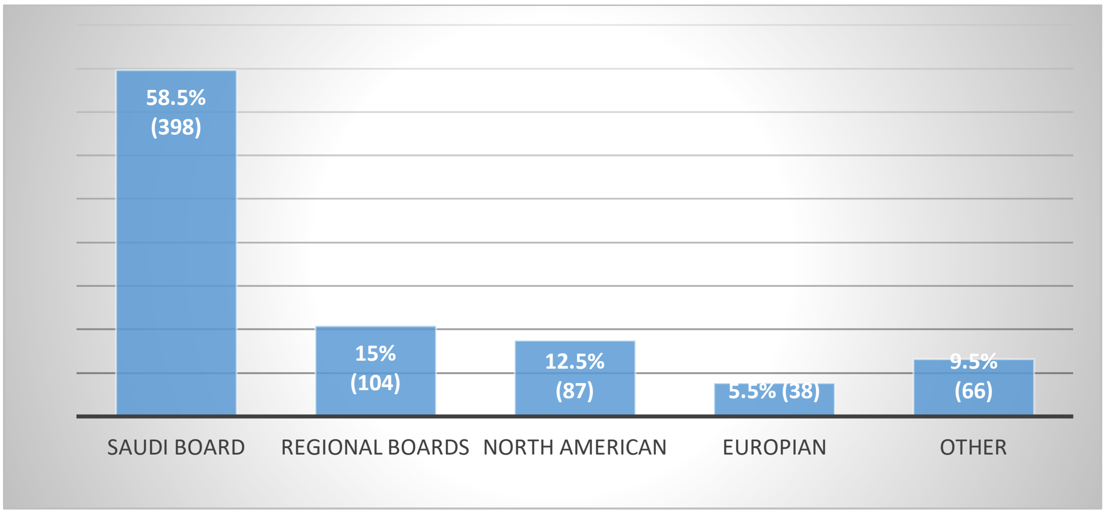
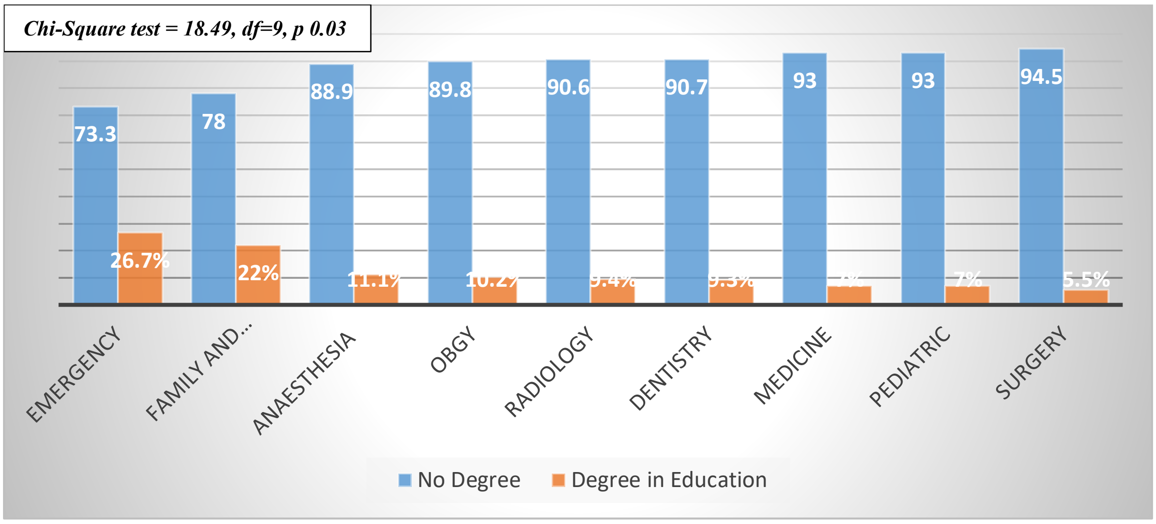
[369] Results in this section and Resident survey section were published in a paper I participated in titled "Evaluation of Key Performance Indicators (KPIs) for Sustainable Postgraduate Medical Training: An Opportunity for Implementing an Innovative Approach to Advance the Quality of Training Programs at the Saudi Commission for Health Specialties (SCFHS)" [369](Housawi, et al., 2020).

Figure 2: The Primary Qualification of the Program Directors



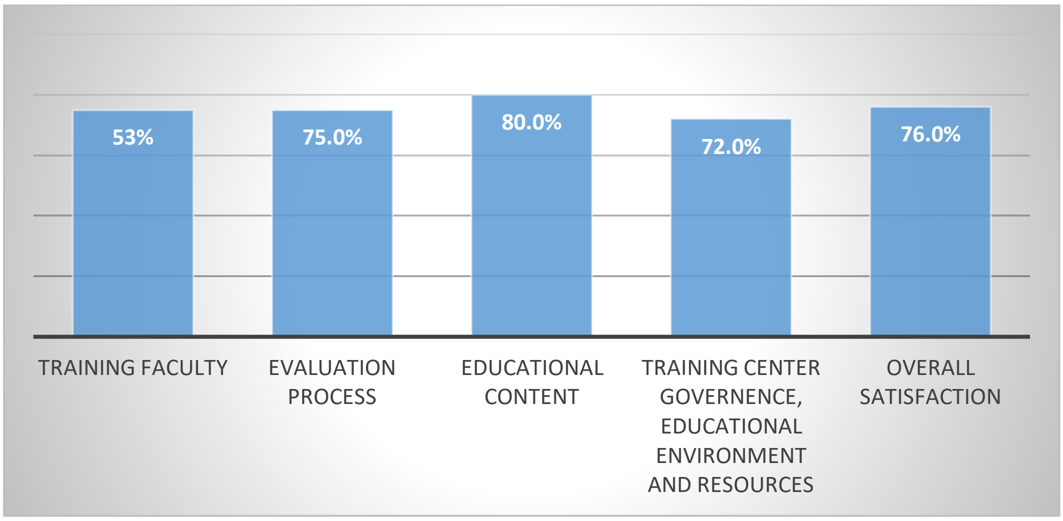
Over 27% of the PD have other special qualifications including medical education, hospital administration, public health, clinical epidemiology and others; but only 8.9% of the program directors have some degree or certificates in health profession education.

Figure 3: Percentage of program directors with degree in health profession education among disciplines



The accumulative score contains four main satisfaction domains: Satisfaction with Training Faculty, Satisfaction with Evaluation Process, Satisfaction with Educational Components and Satisfaction with Training Centre's Governance, Education Environment, and Resources. The overall score for PDs satisfaction is calculated at 76%, slightly below our target value, 80%. This is explained in detail in Figure 4.

Figure 4: Program Directors Satisfaction Scores



Program Directors were also asked about their satisfaction with compliance of training faculty in submitting resident's evaluation within 2 weeks of the end of every rotation. The target was set at the level of 100% compliance, the mean score for compliance was estimated to be 74.2%. This compliance rate was nearly identical in each region, with p = 0.9 (ANOVA test).

Figure 5 : The satisfaction rate of the program directors with the compliance of the training faculty in submitting trainee's evaluation in time

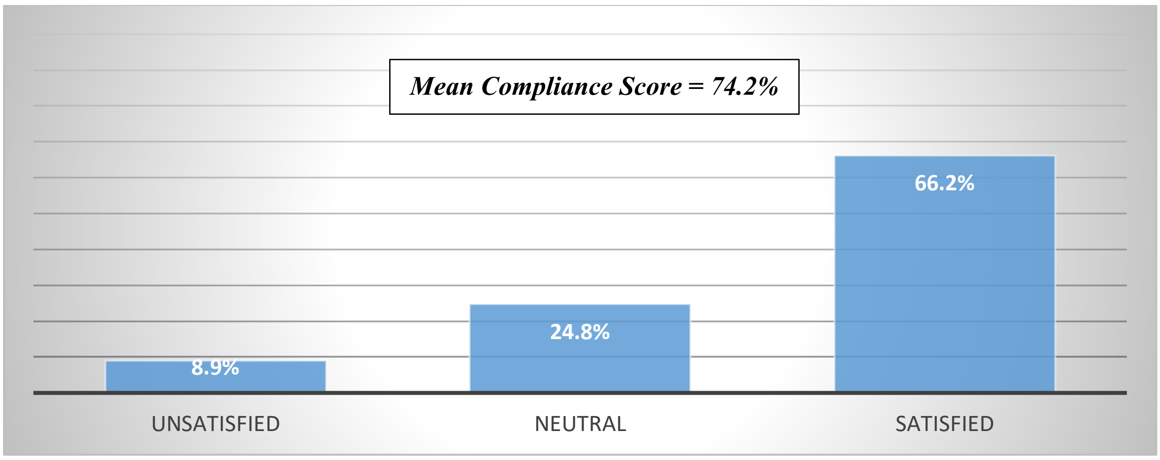
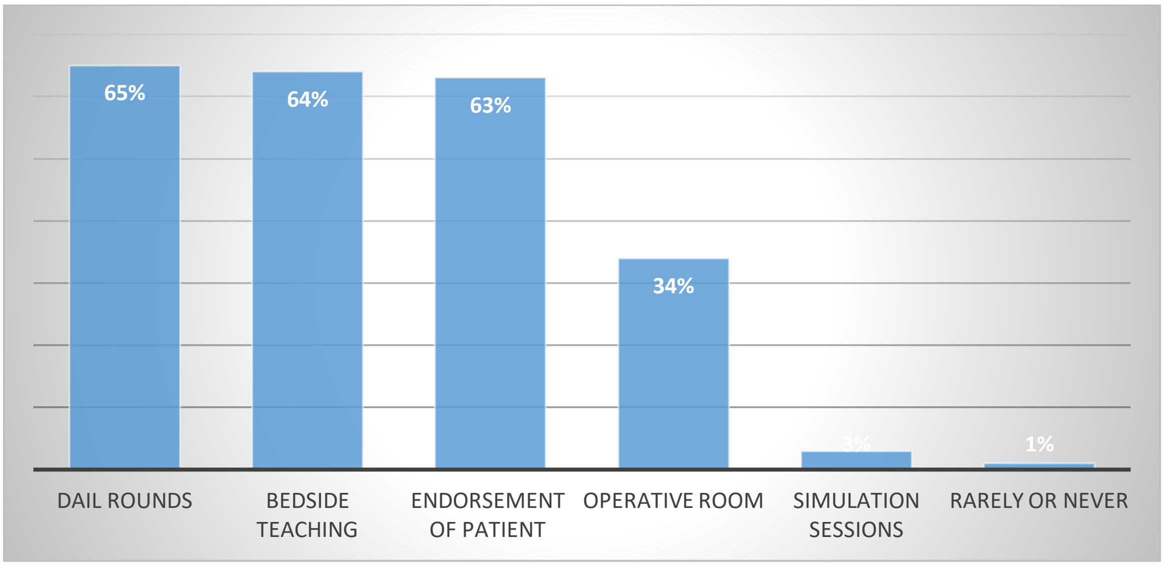


Figure 6: Educational Content



In Figure 6 above, daily rounds, as an opportunity to encounter with patients, were conducted in 64.8%, followed by bedside teaching in 63.8%, endorsement of patient care in 62.5% and operating rooms in 34.3%. Simulation session was utilized in 3.1% only, and it was rare or never in 0.8%.

3.3 Residents Survey & Results[370]

A Satisfaction questionnaires for residents were developed by the PGMT Quality [371]Indicator Committee (QIC) to produce an error-free measure of quality of care, measures should be based on characteristics of best practice such as validity, reliability and transparency. The questionnaire was created on September 25, 2018, published on October 1, 2018, and closed August 4, 2019. The questionnaire consisted of six sections with questions distributed among them. Eight questions were covering the demographic section; in the second section, there were 14 questions asking about trainees' educational activities. Three questions in the third section regarding the program satisfaction/training program. Section four had eight questions regarding perception & personal experience.

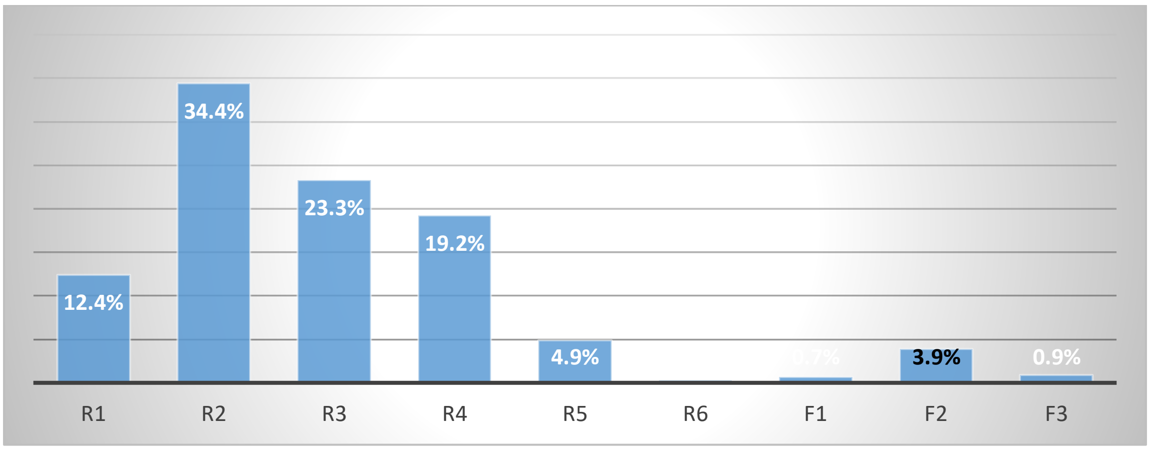
[370] (Housawi, et al., 2020)
[371] PGMT Quality Committee is an internal committee within SCFHS created to address Training Quality issues and monitor and maintain high quality standards within the training programs that are accredited by the Saudi Commission for health specialities.

The fifth and sixth sections has 3 and 5 questions for research participation and satisfaction with SCHFS, respectively.

There were total of 13,688 residents working in different specialties throughout Saudi Arabia, only 3,696 (27%) of the residents agreed to participate in the online survey. The trainers were left out of the survey due to time constraint. A total of 41 questions to represents indicators of quality of training programs were validated by experts and QIC panels for clarity and content relevance.

Residents-in-training represent the most common respondents, 94.5%, while fellows were 5.5%. One third of the residents were working in the R2 1270 (34.4%) level followed by R3 860 (23.3%) level.

Figure 7 : Level of trainees by training year (residents R1-R6 & Fellows in training F1-F3) included in our study sample



The accumulative score of eight different domains retrieved from the trainee's questionnaire. The domains are Residents' Satisfaction of Academic Activities in their training centers, Residents' Satisfaction with other residents in their programs, Residents' Satisfaction with the administrative component of their training, Residents' Satisfaction with the program and recommending it to others, Residents' Satisfaction with their training centre, Residents' Satisfaction with their competency, Residents' Satisfaction with their Specialty, and Residents' Satisfaction with SCFHS Functions. The calculated score for overall trainees' satisfaction is 69%. More details are described in Figure 8. So, the target has not yet been achieved.

Figure 8 : Trainees Satisfaction Scores

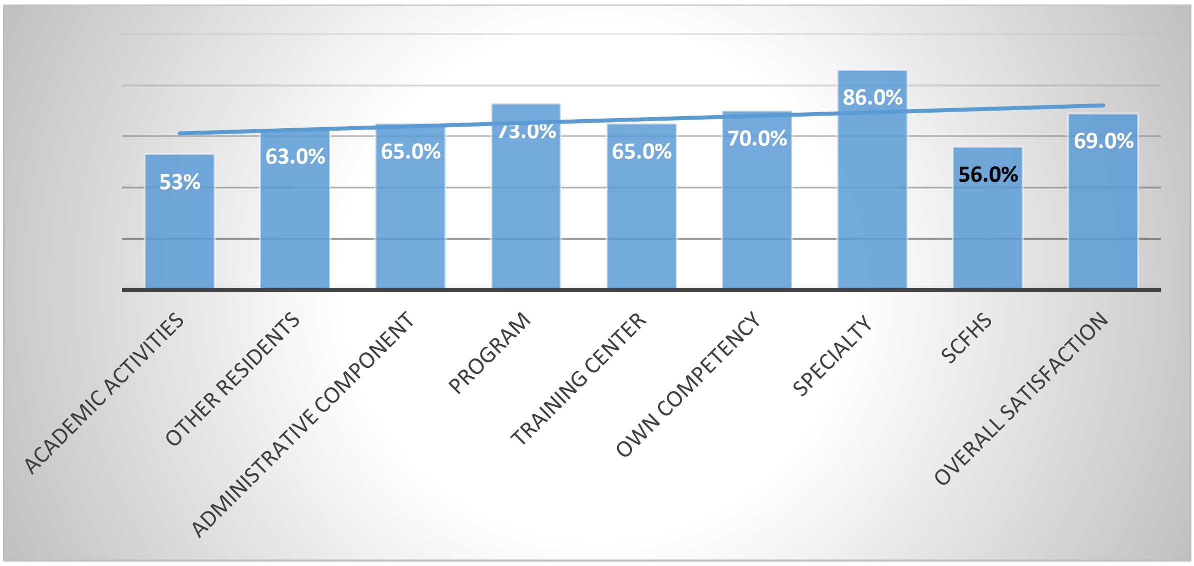
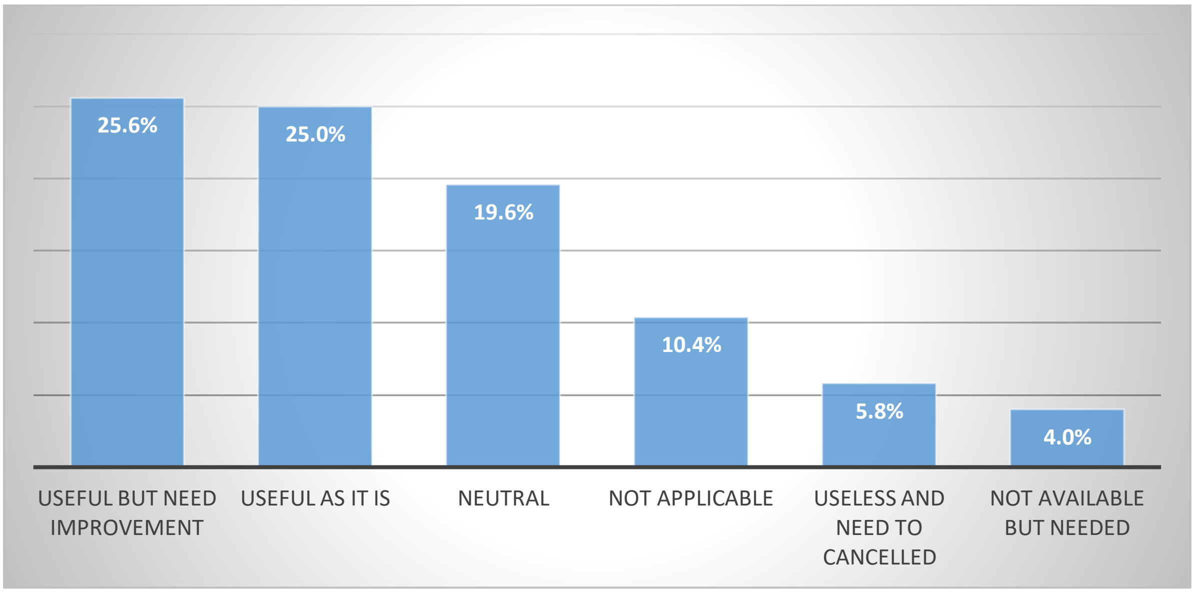
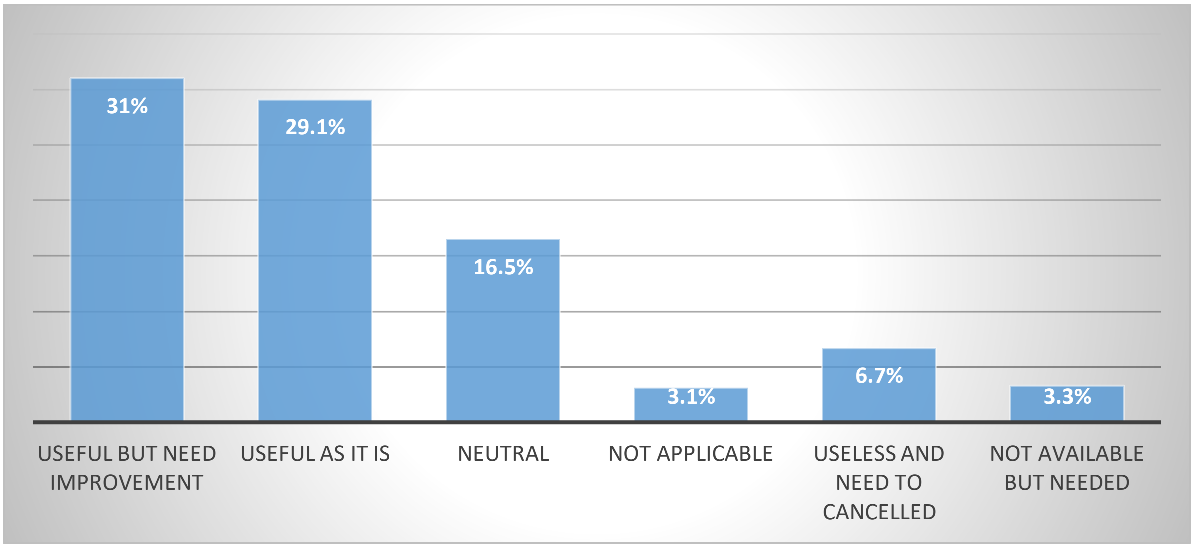


Figure 9: Satisfaction rate of morning report among trainees



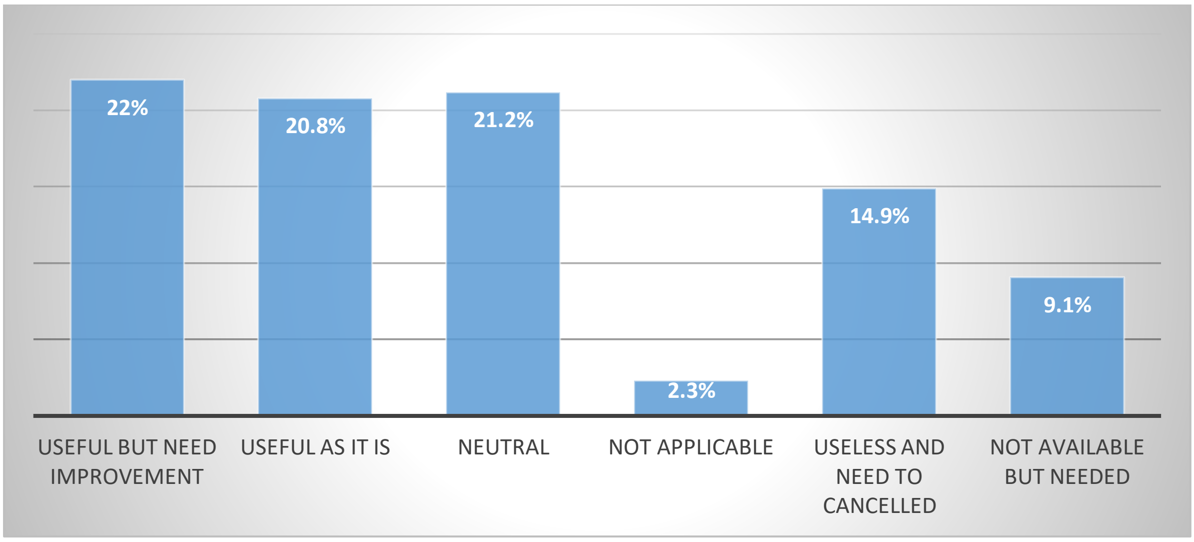
Regarding the evaluation of the academic activities within the training centres, residents were asked to evaluate aspects such as the morning report, academic half day, bedside teaching departmental weekly activity, bedside rounds with senior residents, bedside rounds with consultants, e-learning resources participation in research, training by simulation, mentorship, and multidisciplinary rounds. Figure 9 above addresses the usefulness of the morning report: 25.6% of the trainee found the morning report to be useful but it needs improvement, and 25% think is useful as it is, while 5.8% think that it is useless and needs to be cancelled.

Figure 10: Satisfaction of the trainees in academic half-day



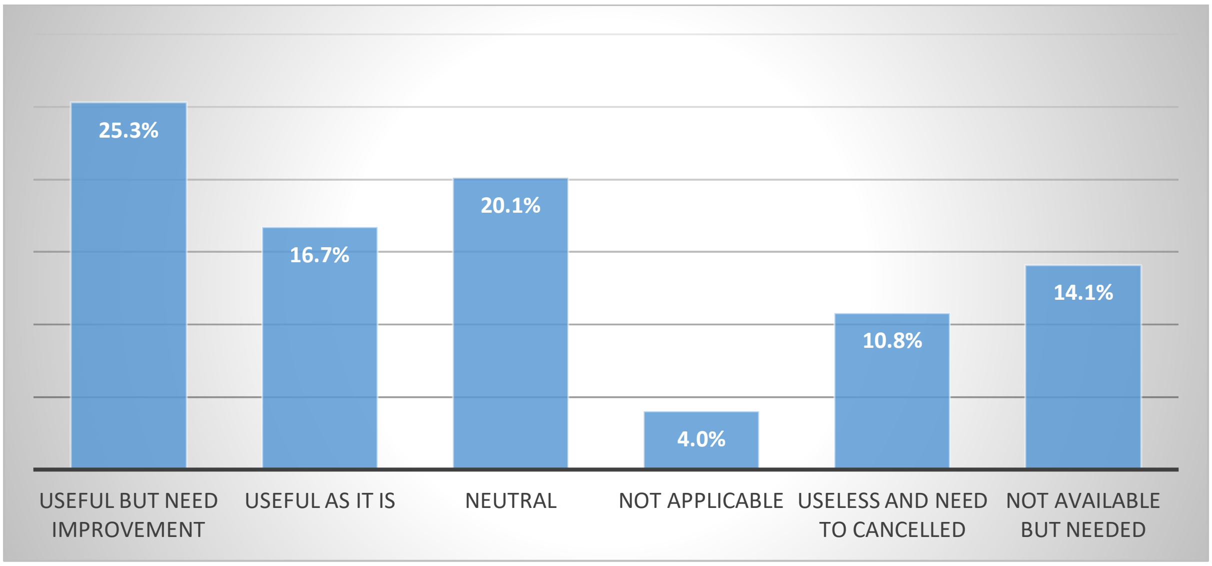
Nearly one third (31%) of the trainees consider academic half-days to be useful, while 29.1% think it needs improvement and for 3.1% of the trainees it is useless.

Figure 11: Satisfaction of the trainees in bedside teaching



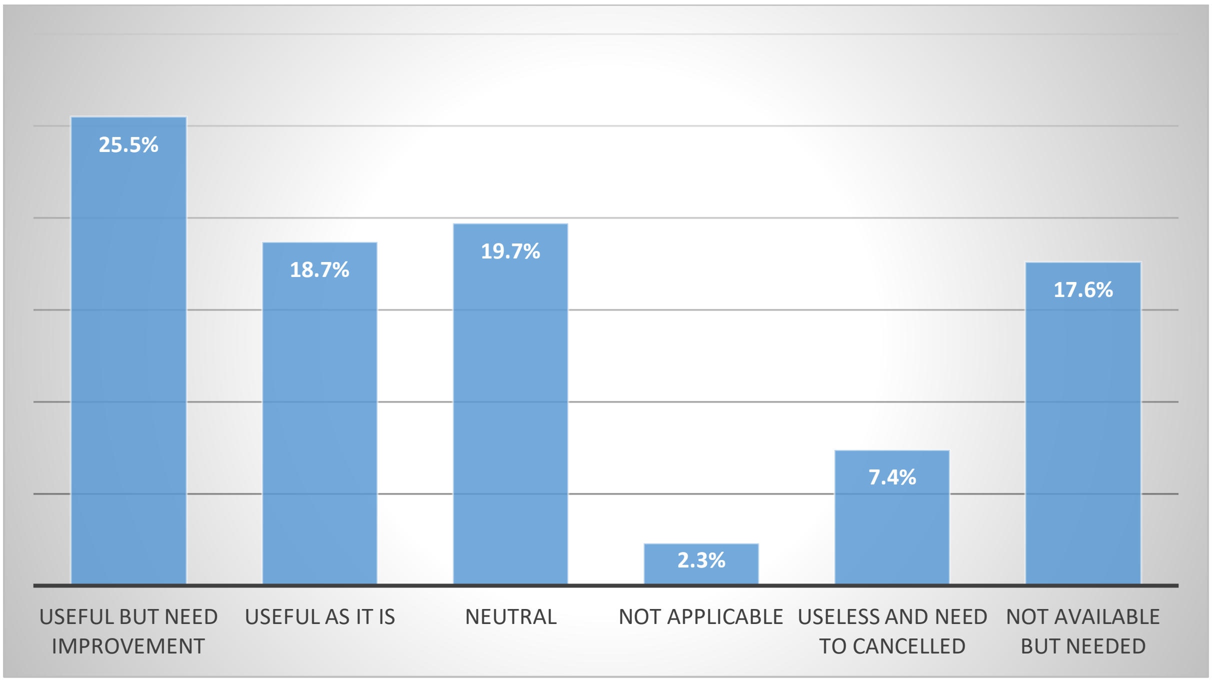
About 22% of the trainees consider Bedside teaching to be useful, while 20.8% think it needs improvement and for 2.3% trainees it is useless.

Figure 12: Satisfaction of the trainees in grand round (departmental weekly scientific activity)



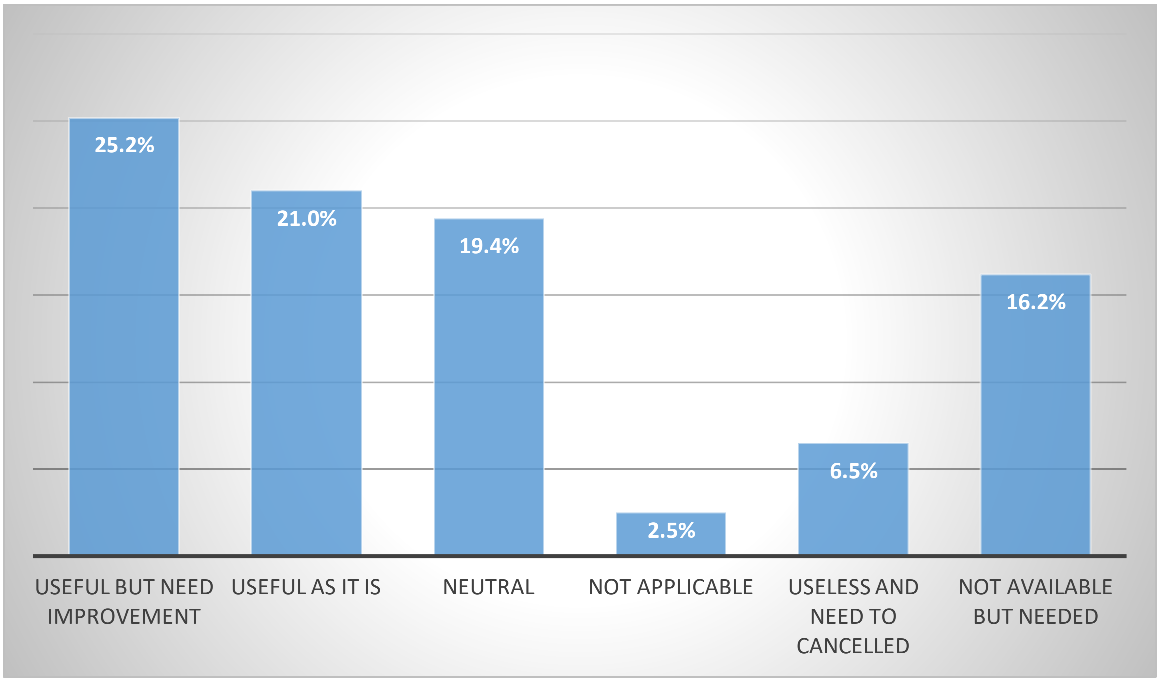
About a quarter (25.3%) of the trainees consider grand round good, while 16.7% think it needs improvement and 4% of trainees think it is useless.

Figure 13: Satisfaction of the trainees in daily bedside rounds with senior resident or fellow



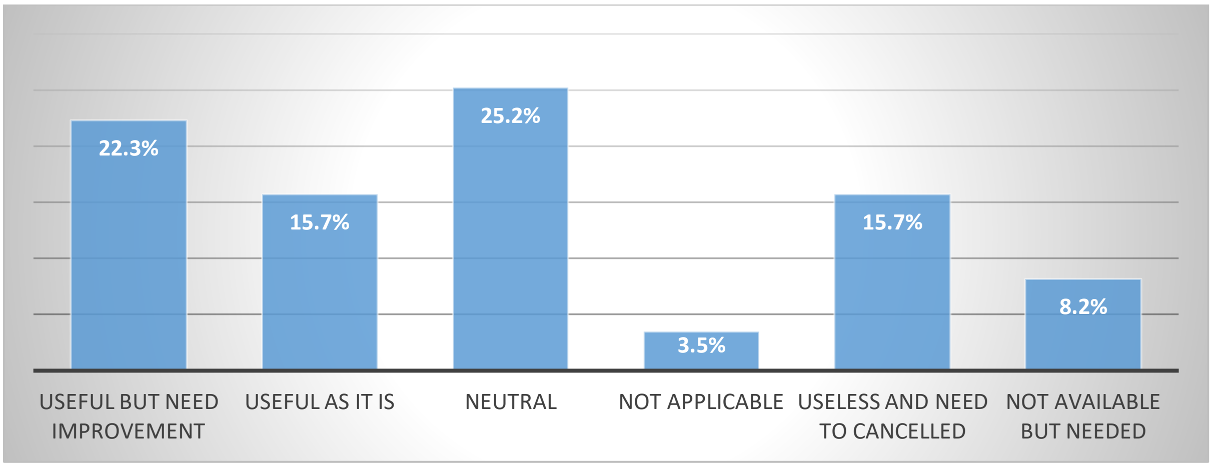
About one quarter (25.5%) of the trainees consider bedside rounds with a senior resident or fellow to be Good, while 18.7% think it needs improvement and 2.3% think it is useless.

Figure 14: Satisfaction of the trainees in daily bedside rounds with consultant



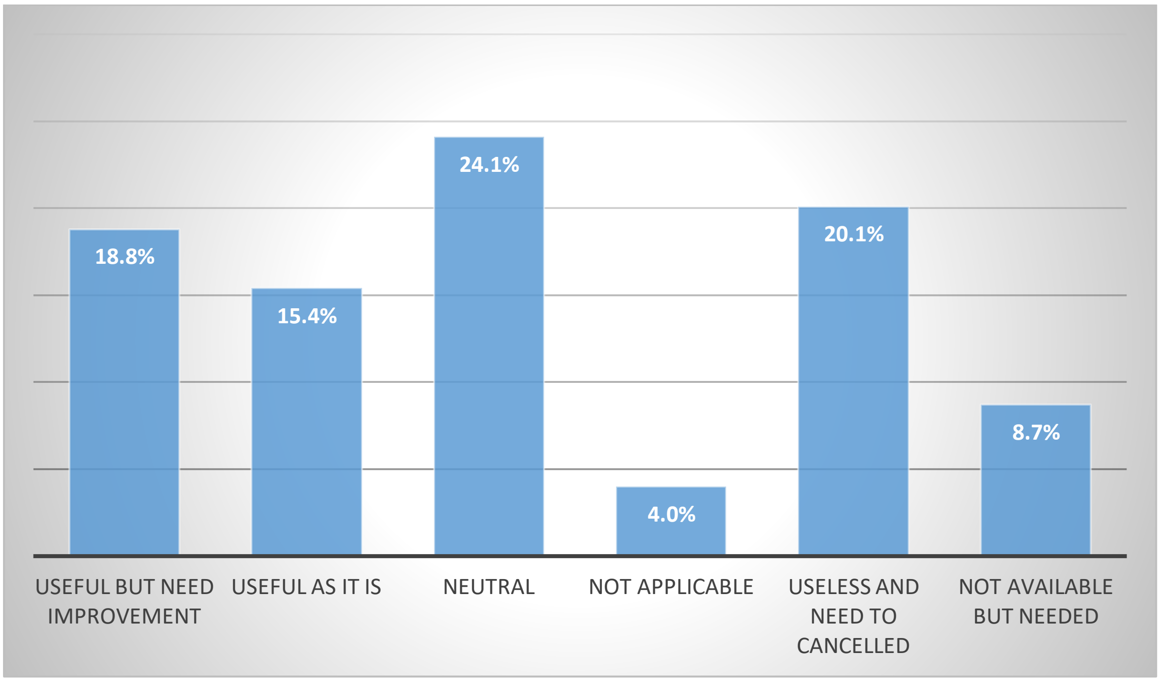
About one quarter (25.2%) of the trainees consider bedside rounds with consultant to be good, while 21% think it needs improvement, and 2.5% of trainees think it is useless.

Figure 15: Satisfaction of the trainees in E-learning resources



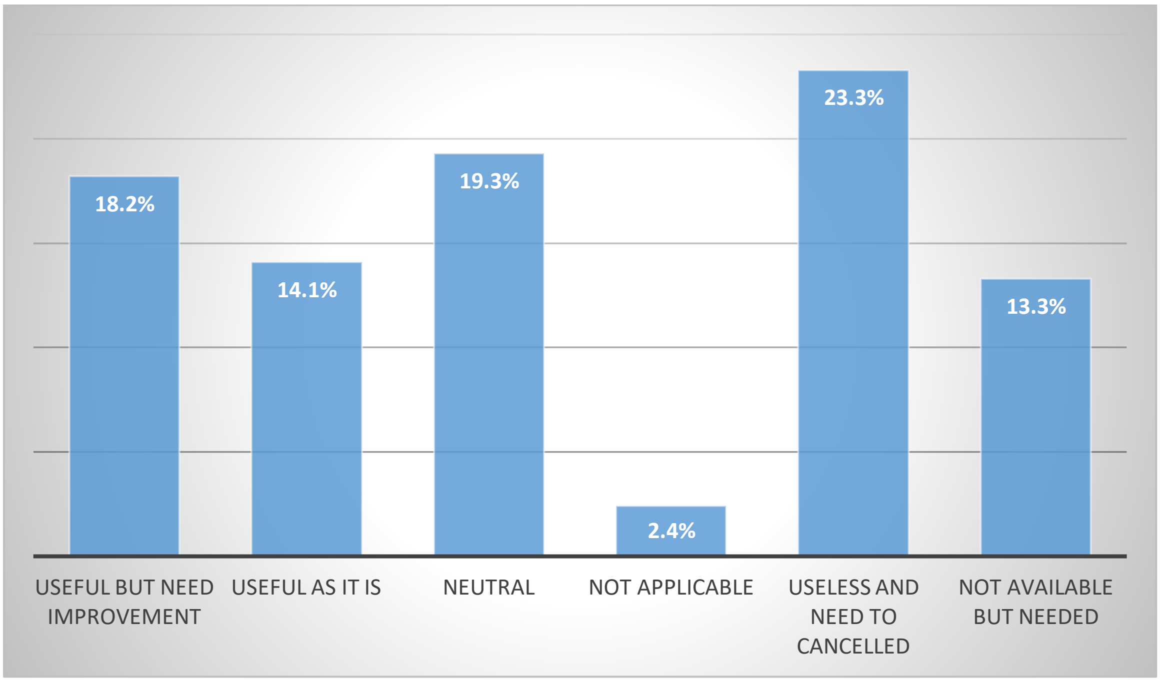
More than one fifth (22.3%) of the trainees consider E-learning Good, while 15.7% think it needs improvement, and 3.5% of the trainees think it is useless.

Figure 16: Satisfaction of the trainees in training and participation in research



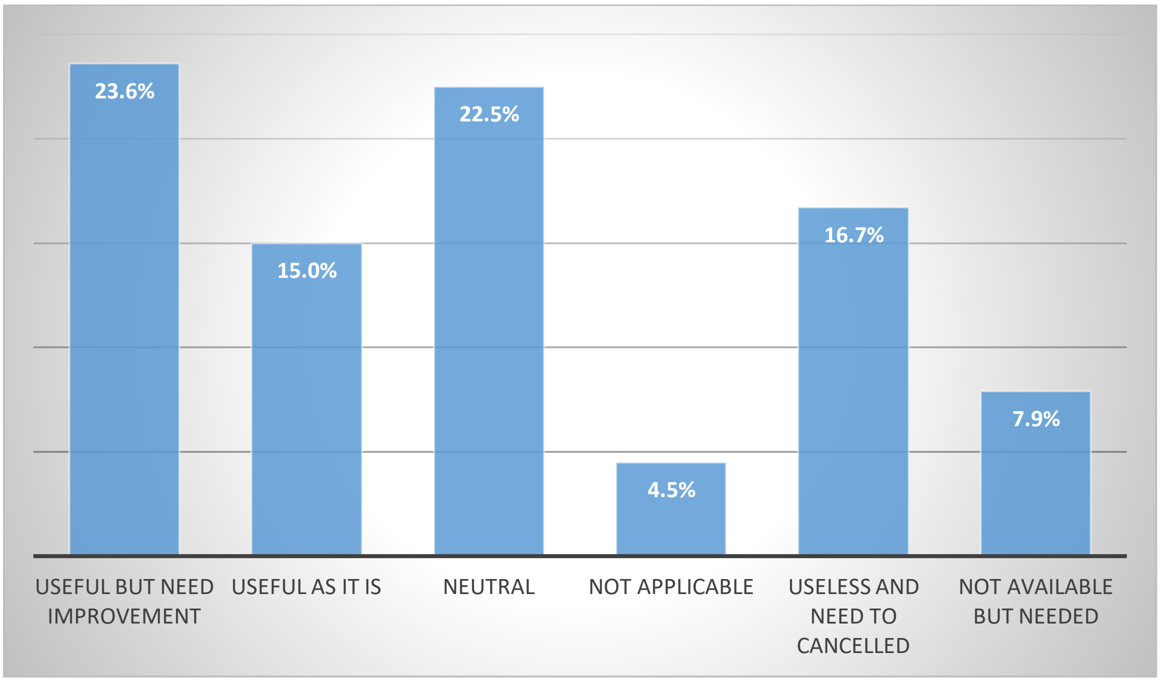
Less than one fifth (18.8%) of the trainees consider Training and Participating in Research to be Good, while 15.4% think it needs improvement, and 4% think it is useless.

Figure 17: Satisfaction of the trainees in training by simulation



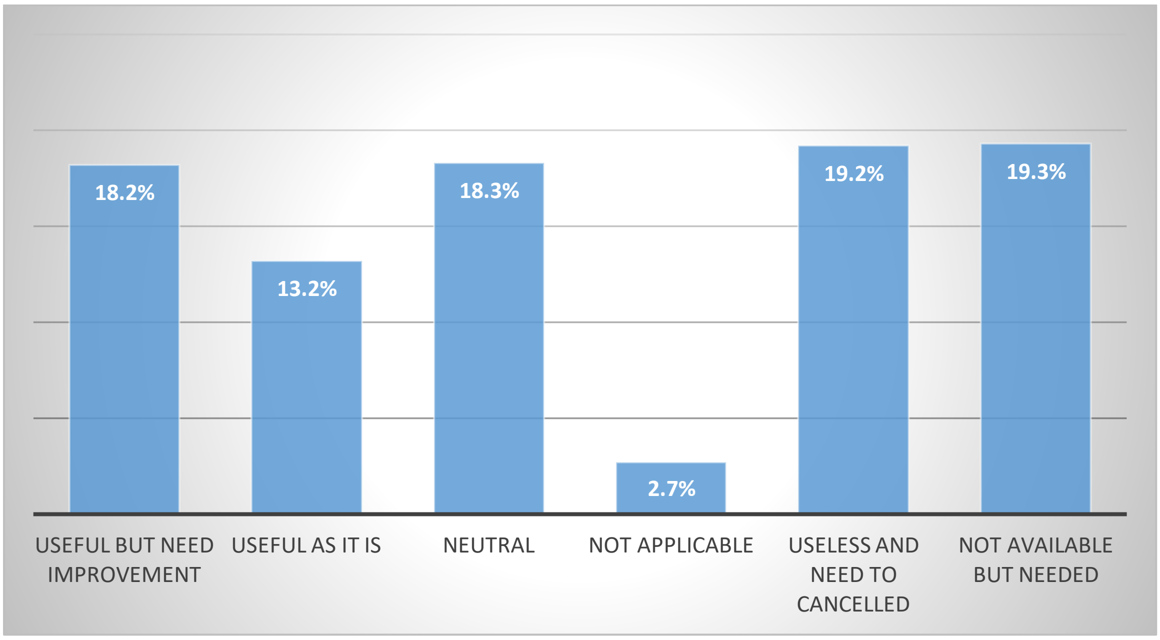
Less than one fifth (18.2%) of the trainees consider Training by Simulation to be Good, while 14.1% think it needs improvement, and 2.4% think it is useless.

Figure 18: Satisfaction of the trainees in mentorship



Nearly one quarter (23.6%) of the trainees consider Mentorship to be Good, while 15% think it needs improvement and 4.5% of trainees think it is useless.

Figure 19: Satisfaction of the trainees in multi-disciplinary rounds



Less than one fifth (18.2%) of the trainees consider multi-disciplinary rounds Good, while 13.2% think it needs improvement and 2.7% think it is useless.

3.4 Focus Groups

3.4.1 Overview of the themes

As previously noted in the preceding section, themes were developed separately for focus groups of residents and program directors. As such, there are two sets of themes that will be discussed below. The first set of themes to be discussed relates to the views of residents regarding issues that impact upon postgraduate surgical training in Saudi Arabia. Three core themes emerged within this sub-set of the data. These have been entitled i) exams over experiences, ii) a lack of support; and iii) tensions between residents and trainers. Within the first two of these themes, additional sub-themes were also identified. For example, within the theme of "a lack of support" sub-themes included a) a lack of policies to support residents and b) a lack of financial support for residents. Within the theme of "exams over experiences," there were additional sub-themes identified regarding a) too many residents and not enough patients, and b) we are not encouraged to conduct proper research.

Following an outline of these themes and sub-themes, those to stem from the sub-set of data relating to the experiences of program directors will then be discussed. From this subset of data, which was smaller than that from the residents, two core themes were identified during the analysis process. These were i) a lack of support for directors, and ii) tensions between staff. Within the first theme, "a lack of support for directors," two additional sub-themes were identified as being present. These sub-themes included a) too few patients, and b) a lack of suitable resources. The following sections will discuss these in greater detail.

3.4.2 Themes relating to residents' experiences

3.4.2.1 Theme 1: Exams over experiences

The first theme to be discussed has been entitled "exams over experiences." At the core of this theme is the assertion made by residents in the focus groups that there has been an over-emphasis placed upon the taking and passing of exams within Saudi surgical training. This, participants felt, was a key difference between Saudi-based training compared to that in Canada as one resident in the focus group put: “Maybe the difference between our program and the program in Canada is that mostly here we focus on exams, we have qualification exams, pal’s exam, promotion exams, and so people almost read for the purpose of exams and not for the training, and not like them in Canada, they promoted without the exams.” (RSR, 83[372]).

This emphasis on examinations comes at the expense of the importance placed on actual clinical skills, according to those residents impacted by this issue. As one resident in the focus group says: “Nobody will evaluate me in the OR [operating room]. We graduate, and nobody saw me in the OR. I will just fulfil the blueprint and show it to any Consultant. Then I will be a Consultant. For example, some of our colleagues did not do any surgical cases that are required part because of only one in the surgical part. It needs to be.” (RJR, 275[373]).

This is a seemingly dispiriting situation for residents who place a greater value on their clinical skills, and the lack of emphasis placed upon such skills seems only to frustrate these individuals: “I been doing super great in clinical areas (and) nobody evaluated this. They just assess me by their questions that had been inherited from the previous banks/batches, and it’s not well written and not well established, and they don’t have a good clinical point when you read their questionnaires. Apparently, they will only evaluate you in exams, promotion exams.” (RSR, 123)

“The main focus is the exams, but the quality of the training itself, it's declining because of the exams. There is focus on the training itself, the quality of the training, and

[372] RSR = Riyadh senior resident interview transcript
[373] RJR = Riyadh Junior Resident interview transcript

there is no feedback from the consultants, there is no individualized training, there is no constructed feedback, no written feedback, no monthly assessment." (RSR, 97)

Within this broader theme of an over-emphasis on exams, there are further sub-themes which provide more information with regards to the damage that this can do on the experiences of residents. One such sub-theme for example — too many residents, not enough patients — relates to the perception that by taking on an increased number of residents in recent years, there are simply not enough opportunities to learn the skills needed with actual patients:

"There are few centres with enough cases and the fact that their increase (in) the number of residents with the deficiencies that they have is not enough to gain experience or confidence in what we are learning." (RJR, 116).

"Theatre room sometimes in training centres are very limited; in some centres, there are only one or two theatres. How can you teach the increased number of surgical residents?" (RJR, 128).

This situation of lack of clinical access may explain the increased emphasis on exams. The final aspect of this theme relates to the sub-theme in which this emphasis also overrides the importance placed upon conducting good quality research. As one resident noted, the myopic focus on exams at all costs "does not encourage us to conduct research or good research" (TSR, 190).

3.4.2.2 Theme 2: A lack of support

The second theme, "a lack of support," relates to the perceptions that residents had regarding the resources and structures that were in place. These resources and structures did not meet their expectations with regards to enabling them to carry out their training in an effective manner, in which they felt valued or supported. Two aspects were most salient within this theme, which related to a lack of policy or structural support, and a lack of financial support. For example, one resident noted that there was: "No policy. Or procedures.

Each one would come on their own and do what they feel like doing that day, with no structure. Another one would put in his program what he feels right! No unified way of delivering the training process?" (TSR, 408).

Furthermore, as an example of a lack of financial support for residents, one participant noted that: "The tuition fees that are required by the center is center-specific, some hospitals such as King Faisal would wave it and pay it instead of the resident to the Saudi Commission, but other centers will not do that, so this would have to be paid to the commission out of pocket which is a financial burden on the residents. So, if there is no training department, there is no financial budget for it, so we have to pay for it." (RJR, 704). This lack of financial support extended to the costs of training, and one resident in focus group recalled how: "During the Residency, there are required equipment that you need in the operation room such as surgical loops, which are very expensive for residents to buy … I personally had to pay 10 thousand riyals to buy these loops out of pocket." (RJR, 684). Both the lack of policies in place to support the learning of residents, and the lack of financial structures created an environment in which residents felt both confused and undervalued, and there was talk of how those being trained in Canada did not have to experience such difficulties, for example in terms of money: "In Canada, you get a student discount to buy these; therefore, some of us ask residents in Canada to buy them for us and send it back to us here"(RJR, 690). Addressing the disparities outlined above would seem to be a priority for those overusing training in Saudi Arabia, therefore.

3.4.2.3 Theme 3: Tensions between residents and trainers

Some of the frustrations outlined in the previous two themes — frustrations regarding the perceived over-emphasis on examinations, and frustrations with the lack of support offered to those training in Saudi Arabia — may perhaps contribute to this final theme. This theme, tensions between residents and trainers, related to the often-inconsistent nature of trainers experienced by residents. For example, one participant noted that what they learned "depends on the mood of the consultant whether he is willing to train us and teach us" (RJR, 202), which very much summed up the sense of randomness some residents felt with regards to the quality of input they received. This was further underlined by another resident within a focus group stating, "The resident is a mirror of the RTP. If the RTP is strong and great, then the resident will reflect that and become great, but if the RTP is weak, then the resident is the same copy of him." (TSR, 380)[374].

The quality of teaching by those training the residents — and the attitudes of these trainers — was viewed as variable, with examples being given by residents that painted a picture of trainers being actively hostile to having to teach, and is described as: "Accusing you [residents] of being wanting to be spoon-fed…Go and read about it and presented tomorrow, this is the usual thing…Yeah, so nobody would ask again!" (RSR, 247).

This, residents stated, was an indication that those doing the training "are not ready to teach…they are not qualified." This situation is clearly not one that is indicative of a satisfactory system from the point of view of those who are receiving the training. The combination of all three of these themes does indicate that regardless of the outcomes that may be engendered by the current system, the experiences of those who are going through it are at times less than optimal. There appears to be a considerable amount of frustration with the inconsistencies and the lack of opportunities to actively learn while in post. The following section will examine the perspective of program directors about this situation.

3.4.3 Themes relating to program directors' experiences

3.4.3.1 Theme 1: Lack of support for program directors

Interestingly, just as residents noted that they perceived a lack of support for their training, the programme directors that were interviewed for this study also noted a lack of

[374] TSR = Taief Senior Resident interview transcript

support for their role. This could be attributed to two additionally linked areas that the interviewed program directors noted in their interviews: the lack of direction regarding their provision of training, and perhaps most notably within this theme, the lack of resources that they have within the program.

In relation to this lack of support, one programme director noted that often people in their position had to "take the blame" for the lack of attainment of those they were taking over the role of; notably in their case they had little structure in place when taking the role of programme director: "When I came three years ago I came to the previous RTP (resident training program director) and asked him, 'do you have policies or procedures or anything?' as this has been an old program 18 years. There is no policy. There is no rule. Nobody developed or did anything. The success rate then was 20%. So, I started from scratch." (TPD, 426[375])

Another director noted that there was "no policy or procedure that we have within the Department of Medicine to create a roadmap and a procedure how to develop research" (RPD, 42)[376] despite the notion of such research being considered a key indicator of quality and attainment within such environments. Such issues contribute to the picture of programme directors having to work within the confines of environments that have not been suitably equipped with either the pre-requisite policies, structures, or resources. This, in turn, creates an environment in which programme directors are not feeling fulfilled, which leads to high levels of professional attrition and turnover: "Every three months they are changing (programme directors) because there are no incentives for them to continue to do so" (TPD, 239) "It is a self-inflicted wound. There's no motivation. There are no salary benefits that you have to travel with your petrol on your own car. Sometimes, you come to the meetings, and

[375] TPD = Taief Program Director interview transcript
[376] RPD = Riyadh Program Director interview transcript

there's a lot of writing and replying and emails. You know, we don't have a designated secretary in the secretary department." (TPD, 242)

This frustration with the lack of financial or secretarial support is further underlined when one programme director notes that they have to at times "pay out of pocket to ensure that we have the logistics" to conduct their work. Such frustration regarding the lack of logistics included what would seem to be basic issues such as lack of internet access or even USB-port access on computers: "There's no online access to residents, that is their home. So, what I do personally is that reach out to private companies to ensure that the institution is up to date. Although the Saudi Council has an update, but it's not that you can access everything. It's limited. So, we have for residents, and we have a dedicated place in our conference room. So that works. But currently, you have the courses that are required by the medical education council. It's okay that you don't know the answer, but it's not okay that you cannot get it very quickly. You have to have access to the resource. That's what is lacking." (TPD, 338)

3.4.3.2 Theme 2: Tensions between staff

The final theme to be discussed relate to tensions between staff and can be seen to relate similarly to the final theme discussed within the reporting of the residents' thematic analysis. This was particularly the case when discussing new residents' concerns or complaints, and the tensions between perhaps the older generation and the viewpoints of the younger generation were very raw in nature. For example, one programme director stated that:

"I think with the newer generation, they want it easy, and they learn these big words, and they use it. I think. Right. The other day, I have an intern so, they can't be actually, basically nothing, and then she started to cry at the door saying that 'I'm burning out!'" (TPD, 477)

This sense of the old versus new generation could be seen in this programme director's response to this situation: "What I mean is that the new generation different from us and they have a different understanding to these words…" (482-483) "You have to work straight. Otherwise. So, I don't know what, you know, I hope you understand it because you know it's a bit shameful." (TPD,473-474).

This did not just create tension, but also the sense of "old school" ways of doing things can be seen to be linked in a way to what the residents were stating in their accounts regarding a lack of structured means of assessing or providing the necessary support. For example, one programme director who was interviewed admitted that "old school" consultants would apply less-than-standardized parameters on whether to advance the career of residents under their tutelage: "Most of the consultants are old consultants (meaning old school), okay. They go with the rule, if you make me happy, and if you are fine with me, and you have a good personality, then you automatically get a 100%. That's how they evaluate residents. No systematic or scientific way to evaluate residents." (TPD, 511)

3.5 Comparing and contrasting the themes between participant groups

This sub-section will now examine the similarities and differences between the thematic outlines provided above for both the residents and the program directors who took part in the data collection processes within this current study. To achieve this, a narrative summary of the themes for both groups shall be outlined. This will be followed by a discussion of the similarities and differences between participant viewpoints.

The first group to be discussed shall be the residents, the data from which stemmed from interviews and focus groups. The thematic tale that stems from this analysis is as follows. The overwhelming impression gleaned from the accounts of residents was that they felt insufficient attention was being paid to valuing clinical experience and clinical learning. This manifested itself in exams being valued by educators over the actual skills needed in situ of their roles. One of the potential reasons for this — and this was noted as another key frustration of residents — was that because of increased resident recruitment rates, there was often too many residents and not enough patients; hence perhaps why assessment had seemed to be unduly weighted onto the theoretical as opposed to the practical. However, the focus on simply preparing for, taking, and passing exams also was said to provide few opportunities for residents to engage in any quality opportunities to be engaged with the research process. This entire theme, therefore, presents a picture of residents feeling frustrated and a little helpless with their situation. This can be seen in more depth when the second resident-centric theme is taken into account. This theme, which details the perceived lack of support they receive, adds to the sense of frustration being outlined by these participants. Perhaps the most salient aspect of this perceived lack of support was to do with the financial pressures faced by those training in Saudi Arabia, especially compared to those who were receiving training in Canada. Participants within the focus group stated that those in Canada were often contacted by those in Saudi Arabia to help secure access to equipment at a discounted price. Again, this seems to — quite understandably — add to the sense of frustration felt by those within the Saudi Arabian surgical training program, and may explain the prevalence of the third theme identified within the data within this study, which identified a sense of frustration at the variable teaching quality that they had access to within their studies. In this theme, residents spoke of the lack of teaching expertise — and perhaps more worryingly, lack of desire to teach well — within those who were tasked to train these residents. This variable nature of teaching contrasts deeply with the sense that residents must become exam-ready within this system, and the fact that participants stated that trainers would actively avoid questions and instead re-direct residents not to be "spoon fed" points to an inherent tension within this system, which seems to prioritize academic achievement, but which does not provide the structures and supports necessary to sufficiently help residents thrive in this environment. It is little wonder that the palpable sense of frustration experienced by those in this was one of the key elements across this analysis.

Whereas the dataset for the programme directors' analysis was more limited than that of the residents, a similar picture of frustration and lack of support was gleaned from this analysis. Just two core themes were developed from this dataset, but they tell a similar story to the one told by residents. For example, the lack of support that the residents noted was echoed by the lack of support experienced by programme directors. For this participant group, this too related to issues of a lack of financial support, which they were required to meet from their own pockets. The sense of frustration with the system that was implied by the residents is also more explicitly handled within the interviews with programme directors, with one stating that high rates of attrition within such roles are the result of the frustrations felt with the lack of resources they are faced with contending with. As with the residents, it is perhaps the frustrations felt with the perceived lack of support for their own professional needs, that give way to tensions with others. Whereas the residents expressed frustration with their trainers for the variability in teaching quality, the programme directors spoke of a sense of frustration with the "new generation" of doctors and their expectations. This tension mirrors that of the residents and provides asymmetry to the analysis of the raw data stemming from this current piece of work.

In conclusion, therefore, although the expectations and experiences of residents and program directors vary depending upon their professional identity, their narrative overviews are actually very similar. In fact, both professional groups described a number of frustrations with the lack of adequate support and the proper structure and went onto describe rifts or tensions with those in other professional groups, perhaps in part as a result of these frustrations. This indicates that the current system requires enhanced examination in order to address some of these issues, as well as enhanced investigation as to how these issues go onto impact professionals' journey through their roles.

3.6 Summary

To briefly summarise this section, the themes developed from both the residents' and Program Directors' accounts indicate that the experiences of these individuals can provide many insights into ways to improve the training experiences within Saudi Arabian surgical programs. Key issues identified include a lack of structure or policies being implemented and an under-emphasis placed on clinical expertise and experience. For both sets of participants, frustrations with lack of support in general, and frustrations with colleagues are also prevalent.

3.7 Delphi Survey

Study design

De Leeuw et, al[377]. indicated that Delphi surveys are well situated in health education, as it informs the health field by pooling intelligence and capturing collective opinion of experts. The Delphi survey was digitally administered using "Survey Monkey," a survey instrument in order to collect responses from the focus groups participants (residents and program directors).

The Delphi survey was created[378] based on two main streams; The resident surveys results and the focus group that was created for each targeted audience. The resident focus group had support, educational content and training faculty as three general themes that arose from the focus group. The programme director focus groups had supervision and teaching, resources, and faculty as the three general themes that were evident from the focus group.

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[377] (Leeuw, Walsh, Westerman, & Scheele, 2018, p. 2)

[378] Please refer to figure 20 for detailed steps in creating the delphi method for this thesis.

Each of the three themes for the two focus groups contained four choices that both group participants had to choose from.

The score column is the weighted average for each option, which indicates which option is most preferred and is calculated as the following:

The average ranking is calculated as follows, where:

w = weight of ranked position

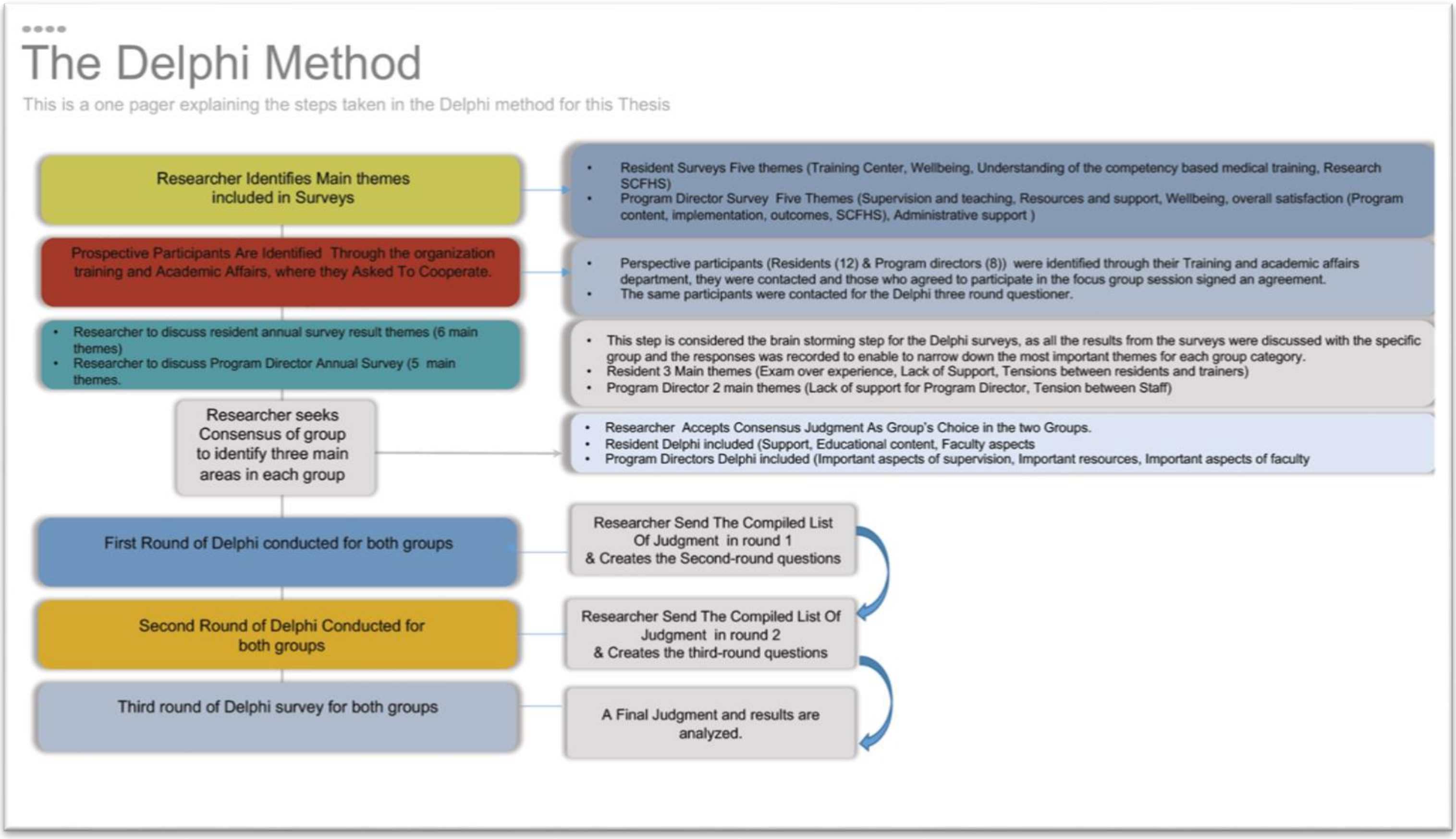
x = response count for answer choice

$$\frac{x1w1 + x2w2 + x3w3 \ldots xnwn}{\text{Total response count}}$$

Participant sampling frame and recruitment

The participants were the same participants in the focus groups, residents had twelve participants from three different focus groups. The program director focus group contained 8 program directors from two different focus groups. All participants gave their verbal consent during the focus group to be part of the Delphi survey as it contained themes that we talked about.

Figure 20:Delphi survey creation process



3.8 Analysis

3.8.1 Delphi survey round 1 analysis

The first round of the Delphi survey was created based on the main themes that were obtained from the various focus groups that were conducted earlier for program directors and residents. Three main areas were identified as themes in both types of Delphi surveys. Each one of these themes included four main aspects that were also identified through the satisfaction surveys and focus groups. These main aspects within each theme will be scored based on ranking, and the highest ranked aspects based on the total score will remain to be re-ranked within the second and third Delphi rounds.

3.8.2 Resident survey round 1 analysis

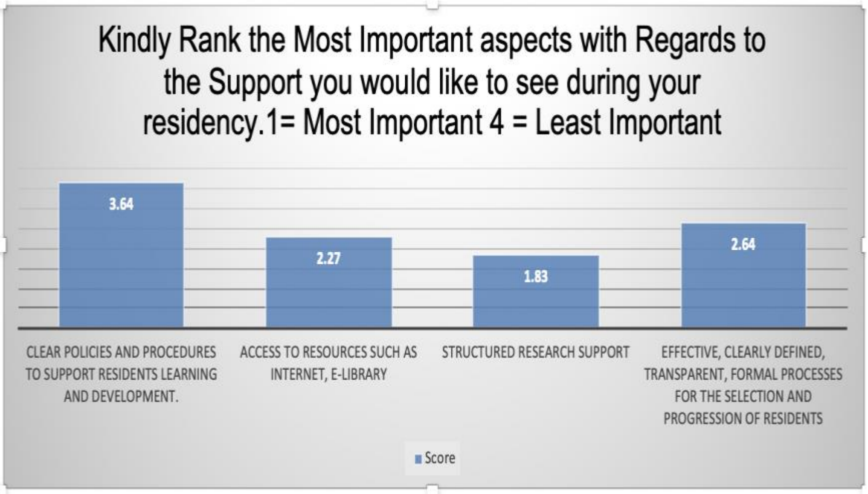
The residents Delphi survey contained three main areas that were identified from the focus groups. These areas included support, educational content, and training faculty aspects. The response rate for this round was 91.6% (11 out of 12 responses), and the average time to complete the entire survey was two minutes.

When asking the residents to rank the most important elements with regards to the resources required to support the training process within their institutions; residents ranked having clear policies and procedures as their first most important aspect that needs to be available to ensure a smooth and continuous training process with an overall weighted average ranking score of 3.64[379].

Having an effective, clearly defined, transparent, formal processes for the selection and progression of residents was their second highly ranked aspect in the support theme with an overall weighted average ranking score of 2.64. The third important aspect as seen in Figure 21 below, is having access to resources such as internet and e-library with overall weighted average ranking score of 2.27. Finally, the resident ranked having a structured research support as the least important aspect of the required support that they need during their residency journey within their respective training centres.

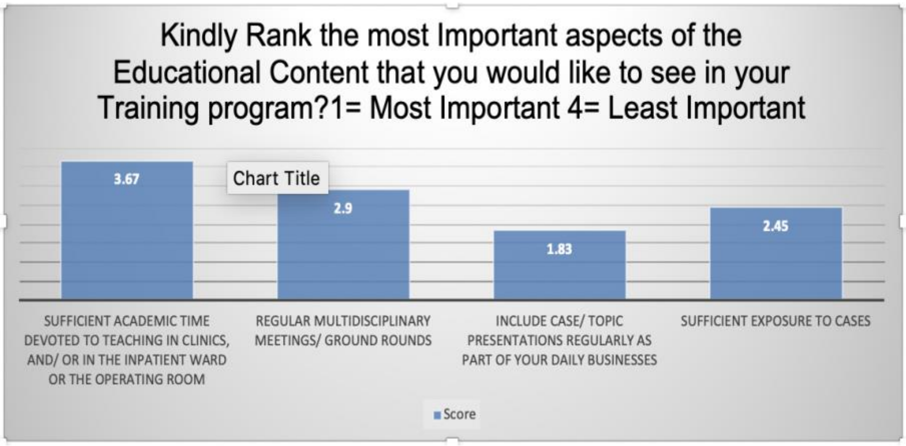
[379] Ranking scale between 1-4, 4 being the highest weighted average and 1 being the lowest weighted average.

Figure 21: Resident Delphi round1 survey responses to Q1



The second theme that was addressed in this first round of Delphi survey is the educational content aspect in their residencies. The residents ranked havening sufficient academic time devoted to teaching in clinics, and /or in the inpatient ward or the operating room as their first most important aspect that they require in their residency program within their training centres, with overall weighted average ranking score of 3.67. Within the same theme residents ranked having multidisciplinary meetings and ground rounds as their second most important aspect of the educational content with overall weighted average ranking score of 2.90. The third element that was ranked as an important aspect was sufficient exposure to cases with overall weighted average ranking score of 2.45. Finally, residents ranked including case/ topic presentations as their least important element within the educational content theme with overall weighted average ranking score of 1.83

Figure 22: Resident Delphi round 1 survey responses to Q2



The third theme to be discussed in this first Delphi round for residents was training faculty. Within this theme residents ranked having a safe a supportive environment for inquires as their first most important aspect of a training program with overall weighted average ranking score of 3.56. Having sufficient instructions by immediate faculty members clinically/ or in the operating room as defined by the clinical site was ranked the second important aspect of the training program with overall weighted average ranking score of 3.33. The third important element according to the residents is having an appropriate number of faculty members to provide the knowledge required with overall weighted average ranking score of 2.09. Finally, the least important aspect within this theme was having accessibility to consultants and program directors to discuss cases or issues with overall weighted average ranking score of 1.67.

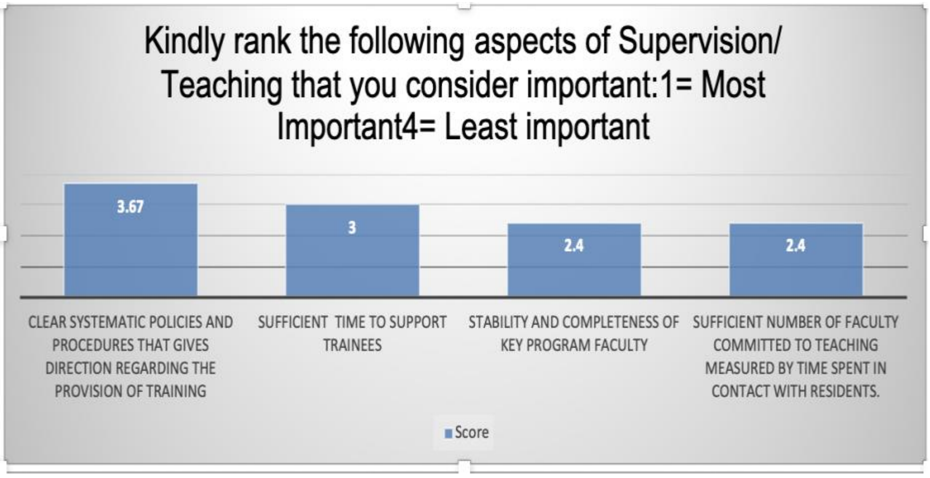
Figure 23: Resident Delphi survey round 1 responses to Q3

3.8.3 Program Director round 1 analysis

The program director Delphi survey response rate was 62.5 % (5 out of 8 responded), with a typical time of four minutes spent to answer the whole survey. Similar to the resident Delphi survey, the program director round one survey contained three themes, such as supervision/ teaching, resources, and finally faculty aspects that are important. These themes were derived from the two focus groups that were conducted earlier to understand what program directors need to be supported during their journey as a program director within a particular field.

With regards to the first theme, program directors ranked having a clear systematic policies and procedures that gives direction regarding the provision of training was the most important aspect that they required in their training institution, this as shown above is also one of the most important elements that the residents pointed out, this aspect had an overall weighted average ranking score of 3.67. The second important element that was identified through this first Delphi round was having sufficient time to support trainees, with overall weighted average ranking score of 3.0. The last two aspects such as stability and completeness of key program faculty, and sufficient number of faculty committed to teaching measured by time spent in contact with residents were of equal importance and score, where they each had an overall weighted average ranking score of 2.40.

Figure 24: Program Director Delphi round 1 survey responses to Q1



The second theme within the program director Delphi survey was resources, having the appropriate infrastructure of the training facility and supportive leadership to adequately deliver the training process was identified by the program directors as the most important element with overall weighted average ranking score of 3.67.

The second element that was identified as important within this theme, is that the residency program has the clinical, physical, technical, and financial resources to provide all residents with the educational experience needed. This also align with what the residents required when identifying resources needs that they required. This item scored an overall weighted average ranking of 3.25.

The third important item that the program directors identified within this theme, was the availability of administrative personnel to support the delivery of the residency program. It was mentioned in the focus groups that some programs lack the sufficient support required to deliver a seamless training process, one of the main support elements they identified was having support personnel that could assist them in clerical work related to the training program, this aspect had an overall weighted average ranking score of 2.25.

The least important element within this Delphi survey according to the program directors' responses was leadership engagement with residents, fellows, and faculty members in designing, developing and continuously stewarding priorities that support wellbeing, with overall weighted average ranking score of 2.0.

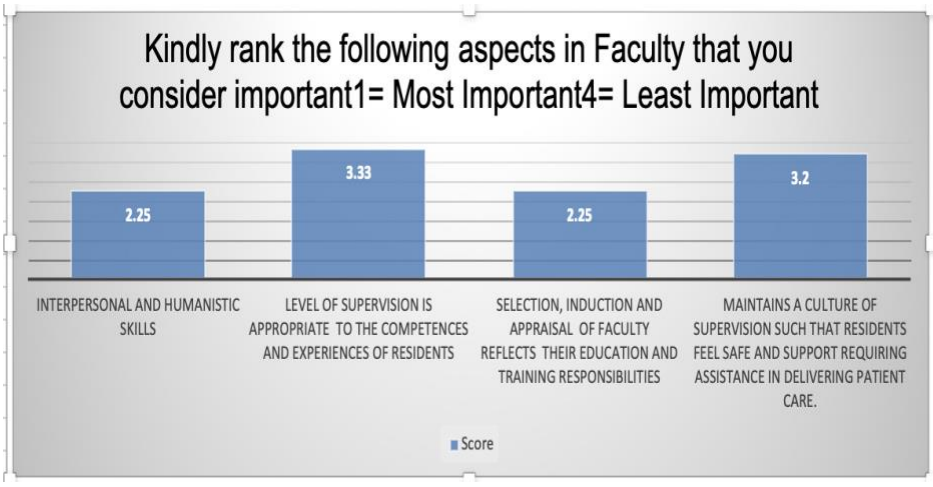
Figure 25: Program Director Delphi round 1 survey responses to Q2

The third theme that program directors had to rank according to importance, is faculty members. They ranked the level of supervision that is appropriate to the competencies and experiences of residents as the most important aspect that looked for in faculty members, with overall weighted average ranking score of 3.33.

Program directors looked for faculty who could maintain a culture of supervision such that residents feel safe and supported when requiring assistance in delivering patient care, this also is aligned with what residents indicated in their Delphi responses where they required a safe environment to learn and ask. This aspect had an overall weighted average ranking score of 3.20.

The last two aspects of the same theme; interpersonal skills, and selection, induction and appraisal of faculty reflects their education and training were equally scored at 2.25 each. Indicating that these are of equal, yet lesser importance for program directors at this time.

Figure 26: Program Director Delphi round 1 survey responses to Q3



3.8.4 Delphi survey round 2 analysis

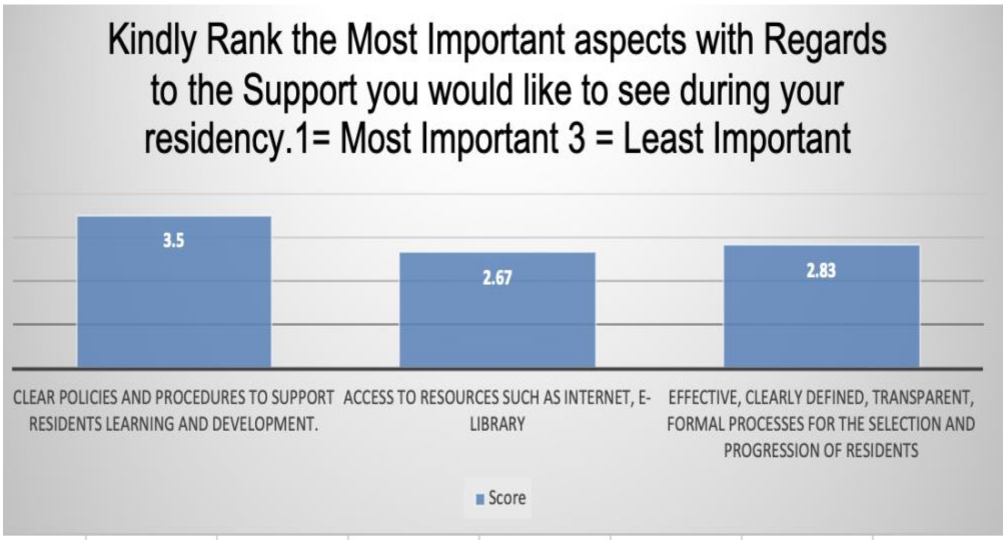
The second round of the Delphi survey for both the residents and program director was created based on the highest score associated with the aspects included in the survey. This allowed for elimination one aspect in each identified themes, that had the lowest total score. The following will be an analysis of the results of the three remaining aspects in each theme.

3.8.5 Resident survey round 2 analysis

The residents Delphi survey contained the same three main areas that were identified from the focus groups. These areas included support, educational content, and training faculty aspects. The response rate for this round was 50% (6 out of 12 responses), and the average time to complete the entire survey was one minutes. There is a drop in responses between round 1 of the Delphi surveys and round 2 by 41.6 % (lower 5 responses than the previous round), this in some way may affect the robustness of the responses, but since it was agreed that as long as response rates were 50% and above responses would be considered valid and therefor, would be analyzed.

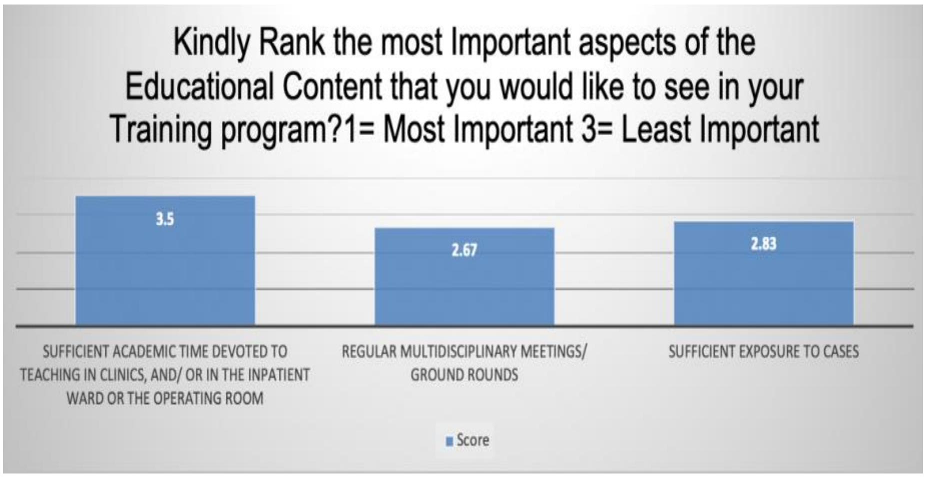
Within the first theme the resident ranked having clear policies and procedures to support residents learning and development as their most important aspect of support that they would like to have in their residency program with overall weighted average ranking score of 3.5. The second most important aspect that they indicated within this survey is having an effective clearly defined, transparent, formal processes for the selection and progression of residents, with overall weighted average ranking score of 2.83. The least important aspects within this round according to residents would be having access to resources such as internet and e-library, with overall weighted average ranking score 2.67.

Figure 27: Resident Delphi round 2 survey response to Q1



The second theme, dealt with educational content within the training program, residents ranked having sufficient academic time devoted to teaching in clinics, and/or the inpatient ward or the operating room as their most important aspect within this theme with overall weighted average ranking score of 3.5. The second most important aspect within the same theme was having sufficient exposure to cases, with overall weighted average ranking score of 2.83. Finally, the least most important aspect to residents within this theme was having regular multidisciplinary meetings and ground rounds with overall weighted average ranking score of 2.67.

Figure 28 : Resident Delphi round 2 survey response to Q2



The third theme that was addressed within round two was the training faculty, within this theme residents ranked having an appropriate number of faculty to provide the knowledge required as their most important aspect with overall weighted average ranking score of 3.17. The second most important aspect within this theme was having sufficient instructions by immediate faculty members clinically and/or in the operating room as defined by the clinical site with overall weighted average ranking score of 3.0. The least most important aspect within this round was having a safe and supportive environment for inquiries with overall weighted average ranking score of 2.83.

Figure 29 : Resident Delphi round 2 survey response to Q3

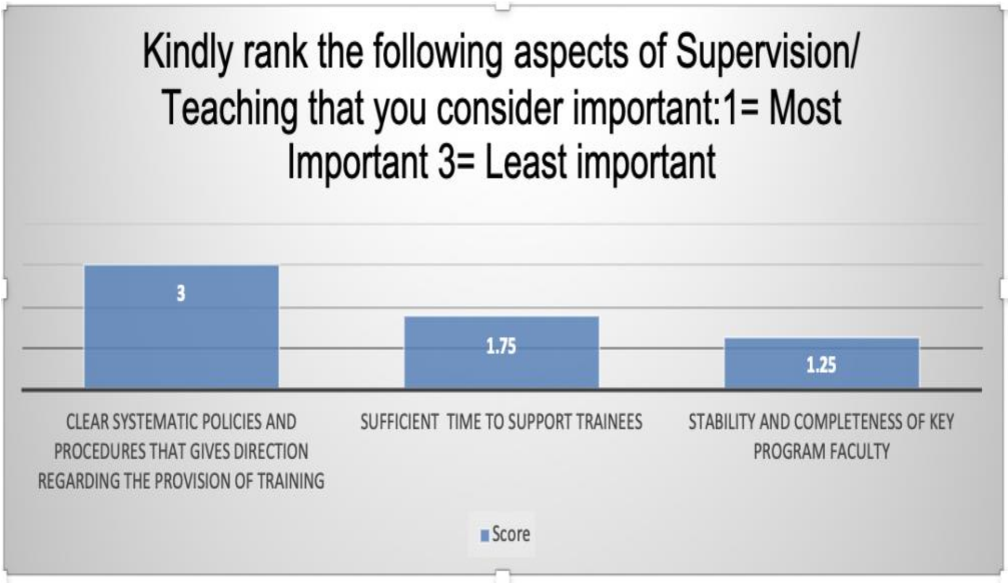
3.8.6 Program Director round 2 analysis

The program director Delphi survey response rate was 50 % (4 out of 8 responded), with a typical time of three minutes spent to answer the whole survey. Similar to the resident Delphi survey, the program director round two survey contained three themes, such as supervision/ teaching, resources, and finally faculty aspects that are important.

Similar to the Resident survey round 2, we will find that there is a drop in responses between round 1 of the Delphi surveys and round 2 by 12.5 % (lower by 1responses than the previous round), since their percentage drop is not that high such as in the resident survey, the robustness of the results may not be affected. Also, since it was stated previously that as long as response rates were 50% and above responses would be considered valid and therefor, would be analyzed.

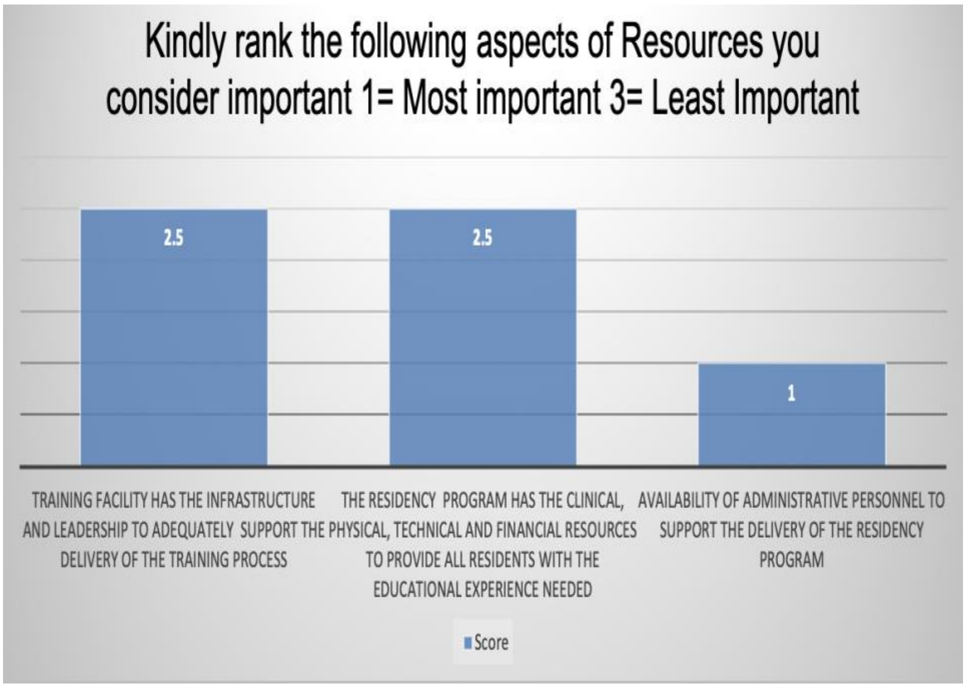
Figure 30 below indicated that program director responses within the first theme rated having a clear systematic policies and procedures that gives direction regarding the provision of training as their most important aspect that would enable them deliver a seamless training process for residents with overall weighted average ranking score of 3.0. Secondly, they rated having sufficient time to support trainees (residents) as their second most important aspect within the same theme with overall weighted average ranking score of 1.75. Finally, as indicated below, their least important aspect within this second round is stability and completeness of key program faculty with overall weighted average ranking score of 1.25.

Figure 30: Program Director Delphi round2 survey responses to Q1



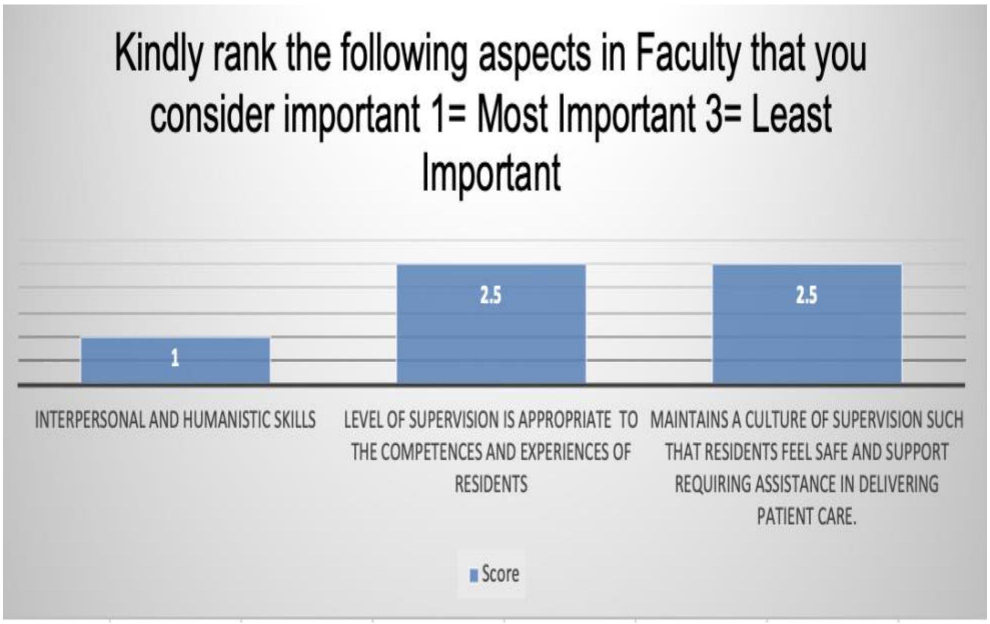
The second theme as shown in figure 31 below, dealt with the resources aspect of the training program, the program directors equally valued the importance of having a training facility that has the infrastructure and leadership to adequately support the delivery of the training process, as well as, the residency program has the clinical, physical, technical and financial resources to provide all residents with the educational experience needed, with overall weighted average ranking score of 2.50 for each aspect. The least important aspect within this round as shown below was the availability of administrative personnel to support the delivery of the residency program with overall weighted average ranking score of 1.0.

Figure 31: Program Director Delphi round2 survey responses to Q2



The third theme (faculty) within the second Delphi round as shown in figure 32 below. Indicated the program director responses indicated that they valued the level of supervision that is appropriate to the competencies and experience of residents, and maintaining a culture of supervision such that residents feel safe and support requiring assistance in delivering patient care equally, with overall weighted average ranking score of 2.50 for each aspect. They valued the interpersonal and humanistic skills as their least important aspect within this round with overall weighted average ranking score of 1.0.

Figure 32: Program Director Delphi round2 survey responses to Q3



3.8.7 Delphi survey round 3 analysis

The final round of the Delphi survey for both groups included the final two aspects within each theme and the participants were asked to rank them based on their importance to them. This final round will highlight the most important aspect in each theme that is included in both surveys' groups.

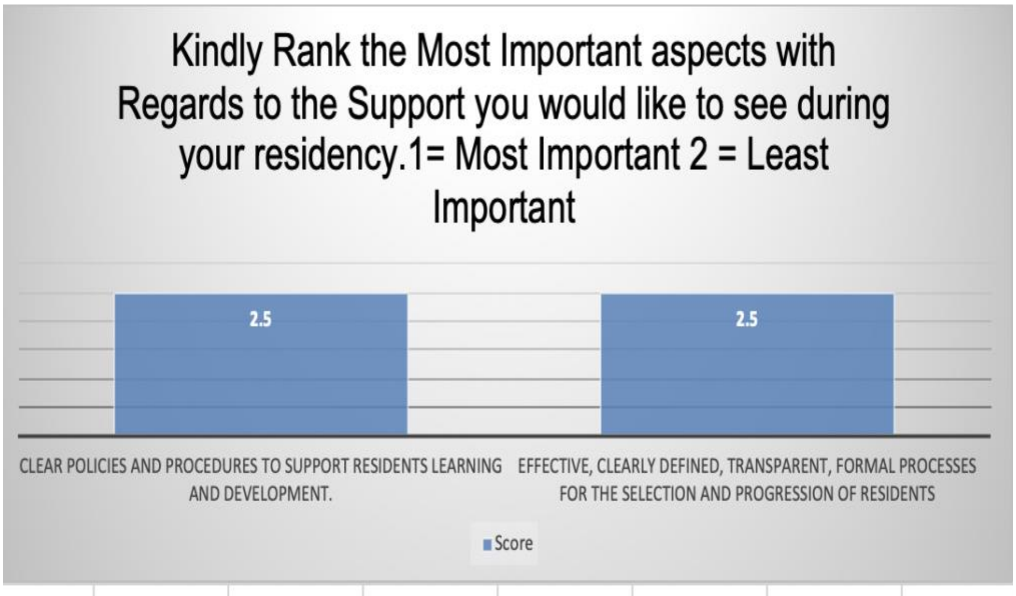
3.8.8 Resident survey round 3 analysis

Response rate for residents within this round was 66.6% (8 out of 12), and the average time spent to complete this round was one minute. This round as the previous rounds contained the same three themes (support, educational content, and training faculty), with the two remaining aspects that they needed to rank based on importance.

The first theme in this final round as shown below in Figure 33, dealt with the type of support that residents would like to see during their residency. The result, to my surprise, was equal importance for having clear policies and procedures to support residents and having a clear effective transparent process for the selection and the progression of residents with overall weighted average ranking score of 2.5 for each of these two aspects.

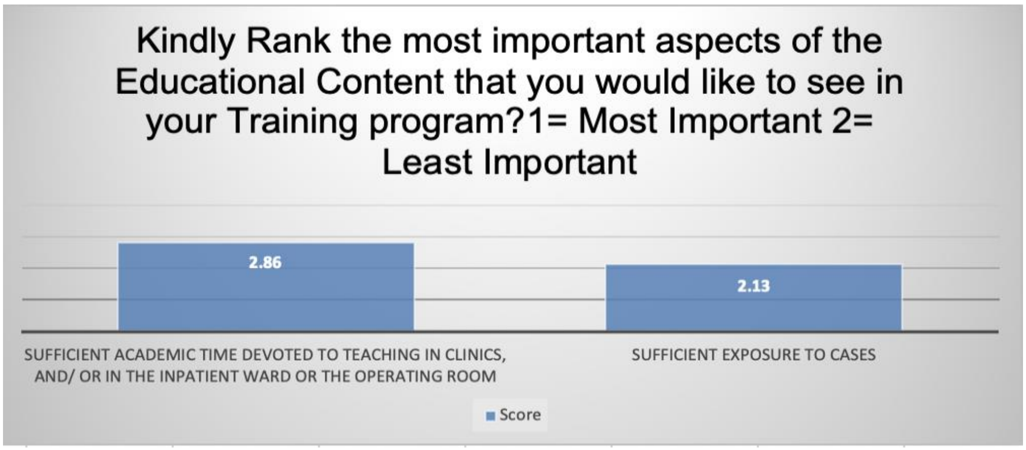
This result in itself is an indication of the great importance of having a systemized training process within programs and its hosting training institution.

Figure 33: Resident Delphi round3 survey responses to Q1



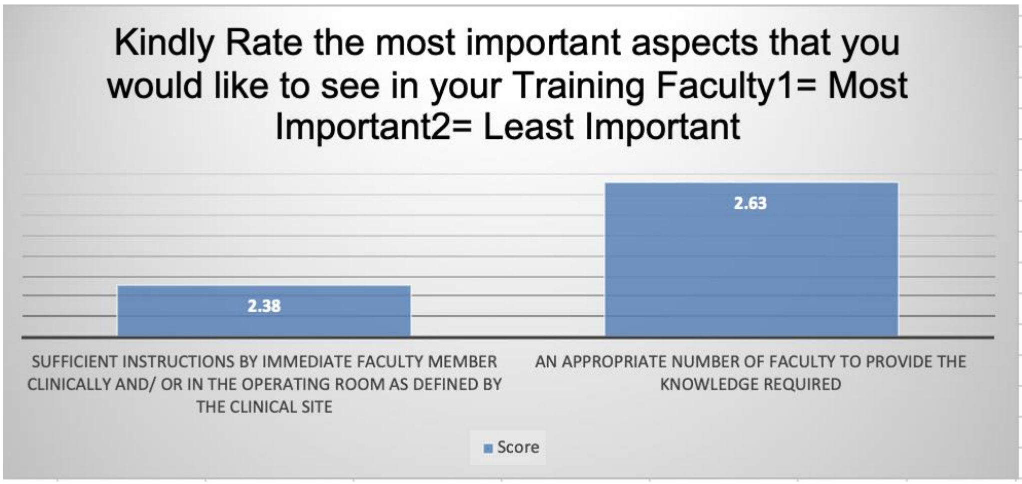
The second theme in this round dealt with the educational content of the training program, where residents ranked having sufficient time devoted to teaching in clinics, inpatient ward, and operating room as their most important aspect that they require in their training institutions, with overall weighted average ranking score of 2.86. The least important aspect was having sufficient exposure to cases with overall weighted average ranking score of 2.13.

Figure 34: Resident Delphi round3 survey responses to Q2



The third theme that was evaluated was training faculty, residents ranked having an appropriate number of faculty to provide the knowledge required throughout their residency journey as their most important aspect with overall weighted average ranking score of 2.63. They evaluated having sufficient instructions by immediate faculty members clinically/ inpatient room, or in the operating room as their least important aspect within this theme with overall weighted average ranking score of 2.38.

Figure 35: Resident Delphi round3 survey responses to Q3

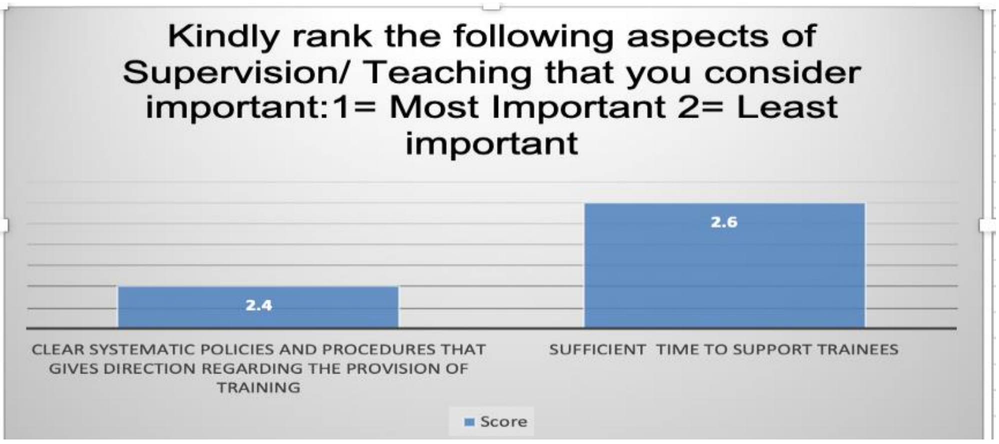


3.8.9 Program Director round 3 analysis

Response rate for program directors within this final round was 62.5% (5 out of 8), and the average time spent to complete this round was one minute. This round as the previous rounds contained the same three themes (support, educational content, and training faculty), with the two remaining aspects that they needed to rank based on importance.

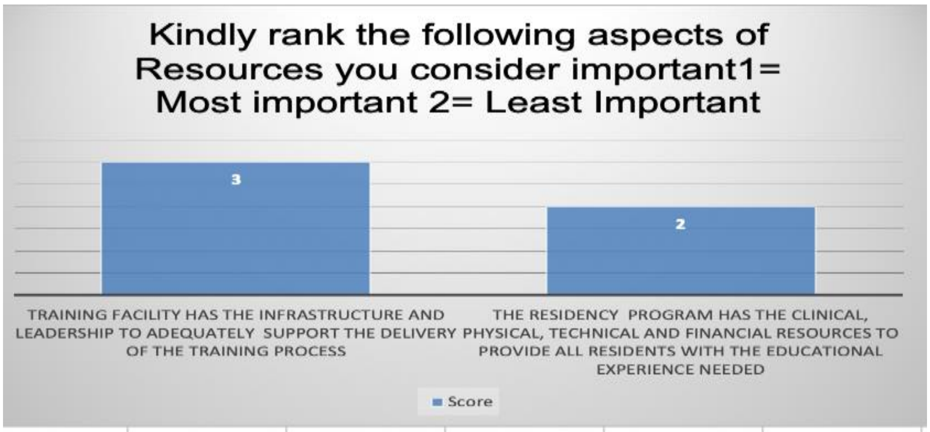
The first theme in this final round as shown below in Figure 36, dealt with the supervision aspect within the training programs. Program directors ranked having sufficient time to support trainees as their most important aspect that they would like to have, with overall weighted average ranking score of 2.6. the least important aspect for them within this round was having a clear systematic policies and procedures with overall weighted average ranking score 2.4.

Figure 36: Program Director Delphi round3 survey responses to Q1



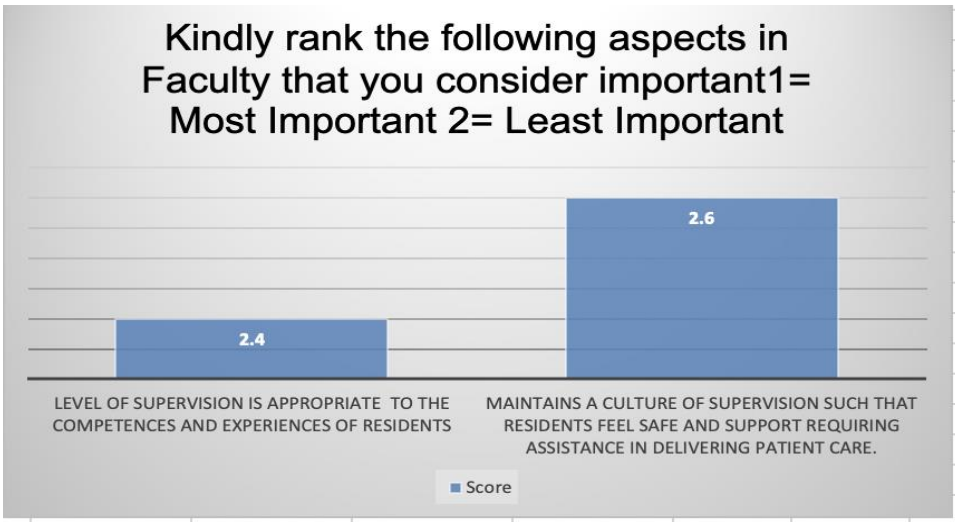
The second theme within the programme director survey dealt with resources within the training program as shown in Figure 37 below. The program directors ranked having the infrastructure and leadership to adequately support the delivery of the training process within the training facility as their most important aspect, with overall weighted average ranking score of 3. The least ranked residency programs having the clinical, physical, technical and financial resources to provide all residents with the educational experience required.

Figure 37 : Program Director Delphi round3 survey responses to Q2



The third theme within the final round of program directors Delphi survey dealt with aspects in faculty that they considered important to have or improve. Figure 38 below indicates that maintaining a culture of supervision such that residents feel safe and supported requiring assistance in delivering patient care with a total score of 2.6. They ranked having the level of supervision that is appropriate to competencies and experience of residents as their least important aspect within this round, with overall weighted average ranking score of 2.4.

Figure 38: Program Director Delphi round3 survey responses to Q3



Chapter 4. Discussion

As mentioned previously, the purpose of qualitative research is to identify a list of the most critical aspects that both stakeholder groups considered essential and highlight the areas that needed improvements. Using a satisfaction survey, as the first methodology in this paper, helped identify weak areas according to participants or needed to improve and highlight the major strengths that various training programs had taking these identified areas and categorizing them into themes made conducting focus groups more fruitful.

The data generated from the focus groups highlighted the most important aspects to be included for further exploration in the final Delphi method used. These areas included variation in training faculty skills and experiences, reflecting on the residents' quality who graduate under their supervision. Resources or the lack of it was a common area through the three methods used in this paper, support included structural, process, and emotional was another critical factor that was highlighted and prevailed in the Delphi survey third resident round.

All these variations in the level of resources, support, teaching faculty qualifications, and ability to train leads to residents who are as qualified as the program they graduated from; one of the residents indicated that they are a mirror of their training programs! If the program is strong, then the resident's knowledge and skills are solid. If the program is weak, then the resident will also be week.

Ali (2018) stated in his Ph.D. thesis that "Inadequate physician skills after the completion of residency has become an international concern[380]". Like many of these countries, Saudi Arabia is experiencing variation in physician skills after passing its residency board. This variation is primarily due to the institutional and training process that they underwent as residents and delivered this process the way they received it. In paper one

[380] (Ali, 2018)

of this thesis titled "Saudi Arabia vs. Canada—Is there a difference in the quality of patient surgical outcomes based on postgraduate surgical training location[381]? " it was shown that there is, in fact, an impact on patient outcomes based on the location of training. The Canadian-trained Saudi surgeons had fewer postoperative adverse events than the Saudi-trained surgeon trained nationally.

Throughout the various methods used in this final paper, it was evident that this is an existing situation in 2020, as residents and program directors both indicated a difference in trainers' knowledge and their way of teaching. Further, program directors indicated continuous tensions between old vs. new school consultants within the focus group. The tension arose because some trainers teach (old school vs. new school), questioning the status quo, and identifying issues that needed to be improved within the training program are all contributing factors to the existing tension between staff and residents and between staff themselves.

The program director satisfaction surveys indicated a 53% program director satisfaction rate with their training faculty[382]. On the other hand, residents had evaluated the academic activity satisfaction rate 53% and 56% satisfaction with the training center. Breaking the academic evaluation satisfaction rates for residents, it was shown that 25.6% found that the morning report to be useful but needed improvement. Another, 31% considered the academic half-day to be useful, 22% of the trainees consider bedside teaching good, 25% of trainees considered grand rounds good as part of their departmental weekly scientific activity, 25.5% of the trainees consider bedside rounds with Senior to be good, and 25.2% of the trainees consider bedside rounds with the consultant to be good. Regarding resources, 22.3% of the trainees consider E-learning good, 18.8% of the trainees consider training and participating in research to be good, 18.2%of the trainees consider training by

[381] (AlAmoudi, 2019)
[382] Figure 4, p.234

the simulation to be good, 23.6%of the trainees consider mentorship to be good, and 18.2% of the trainees consider multidisciplinary round good.

Stating the satisfaction of trainees (residents) above shows that while there is a small number of satisfaction rates with academic and resources aspects of the training process (18% - 25%), the majority of trainees think that these two aspects require improvement, and a small number of residents think that they are useless.

Through the literature review and results of this paper, it had been established that academic activity and training centers have a significant impact on the training process and, eventually, the outcome of these training programs. This indicates that these are issues that need to be looked into and improved if we want the outcomes of these training programs to improve. Process measures above assess the delivery of the training program by trainers, programs directors, and their hosting training institution.

Since the multiple factors addressing the learning-teaching process cannot be fully addressed in this paper, aspects such as structure and support through having clear policies and procedures for training processes; as well as teaching faculty aspects (ability to teach and motivate residents), will be looked into in detail as they were highlighted in the themes that were addressed in both the focus groups and the Delphi survey.

Lynn et al. (2012) stated, "To ensure that medical residents will be prepared to deliver consistently high-quality care, they should be trained in settings that provide such care[383]". This statement reflects the importance of the structural and organizational aspects of PGMT programs to help identify aspects that are important for both selected groups; using the Delphi survey as the final method was quite fitting, as it helped in highlighting these aspects within the themes identified. This method has pulled together all the major themes from both the satisfaction survey and the various focus groups held in Riyadh and Taief.

[383] (Lynn, Hess, Weng, Lipner, & Holmboe, 2012 p.150)

It was quite reassuring to find that the required aspects in various postgraduate medical and surgical programs within Saudi Arabia are similar in nature based on the responses of the two groups. Both groups called for a systematic way of delivering the training process. Further, the lack of explicit training strategies and internal policies caused a considerable variation in residents' skills and knowledge.

In the three Delphi rounds for residents, the most common called for resource is having clear policies and procedures to support residents learning and development. They also called for an effective, clearly defined, transparent formal process for the selection and development of residents. Grady 2009 stated that "Trainees require service-based education within structured training schemes specifically developed to prepare them for specialist practice[384]". They also identified havening sufficient academic time allocated to them by their trainers in the clinics, inpatient ward, and most certainly in the operating room. The sufficient devoted time to teaching and counseling could only have a sufficient and appropriate number of faculty members to provide the knowledge required. The latter was the highest score in the final round of the resident Delphi survey, with a total score as mentioned of 2.63.

If competencies of physicians (medical or surgical), reflects their training journeys', which is known to be a combination of skills, knowledge, and attitudes derived from systems that enable these elements to become the basis of their learning experience; and since competencies are evaluated not only by the programs through board certification but also by patients themselves through patient satisfaction surveys. Thus, identifying core outcome sets to focus on becomes an integral part of adopting minimal quality standards within training programs and can eventually be used to measure training processes and identify performance improvement initiatives.

[384] (Borman & O'Grady, 2009)

Barret et al. (2015) called for a work-based assessment to identify and remedy poor performance among postgraduate medical trainees. John Norcini 2005 conducted a mini clinical evaluation exercise to assess trainees' clinical skills and offer them feedback on their performance in real-time. "The faculty member scores the performance using a structured document and then provides educational feedback. The encounters are intended to be relatively short, about 15 minutes, and to occur as a routine part of the training program. Each trainee should be evaluated on several different occasions by different faulty examiners[385]".

The difficulty in implementing what Norcini (2005) suggested in Saudi Arabia is that we do not have sufficient trainers to begin with[386] and that most of the training programs are required to increase the capacity of accepted residents in their programs to meet the requirements national 2030 vision. Further, the training facilities within the kingdom do not have the same allocated resources for training, causing variation in residents' skills and knowledge. Thirdly, there are no national training policies that dictate what training centers must do to ensure a seamless training process; this aspect has to be incorporated in the training centers' overall training strategy.

The program director satisfaction survey demographic section indicated that only 8.9% of the 716 program directors hold some degree or certification in medical education; tying this information with the focus group results showed that there was an evident under-emphasis placed on clinical expertise and experience by training institutions, this added to the variation of training outcomes between centers.

As mentioned previously, the Delphi survey contained attributes of the training process, such as faculty numbers, support required during residency, educational content, and training policies and procedures. The common result between the two survey groups was a call for a systematic training process that enables both program directors to ensure a seamless

[385] (Norcini, 2005, p.25)
[386] Resident Delphi survey Q3 response round 2

training program and enables the residents to get the best knowledge and experience they can within their designated program. The results obtained from the Delphi method can be used by SCFHS[387] to identify the core outcome sets that need to be focused on during the upcoming years and can be highlighted in the upcoming proposed minimal quality standards in training programs.

Saudi Commission for Health Specialties is undergoing a long-awaited reform that includes all aspects of the training process, from accreditation (institutional and program), training and quality. The ultimate goal is to achieve the national excellence in health training that they launched in 2019. Therefore, the quality reform became front and center of this initiative and called for creating a quality framework that encompasses structure, process, and outcome aspects of the training process.

The quality reform began with reviewing the existing literature and examining the proposed domain in various countries such as Scotland, U.S.A., Canada, U.K. and how these domains are implemented. The following section will describe in detail the proposed quality initiative in postgraduate training.

[387] Saudi Commission for Health Specialties

Chapter 5. PROPOSING "Excellence by Design" a new postgraduate medical & surgical Training Quality standards to be adopted by SCFHS

5.1.Introduction

A call for quality reform in postgraduate medical and surgical training has gained worldwide attention; this is evident in the number of quality frameworks that have been developed to address this topic. However, to ensure the success of implementing these quality frameworks, quality interventions must be contextually appropriate and proportional to what is intended by this intervention[388].

Through the Saudi Commission for Health Specialties (SCFHS), Saudi Arabia is no different in its continuous pursuit for excellence and Quality in the postgraduate health training programs it oversees. However, before proposing the quality framework "Excellence by Design" to the SCFHS, it is crucial to agree on what we mean by Quality within the realm of postgraduate health training. The proposed quality definition within the SCFHS national training excellence would be "any activity that is explicitly aimed to teach professionals about methods used to analyze and improve, structure, process, outcome to meet and exceed the direct customer's expectations.[389]"

Having this quality definition as the basis of the framework will help clarify the roles and responsibilities of the SCFHS and Training institutions, where training institutions will be responsible for quality activities such as monitoring and reporting on required training outcomes to the SCFHS. On the other hand, SCFHS will assume the role of the regulator, educator, and supporter to centers and provide them with the necessary quality tools and standards. Having this understanding will aid in fostering an ongoing partnership and communication with all stakeholders within the training process. Further, this partnership will

[388] Nolte, Fry, Winpenny, & Brereton, 2011, pp. 9, 10, 11).
[389] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 7).

allow for maintaining an open line of communication between SCFHS and all training centers and their accredited programs and its extended benefits of verifying submitted data and continuously sharing concerns and risks. Establishing this relationship will enable the Saudi Commission for Health Specialties to work closely with all stakeholders more effectively and ultimately provide a healthier and safer society[390].

Currently, SCFHS does not have a system that addresses quality standards, nor does it have a quality matrix that includes key performance indicators (KPIs) to measure the outcomes of various training programs. Addressing this issue will require changes to the current status of programs. This section aims to outline the proposal of a new quality framework, adopted from the available literature, and adjusted to the current needs of the PGHM[391] training process in Saudi Arabia. These new standards will act as the basis for the PGHM training KPIs, which will be used to measure the outcomes of training programs throughout the residency life-cycle and create a national benchmark, which is defined in healthcare as the continual and collaborative discipline of measuring and comparing results of key processes with those of the best performers[392]". Benchmarking could be conducted internally year to year according to the number of quality standards that they have achieved, Alternatively, the number of quality standards that they have improved. Benchmarking could also be conducted externally, nationally within centers that provide the same training programs, or internationally with centers that have achieved excellence in postgraduate medical and surgical training.

The outcome variation of postgraduate medical and surgical training programs elevates the importance of looking deeply at training criteria and measure the efficiency and efficacy of these programs in various training settings for two main reasons: first, to ensure

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[390] (WFME, 2015).
[391] Please see appendix 15
[392] (Crampton, Mehdizadeh, Page, Knight, & Griffin, 2019)

that the quality of postgraduate health and medical training provided to residents meets the highest international standards, and second, to ensure that the development of the healthcare workforce meets the needs of the healthcare market. In addition, this outcome-based approach is essential to "ensure that the right skills are acquired at the right time, right place, and in the most effective mode[393]". However, according to Nolte et al. (2011), "little work [has] specifically aimed at developing metrics for the evaluation of the quality of delivery of training and education[394]".

The primary documents influenced the proposal for a national PGHM Training Quality framework to SCFHS: was published by the World Federation for Medical Education (WFME)[395] and by the National Health Service Scotland (NHS Scotland)[396]. These reports were scrutinized to determine the applicability of their quality standards for current SCFHS training programs. Four additional frameworks currently in use were carefully examined as a continuum of the previous two mentioned above. These frameworks focused on postgraduate medical and surgical training processes (primarily accreditation) rather than undergraduate medical education. The four frameworks' comparative analysis is presented in Appendix 14 and shows the differences between them and what each framework encompasses types of standards, the purpose of existence, and the number of domains.

Considering the last qualitative method's results (Delphi survey), it was found that in the resident Delphi, the three main themes that were considered were support, educational content, and training faculty. The program director Delphi survey themes included supervision and teaching, resources, and faculty. From the above, there is a clear overlap between the resident and the program director themes, all calling for a structured training

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[393](Nolte, Fry, Winpenny, & Brereton, 2011, pp. 9, 10, 11).
[394] (Nolte, Fry, Winpenny, & Brereton, 2011, p. 7).
[395] (WFME, 2015).
[396] (NHS Scotland, 2010).

process by competent staff in an institution with the required resources to deliver a seamless training process.

Although the suggested framework is composed of eight domains that were adopted from the amalgamation of the four countries that used quality standards in PGHMT and cover a wide range of areas, such as patient safety; quality management, review and evaluation, and continuous improvement; program selection, delivery, and supervision; support and development of trainers, residents, and local faculty; educational resources and capacity; well-being; professionalism and finally outcomes[397]. It is highly recommended that the SCFHS, if and when considering adopting the proposed framework with the proposed standards; to

look into implementing the standards that relate to the identified themes in

the Delphi survey first. These standards will define the level at which the provider needs to function to reach a specific outcome[398]. The implementation could be through a self-assessment survey that deals with these identified themes, and results should be obtained before any program accreditation process. This will allow the center to work closely with the Saudi commission to improve identified areas and positively impact the reciprocal relationship that the SCFHS tries to maintain with training stakeholders and building trust.

Further, this will allow training stakeholders to co-design and coproduce required improvement initiatives based on the standards implemented while ensuring that the appropriate knowledge transfer and education are conducted throughout the proposed Quality improvement framework and "Excellence by Design" Standards.

Although there are many Quality improvement frameworks found in the literature, the most suitable framework for (SCFHS) is adopted from the ISO21001 shown in figure 39 below, as this framework is the basic PDCA cycle which includes having a clear scope of the

[397] Please see appendix 15
[398] (Crampton, Mehdizadeh, Page, Knight, & Griffin, 2019)

application of the "Excellence by Design," as well as the terms and definitions of the various proposed standards. ISO 21001 was chosen because "It focuses on the management systems of educational organizations as well as the impact of these on learners and other relevant interested parties."[399]

Further, this framework includes inputs from all postgraduate health training stakeholders, understanding the needs and expectations of interested parties, and determining the scope required of "Excellence by Design" standards proposed in this thesis. It also clearly defines the leadership role in planning, providing resources for implementation, and reviewing the performance evaluation before approving the necessary improvements in the process. In addition, this PDCA framework enables institutions to create an enterprise educational quality management system that allows for accurate data collection and reporting to the Saudi Commission by reporting their results systematically. Finally, the successful implementation of this framework and the proposed Excellence by Design framework is measured through the Kirkpatrick model[400], where clear key performance indicators are identified at each stage. To ensure the effectiveness in measuring training outcomes through the Kirkpatrick model, it was decided that a fifth level would be added, which is governance. Adding governance [401]as a fifth level to the Kirkpatrick model would ensure training center commitment in applying the proposed framework and accurately using the "Excellence by Design" standards. To position "Excellence by Design" standards within the ISO 21001 quality improvement framework, it would be used in the planning phase of the PDCA cycle. In addition, results collected from the associated KPIs would allow for better improvement planning.

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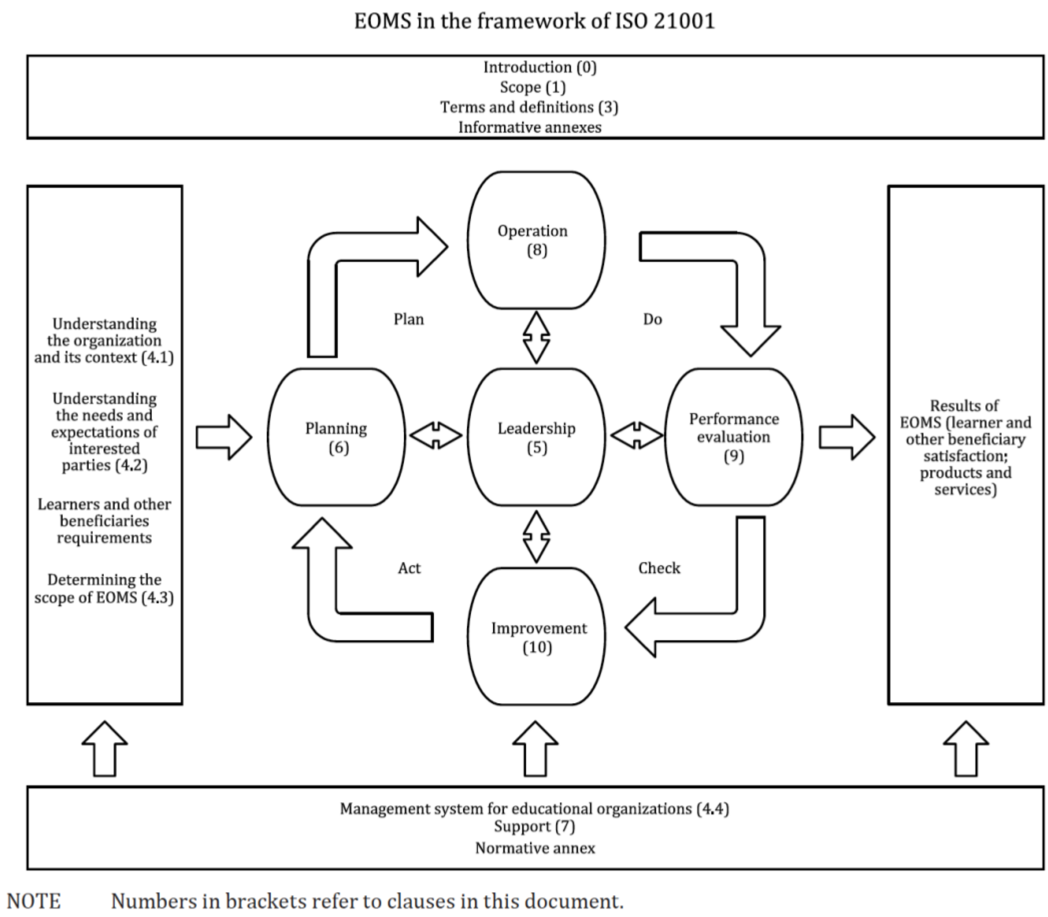
[399] (ISO 21001-International Standards, 2018)
[400] Kirckpatric model is a four step-model that was developed in 1959 to measure training effectivness.
[401] Governance here refers to structures and processes designed to ensure accountability, transparency, responsiveness, equity, and inclusiveness of the "Excellence by design" components and standards, to enable a quality culture that is institutionally adapted to generate an environment that would improve training outcomes throughout the trainees' training journey.

The main objectives in adopting such a framework were to create national quality training standards that institutions and postgraduate training programs could implement to ensure minimum training quality standards. Also, to address variabilities in training outcomes by creating a unified training quality framework able to ensure that competencies of trainees are comparable globally and to create a framework that embraces all aspects of postgraduate medical and surgical training and could be the basis of performance improvement initiatives for key performance indicators that were not met or barely met.

The subsequent paragraph will explain the "Excellence by Design" standards, their applicability, and how they would generate improvement.

Figure 39: Adopted ISO 21001 Quality Improvement Framework[402]



402 (ISO 21001-International Standards, 2018)

5.2 Introducing “Excellence by Design” standards

Excellence by Design is a proposed quality standards adopted from "NHS Scotland," modified to make it culturally appropriate and applicable. These standards were divided to support structure, process, and outcomes. In addition, they were assigned weighing definitions so that training programs administered in accredited institutions would transform to ensure a total quality management system is implemented.

Figure 40 shows a sample of these standards[403], and these standards are supported with key evidence areas that would help training programs find the required elements to fulfill that standard. In the event that the training program does not have evidence to fulfill the standards, the standard would act as a trigger to have the training program use the PDCA cycle to improve and show evidence of that improvement through the fulfillment of the standard.

Figure 40: Proposed SCFHS Excellence in training proposed standards

Excellence in Training Standards' Weighing Definitions:	
ETS1	These are the minimum Excellence requirements that would ensure quality in training delivery (Quality Assurance)
ETS2	These standards when implemented would ensure that the organization is transitioning from quality assurance to quality management
ETS3	These standards when implemented would ensure a total quality management system is implemented

I. Structure (Governance)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards ETS1 are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. The educational governance system continuously improves the quality and outcomes of education and training by measuring performance against the standards, demonstrating accountability and responding when standards are not being met.				• Training governance policy. • RACI matrix • Policies & procedures (Training delivery) • Training Quality matrix results.	• % Healthcare Facilities reporting comprehensive Performance and Quality measures (NTP) • %Satisfaction with the timeliness and accuracy of reports requested.
1.1. Training centers MUST have effective, transparent and clearly understood educational governance system and processes to manage or control the quality of medical education and training.				• Evidence of annual program review that includes effectiveness measures of curricula, curricula review documentation • Training governance policy.	• % Program objectives met annually. • % Pd satisfaction with training policies • #Training policies reviewed according to schedule. • % Adherence to training governance system.
1.2. Training centers MUST consider the impact on learners policies, systems or processes. They must take account of the				• Evidence of annual program review that includes effectiveness measures of curricula, curricula review documentation • Training governance policy.	• #Trainees demonstrating their understanding in verity of ways. • %Patient satisfaction with trainee interaction

The "Excellence by Design" standards are divided into excellence standards (ETS1, ETS2, ETS3), where (ETS1) are the minimum Excellence requirements that would ensure

[403] Please refer to Appendix 15 for a full version of these standards

quality in training delivery. ETS2, are the standards, when implemented, would ensure that the training organization in transitioning from quality assurance to quality management. Finally, ETS3 is a set of standards that, when implemented, would ensure a total quality management system is implemented.

The beauty of the proposed "Excellence by Design" standards accompanied with the PDCA cycle allows training centers to start at their convenience at any stage of these standards once they have shown proof that they have fulfilled the previous stage. Furthermore, a group of medical education experts and program directors have validated the proposed standards to ensure their applicability and suitability to the accredited health training programs within the kingdom.

To ensure that there is no significant overlap between these standards and the Institutional and program accreditation standards that the SCFHS uses to accredit training centers and programs, a comparative analysis was conducted. In figures 41 and 42, the comparison showed a possible overlap in seven areas between excellence by design standards and institutional accreditation. While in program accreditation, there were only three possible overlap areas. The identified overlap per se between the two standards would show that the excellence by design standards, although similar to Institutional accreditation standards, is a silver lining that would enhance those standards and provide possible gap areas that should be addressed. The comparison with program accreditation showed three overlap areas, and it is also evident that the proposed standards add an additional layer that would enhance the standard and address gap areas.

Figure 41: Comparison between Institutional Accreditation standards and Excellence by design standards

No	Institutional Accreditation	Proposed Standards	Gap areas
1	(ITC) 2.1 Develops and reviews all aspects of Training carried out within the Institution. (ETR1	Training centers MUST regularly evaluate and review the curricula and assessment frameworks, education, and training program placements. They are responsible to ensure that standards are being met and to improve the quality of education and training.	Timeliness of the process. Accuracy of the process of evaluation. PI projects specifications based on the reviews.
2	3.1 The ITC establishes and supervises the implementation of all Training related Policies and Procedures. 3.3.1. The IR for all Training Programs occur at least once during the Accreditation Cycle.	Training centers MUST have effective, transparent, and clearly understood educational governance system and processes to manage or control the quality of medical education and training.	• Quality Management review annually. • IA requires it once during the accreditation cycle.
3	3.6. The ITC has and maintains an Appeal Mechanism for Trainees for matters related to the Training Decisions. (ETR1) **	Under **Structure Matching:** Have an Appeal system **Matching Process:** Have an appeal system against non-selection on the grounds that selection criteria were not applied correctly. **Training Process:** The process for applying for a study leave MUST be fair and transparent and information about the appeal process must be readily available.	Institutional Accreditation standard 3.6. generic and can be interrupted based on subjective understanding of the standard. Details and break down on appeal areas of the training process is required to govern the appeal process within the training institution.
4	3.11 The Supervision of Training Policy regulates the Direct and In-Direct Supervision of the Faculty Trainers during the Patient Encounters and Procedures performed by the Trainees, where all Trainees are Supervised by Credentialed and Privileged Trainers. (ETR1)** 3.12 The Supervision of Training Policy regulates the Assurance and Assessment of Progressive Competence of the Trainees for Graduating Responsibilities. (ETR1)**	Training center MUST have a system to make sure that education and training comply with SCFHS legislative bylaws. Trainees MUST regularly be involved in the audit process, including personally participating in planning, data collection and analysis.	Trainee involvement in the training policy audit process. No indication on policy audits, Performance improvement.
5	3.20 Institution should facilitate Trainee access to Well- Being Program, Confidential Counselling, Medical and Psychological Support Services. (ETR2)	**Training process;** 8. Trainees must have access to resources to support their health and wellbeing, including; 8.1. Confidential counseling services. 8.2. Career's advice and support.	What are the measures associated with center accreditation that would verify the well-being of residents?

		8.3. Occupational health services.	
6	Training sites: Sufficient Number of Qualified & Competent Clinical Staff for Training & Supervision. (ETR1) 2. Appropriate Supervision of the Trainees by the Training Faculty at each Training Site. (ETR1)	**Under structure (Trainer)** There must be a suitable ratio of trainers to trainees. The educational capacity in the department or unit delivering training must take account of the impact of the training needs of the others, including clinical supervision, adequate time for training MUST be identified in their job plans.	Training systems must make sure that recruitment, selection, and appointment of Trainers are open fair and transparent.
7	5. Quality Department is available, where Trainees Participation in Quality Improvement and Patient Safety Projects is encouraged and monitored. (ETR1)	1. Education on quality improvement 4.1. Training Centers MUST show evidence that they Provide the clinical care team, including residents, fellows, and faculty members with ongoing education and training on quality improvement that involves experiential learning and interprofessional teams. 4.2. Training Centers MUST show evidence that they Ensures the integration of quality improvement processes and lessons learned into the daily workflow of clinical care.	In the proposed standards Quality management is the overarching theme that specify what is required in terms of knowledge acquired and the type of involvement that the participating stakeholders would play.

Figure 42: Comparison between Program Accreditation standards and Excellence by design standards

No	Program Accreditation	Proposed Standards	Gap areas
1	The Training Program Does Not Exceed the Training Capacity as Accredited by the SCFHS. **(ETR0)**	Under **Structure (Governance)** The overall training capacity of the institution MUST be adequate to accommodate the practical experience required by the curriculum, along with the educational requirements of all trainees in the program.	
2	4.5 Principles and Practice of Healthcare Quality Assurance and Quality Improvement. **(ETR1)**	1. Education on quality improvement 5.1. Training Centers MUST show evidence that they Provide the clinical care team, including residents, fellows, and faculty members with ongoing education and training on quality improvement that involves experiential learning and interprofessional teams. 5.2. Training Centers MUST show evidence that they Ensures the integration of quality improvement processes and	Proposed standards TQ ensures appropriate level of quality training for all those who are involved in the training process.

		lessons learned into the daily workflow of clinical care.	
3	7.4 Personal Health and Well-Being. **(ETR1)**	**Training process;** 8. Trainees must have access to resources to support their health and wellbeing, including; 8.1. Confidential counseling services. 8.2. Career's advice and support. 8.3. Occupational health services.	No indication on how this is achieved? Available channels? Staff trained? Policy involved?

5.3 Fitting "Excellence by Design" in the current system

The name "Excellence by Design" was chosen due to its flexible nature. These proposed standards could be used proactively to maintain the quality of training program outcomes or reactively as a trusted tool to identify areas that needed to be improved within the training process. In addition, these standards can be implemented at any point in time within the training process, and outcomes of the specific key performance indicators associated with each standard would give the training center and the Saudi commission a sense of the robustness of the training process.

Accreditation standards in any training process measure the appropriateness of the structure through the institutional accreditation standards. In addition, the program accreditation standards measure the content or curriculum. The proposed "Excellence by Design" standards measure a third dimension, the intangibles in the training process through perception and quantitative data collected regularly, which is the appropriateness and effectiveness of the training process delivery, and many advanced countries rarely measure this dimension.

It was mentioned in the previous paragraphs that "Excellence by Design" standards would be used alongside the PDCA cycle adopted from the ISO-21001 would act as a silver lining for the approved accreditation standards. In addition, the proposed standards would be used as a quality check for the training process implementation by training centers. Figure 43 gives a visual of how the proposed standards would fit within the existing training system.

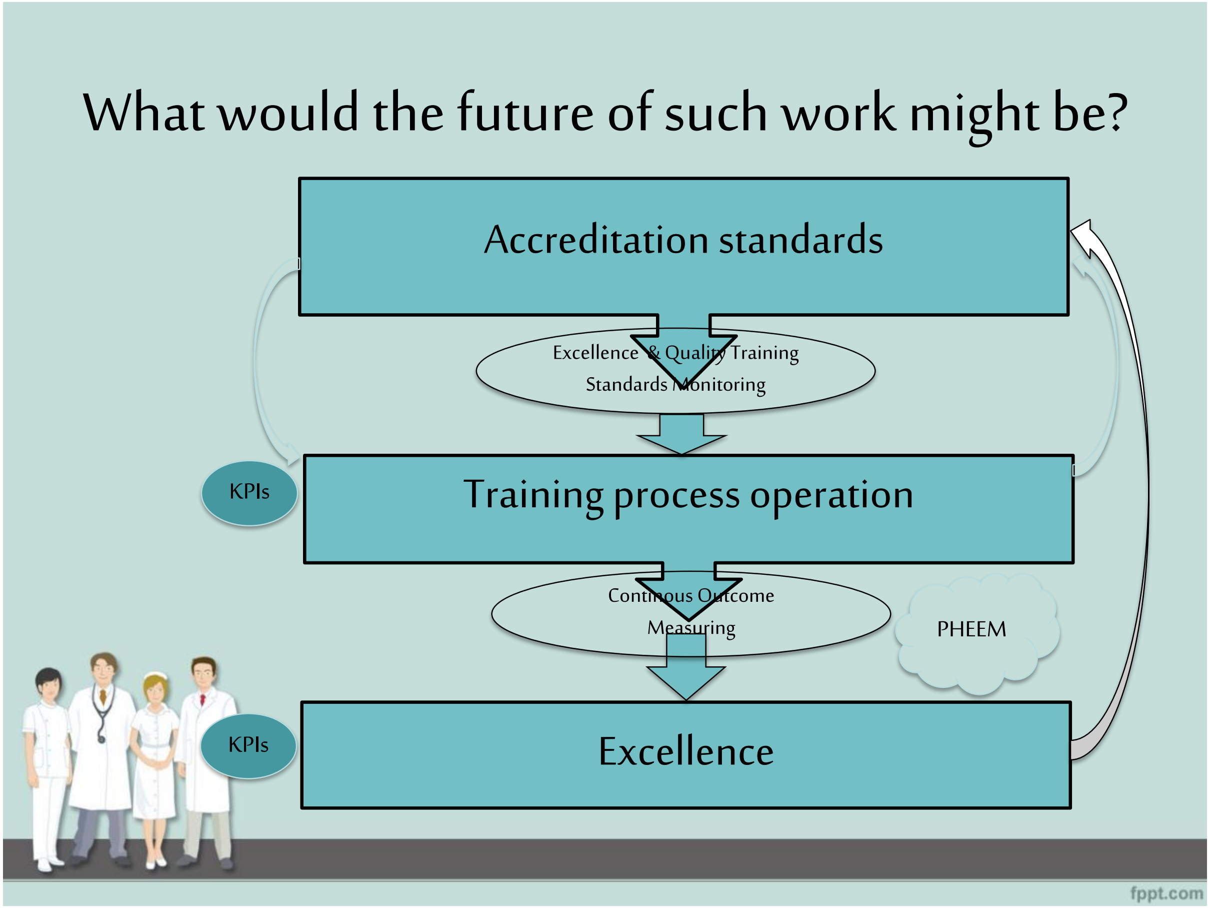
The effectiveness of the proposed standards will be measured through predefined Key performance indicators that would act as health checks that would highlight areas that require improvements. The continuous outcome measuring will drive training institutions to achieve excellence in training. The effectiveness of this proposed quality improvement framework can also be verified by positioning the key performance indicators in Kirkpatrick's four levels and the additional level of "Governance" that was added to ensure a systematic and comprehensive model that was contextually appropriate. An additional verification tool will also be used. This tool is the Postgraduate Hospital Educational Environment Measures (PHEEM[404]) that would measure the improvement in the training environment from the trainee's point of view.

Having clear quality standards that training institutions and programs could use to identify areas for improvement in the training process delivery would lead to excellence in both university-based teaching hospitals and service-based training centers. Therefore, achieving our ultimate goal in minimizing the variation in training outcomes between centers and providing an equal opportunity for trainees to receive the same quality of training no matter which program or center they get accepted in.

Further, the adaptation of the proposed framework would have a broader positive effect on realizing its goals in achieving increased patient safety within Saudi Arabia and becoming an exemplary model throughout the gulf countries.

[404] PHEEM can identify specific strengths and weaknesses within a certain educational environment. we aimed to assess PHEEM as a possible tool for performing future evaluations. Using a 5-point Likert scale ranging from ‘strongly agree’ to ‘strongly disagree’. It is important that each doctor applies the items to their own current learning situation and respond to all 40.
Items should be scored: 4 for Strongly Agree (SA), 3 for Agree (A), 2 for Uncertain (U), 1 for Disagree (D) and 0 for Strongly Disagree (SD). However, four of the 40 items (Numbers 7, 8, 11 and 13) are negative statements and should be scored: 0 for SA, 1 for A, 2 for U, 3 for D and 4 for SD.

Figure 43: Proposed SCFHS Excellence by Design Framework



Chapter 6. Limitations

Whilst the finding of this mixed-methods research has some pertinent implications for resident education and training and related policy, a number of methodological limitations to the quantitative and qualitative components exist and are discussed in the following text for transparency and objectivity purposes. Regarding the qualitative focus groups, the first limitations relates to the low sample size of residents and program directors. In effect, although the purposive sampling approach identified subjects who were deemed to be rich sources of information, the low number of participants are unlikely to have been sufficiently representative of other residents and program directors in Saudi Arabia. In addition to sample size, the trustworthiness of the thematic analysis was somewhat compounded by the limited use of techniques to enhance validity and dependability in the interpretations. According to

Noble (2015)[405], qualitative authors can utilize a range of techniques, such as constant comparative analysis, respondent validation and reflectivity, to help improve the trustworthiness of analyses but in this study, only two techniques were employed: data/investigator triangulation and data saturation. Therefore, the limited use of such methods may limit confidence and certainty in the themes reported.

Similar methodological issues were also encountered in the quantitative component of this study. Firstly, the quantitative survey suffered from a low sample size and low response rate, which could have imparted negative effects upon the analysis conducted. In this regard, low response rates can often introduce a risk of selection and recall biases as subjects with specific characteristics may have been more inclined to complete the surveys but also, the nature of survey research can lead subjects to reporting biased or altered responses[406]. Response bias can include subtypes, such as extreme response and social desirability, and thus, answers to the specific survey questions may be erroneous or over-exaggerated in some cases and in turn, the collective analysis could have comprised a number of such results skewing the outcome effects away from the actual truth[407]. The low response rate could have also imparted implications upon the validity of statistical analysis as insufficient power, falling below the usual threshold of 0.8, could have resulted in type II error – false positive or negative results[408]. Furthermore, the low response rate and resulting low sample size also affected the external validity of this research as the cohort evaluated cannot be inferred to be sufficiently representative of wider Saudi populations of residents and training program directors. Secondly, the survey used to collect quantitative data was developed de novo and whilst the questions were based on previously validated surveys, the instrument had unclear psychometric validity. Therefore, the outcomes of the survey may have been impaired as

[405] (Noble, 2015)
[406] (Rosenman, 2011).
[407] (Rosenman, 2011)|.
[408] (Banerjee, 2009).

measuring subjects' responses to each question may have been misguided or under- or over-estimated[409].

As a final and general limitation of this research, the question focused upon answering a specific problem – knowledge regarding the barriers and facilitators of resident training and competence, which are important but cannot be assumed to associate with care quality and patient outcomes. Indeed, as noted in the background sector, a diverse range of factors contribute to quality of care and patient experiences and outcomes and these could not be directly explored in this research.

Chapter 7. Conclusion and Implications for policy and further research

This paper is proposing a quality improvement framework for postgraduate medical and surgical training programs within the Kingdom of Saudi Arabia. It also aims to add to the body of knowledge concerning issues surrounding postgraduate medical and surgical training in developing countries, highlighting the difficulties and proposing a contextually fitting solution. As well as, determining the effects of performance improvement outcomes using the proposed framework on effective, safe, patient centred, timely, efficient and equitable measures within the training program and its hosting training institution. The rationale in measuring quality improvement according to Hughes (2008) "is the belief that good performance reflects good quality of practice, and that comparing performance among providers and organizations will encourage better performance[410]".

Saudi Arabia, as mentioned previously, is undergoing an enormous change in all of its governmental sectors. Healthcare has the lion share of reform required to ensure a healthier community. Saudi commission for health specialties has the responsibility of providing the

[409] (Truijens, 2019).
[410] (Hughes, 2008, pp. 3-1)

healthcare sector with qualified healthcare practitioners that can ensure a healthier community through providing healthcare services with the highest quality.

This paper has shown that there is a current need to look deeply into the structure and support elements of the training process. There was a unanimous call for having clear policies and procedures in training programs, sufficient institutional support for residents and program directors to gain and provide a seamless training process. The proposed quality framework, encompasses standards that deals directly with the two issues mentioned above, as well as having a broader scope to cover other areas in the training system.

The rationale here is to show improvements in training processes within hosting institution, and hoping that this would have a snowball effect on the rest of training institutions and encourage them to follow the same path, and encourage them to ascribe to national and international level bench marks[411]. The effect of this framework has not been studied, as it is in the approval stage within the Saudi Commission for Health Specialties. Once approval of the framework and the standards is obtained, it would be interesting to study the effect of this performance improvement initiative and document the 'as is' and the 'desired to be,' to measure the impact of this framework, and whether it achieved the desired objectives or not.

Further, I would highly recommend looking into this performance improvement framework against the Kirkpatrick model domains to determine the training program's effectiveness after the implementation of the proposed framework. The value in looking at the proposed quality framework against the Kirkpatrick model offers a theory-driven structured evaluation of the immediate training effectiveness methodology against clear quality domains identified. Each quality domain proposed would be situated within the five proposed levels (4 Kirkpatrick and the additional proposed fifth level training governance).

[411] (Hughes, 2008, pp. 3-1)

Further, Kirkpatrick model as mentioned previously will act much like the audit cycle used in contemporary continuous quality improvement projects where information and knowledge about an outcome is based upon factual evidence that can be measured using specific methods and tools[412]. Importantly, several studies have shown and utilized the Kirkpatrick model to be a feasible and reliable means to evaluating training effectiveness across various clinical contexts[413].

Whilst this research has some clear implications for current resident training programs and related policy, future research should focus upon addressing several priorities. Firstly, there were some methodological limitations to this mixed-methods study that could be addressed, and the research problem re-explored, to assist in generating evidence to validate the findings herein. Secondly, future researchers should explore the same construct but across other populations of residents in Saudi Arabia, in order to determine whether such problems exist on a regional or national level. Thirdly, there is an assumed relationship between resident competence and patient outcomes given the nature of clinical practice, but this association is methodological challenging to ascertain. Therefore, it may be wise for future researchers to explore the association between clinician competence and patient outcomes, although accounting for a diverse array of confounders would be necessary and even so, associational inferences may only be derivable.

Conflict of interest statement

I declare no personal, financial, or political interest, which could influence the findings submitted in this paper.

[412] (Benjamin 2008).
[413] (Heydari, 2019 & Dorri, 2016).

Appendices

Appendix 1: List of universal topics included in CanMEDS: Saudi Arabia context (Amin & Alshammary, 2015, p. 209)

Table 1: List of universal topics
Module: Introduction
Safe drug prescribing
Hospital-acquired infections
Sepsis; SIRS; DIVC
Antibiotic stewardship
Blood transfusion
Module: Cancer
Principles of management of cancer: Chemotherapy; radiotherapy, surgery, immunotherapy
Side effects of chemotherapy and radiation therapy
Oncologic emergencies
Cancer prevention
Surveillance follow-up of cancer patients
Module: Diabetes and metabolic disorders
Recognition and management of diabetic emergencies
Management of diabetic complications
Comorbidities of obesity
Abnormal ECG
Module: Medical and surgical emergencies
Management of acute chest pain
Management of acute breathlessness
Management of altered sensorium
Management of hypotension and hypertension
Management of upper GI bleeding
Management of lower GI bleeding
Module: Acute care
Pre-operative assessment
Post-operative care
Acute pain management
Chronic pain management
Management of fluid in the hospitalised patient
Management of electrolyte imbalances
Module: Frail elderly
Assessment of frail elderly
Mini-mental state examination
Prescribing drugs in the elderly
Care of the elderly
Module: Ethics and Healthcare
Occupational hazards of HCW
Evidence-based approach to smoking cessation
Patient advocacy
Ethical issues: Transplantation/organ harvesting; withdrawal of care
Ethical issues: Treatment refusal; patient autonomy
Role of doctors in death and dying

HCW: Health care workers, GI: Gastrointestinal, ECG: Electrocardiogram, SIRS: Systemic inflammatory response syndrome

Appendix 2: SCFHS-accredited programs in 2014–2015

Specialty	Duration	Mean Pass Rate		Total Number Trainees (Programs)	% Pass Part 1 & 2 Exams
		Part 1	Part 2		
Anesthesiology	5 years	62.50%	80%	288 (35)	50%
Cardiac Surgery	7 years	71.40%	-	41 (11)	-
Community Medicine	4 years	70.60%	62.74%	15 (21)	44%
Dermatology	4 years	68.9%	36.12%	104 (16)	24.8%
Emergency Medicine	4 years	70.5%	70.90%	259 (17)	49.9%
Family Medicine	4 years	70.86%	90%	1318 (91)	63.7%
General Surgery	5 years	72.80%	53.29%	792 (55)	38.7%
Internal Medicine	4 years	56.90%	68.85%	1713 (53)	39.2%
Neurology	4 years	69.60%	84%	128 (22)	58.4%
Neurosurgery	6 years	81%	63.64%	94 (18)	51.5%
Obstetrics and Gynecology	5 years	66.6%	67.12	671 (46)	44.7%
Ophthalmology	4 years	73.20%	77.77%	141 (26)	56.9%
Orthopedic Surgery	5 years	72%	80.83%	334 (41)	58.2%
Otolaryngology	5 years	81.69%	87.50%	230 (30)	71.5%
Pathology	5 years	73.08%	87.50%	85 (18)	63.9%
Pediatrics	4 years	71.4%	73.15%	1106 (40)	52.2%
PM&R	4 years	62.50%	87.50%	34 (3)	54.6%
Plastic Surgery	6 years	71.40%	70%	40 (17)	50%
Psychiatry	4 years	70.60%	86.12%	137 (21)	60.8%
Radiology	4 years	68.9%	Not Approved yet	426 (7)	
Urology	5 years	70.5%	73.92%	200 (30)	52.1%

Appendix 3: Resident survey form

Section 1: Identification

Please note that your cooperation in filling this survey is highly appreciated and will help SCFHS to improve your training experience. We assure you that your participation is confidential and no personal identification is going to be retrieved.

* 1. Gender:

- ◯ Female
- ◯ Male

* 2. Nationality:

- ◯ Saudi
- ◯ Non-Saudi

* 3. Discipline:

* 4. Specialty:

* 5. Residency Level:

* 6. Training City:

7. Training Center (Optional):

* 8. How frequent do you access your email?

- ◯ **Once a Week**
- ◯ **Never**
- ◯ **Many times a Day**
- ◯ **Twice a Week**

Other (please specify)

* 9. What is your source of information with SCFHS ?

- ◯ **Phone**
- ◯ **Email**
- ◯ **Social Media**
- ◯ **Website**
- ◯ **Twasul - تواصل**
- ◯ Other (please specify)

Section 2: Training Center

* 10. How do you rate the following academic activities in your training center ?

	Useful, but needs improvement	Useful as it is	Neutral	Useless and needs to be canceled	Not available and needed	Not applicable
Morning report (Daily Activity)	○	○	○	○	○	○
Sign-out (Endorsement of Patient Under Your Care)	○	○	○	○	○	○
Academic Half-Day	○	○	○	○	○	○
Bedside teaching	○	○	○	○	○	○
Grand Round (departmental weekly scientific activity)	○	○	○	○	○	○
Daily Bedside rounds (with senior resident/fellow)	○	○	○	○	○	○
Daily Bedside rounds (with consultant)	○	○	○	○	○	○
Weekly clinical bedside grand-round with all consultants	○	○	○	○	○	○
E-learning Resources	○	○	○	○	○	○
Training & Participating in Research	○	○	○	○	○	○
Training by Simulation	○	○	○	○	○	○
Mentorship	○	○	○	○	○	○
MCQ Review Sessions	○	○	○	○	○	○
Multi Disciplinary rounds (eg: Radiology, Pathology)	○	○	○	○	○	○

Other (please specify)

Section 3 : Residency

* 11. How do you rate other residents in your program in the following aspects? (in other words what do you feel about other residents currently enrolled in the program)?

	Very poor	Poor	Not Sure	Good	Excellent
Their Interest to learn	◯	◯	◯	◯	◯
Their Interest to help others	◯	◯	◯	◯	◯
Their Interest to teach others	◯	◯	◯	◯	◯
Their Attitude (Moral, Honesty..)	◯	◯	◯	◯	◯
Their Communication skills	◯	◯	◯	◯	◯
Their Time-Management skills	◯	◯	◯	◯	◯
Their skills in Evidence- based medicine	◯	◯	◯	◯	◯
Their Leadership skills (for Senior Residents)	◯	◯	◯	◯	◯

Other (please specify)

* 12. How do you rate the following administrative components of the program?

	Lacking	Not Supportive	Neutral	Supportive	Very Supportive
Program Admin (Coordinator) in your center	◯	◯	◯	◯	◯
Chief Resident	◯	◯	◯	◯	◯
Deputy Program Director	◯	◯	◯	◯	◯
Program Director	◯	◯	◯	◯	◯
Departmental Support (e.g Chairman section header etc)	◯	◯	◯	◯	◯
Department of Academic & Training Affairs (in your center)	◯	◯	◯	◯	◯

Other (please specify)

* 13. How likely would you recommend your program for other trainees?

◯ Very likely

◯ Not sure

◯ Unlikely

Other (please specify)

Section 4: Personal

* 14. How frequent you feel that you are "burned out" and you "can not cope anymore" due to work stress?

	Never	Rarely (≤1/month)	Sometimes (2-3 month)	always (≥4/month)	It Depends
Burn-out, feel stress!	◯	◯	◯	◯	◯

Comment box:

* 15. On scale from 1 to 10 How Much confident do you feel to be a team leader or team member ?

	1 (Not Confident at all)	2	3 (Neutral)	4	5 (Extremely Confident)
Confident as a team leader	◯	◯	◯	◯	◯
Confident as a team member	◯	◯	◯	◯	◯

Other (please specify)

* 16. How "proud or bad" do you feel being a trainee in your (current training centre) ?

- ◯ **Very Bad**
- ◯ **Bad**
- ◯ **Neutral**
- ◯ **Proud**
- ◯ **Very Proud**
- ◯ Other (please specify)

* 17. In retrospect (after you have joined the program) would you choose another center to do your your residency training?

- ◯ **Yes,** I will choose another center
- ◯ **No,** I will again choose my same center

If yes which one and why?

* 18. Do understand the concept of **(Competency-Based Medical Education)** and do you believe in it?

	Very Weak	Weak	Average	Good	Excellent
I understand the concept of **Competency Based Education**	◯	◯	◯	◯	◯
I Believe the concept of **Competency Based Education** is useful	◯	◯	◯	◯	◯

Other (please specify)

* 19. How do you rate your competency in the following aspects ?

	Very weak	Weak	Average	Good	Excellent
Being Medical Expert	◯	◯	◯	◯	◯
Communicating Effectively	◯	◯	◯	◯	◯
Leadership and Management Skills	◯	◯	◯	◯	◯
Participating in Research	◯	◯	◯	◯	◯
Being Active in Healthcare Advocacy	◯	◯	◯	◯	◯
Collaborator	◯	◯	◯	◯	◯
Dictating Medical Reports	◯	◯	◯	◯	◯
Your skills in Teaching and Presentation	◯	◯	◯	◯	◯
Practicing according to your Profession Standards	◯	◯	◯	◯	◯
Your skills in Scientific Writing	◯	◯	◯	◯	◯

Other (please specify)

* 20. Did you ever experienced any form of insult or harassment during your work in the hospital? (if yes please specify?)

	Yes	No
Verbal insult	◯	◯
Physical insult	◯	◯
Sexual harassment-Verbal	◯	◯
Sexual harassment-physical	◯	◯

If yes please specify

* 21. In retrospect (after you have joined the program) would you choose another Specialty?

◯ **Yes,** I will choose another Specialty

◯ **No,** I will again choose the same Specialty

◯ Other (please specify)

Section 5: Research

* 22. Have you worked on or published a Research during your Residency/Fellowship program ?

- [ ] **Yes**, I participated in conducting a Research
- [ ] **Yes**, I published a Research
- [ ] **No**
- [ ] Other (please specify)

* 23. In which level of your training you have published your Research?

- ○ R1
- ○ R2
- ○ R3
- ○ R4
- ○ R5
- ○ F1
- ○ F2
- ○ F3
- ○ Other (please specify)

* 24. From your point of view: What are the difficulties / barriers that complicate conducting a Research?

- ○ High Cost
- ○ Limited Time During Training
- ○ Limited Research Supervisors
- ○ Unclear Publishing Procedure
- ○ Lack of Interest
- ○ Other (please specify)

Section 6: SCFHS

* 25. How do you rate your satisfaction in the following SCFHS services :

	Very Poor	Poor	Not Sure	Good	Excellent
Training Registration	○	○	○	○	○
E. Learning Support	○	○	○	○	○
Program Curriculum	○	○	○	○	○
One-45	○	○	○	○	○
Administrative support	○	○	○	○	○

Comment box:

* 26. Mention **3 top** strengths of your current (Residency Program)

* 27. Mention the **3 top** weaknesses in the (Residency Program)

* 28. Who is your "role-model" during your residency? (Can be a consultant or a Senior Trainee)

* 29. Do you have any suggestions to improve your training experience?

We really appreciate your time in filling the survey. Thank you

Appendix 4: Program director survey questions Postgraduate Program Directors Survey

Dear Program Director,

This survey aims to understand program director perspectives on their current programs, as well as addressing graduate health professions education (GHPE) KPIs with a focus on the program director's contribution to the training process. This survey addresses four main areas: training supervision, educational content, support & resources, and global evaluation. Theses identified areas will act as a tool to identify improvement opportunities benefitting the overall delivery of training content. A final report of findings and analysis will be generated, highlighting major areas for improvement.

Thank you for allocating time to answer the following questions.

Regards

Section 1: Demographics
Gender:
Female
Male

Age:
30–40
41–50
51–60
Above 60
Nationality:
Saudi
Non-Saudi (please specify)

Qualifications:
Saudi Board
Arab Board
North American Board
European Board
Australian Board
Other, please specify

What is your program name?

For how many years have you been in this position?
0–2
3–4
5–6
> 6 yr.
Please select your training center:

Other: ………………………
Please select your city:

Please select your region:

Please select your sector:

What type of center are you involved in?
Independent: trainees spend majority of their training in your center
Part of joint program: where trainees rotate through multiple centers during their training experience

In addition to your position as a program director, what other administrative positions are you currently holding?
None
Head of department
Head of section/unit

Dean/vice dean
Other, please specify:…………………….

Do you have special qualifications in postgraduate education (i.e., master's/PhD in medical education or equivalent?)
Yes
No
If you answer "yes" to Q13, please specify special qualifications:

Other, please specify:…………………………..

Section 2: Supervision & Teaching
Did you receive any orientation regarding the duties of program directors?
No
Yes,
please specify how
What is the average number of hours you need daily to manage the training process in your center?
< 1
1–2
2–3
> 3

What is your protocol for supervising the clinical side of the training process in your center?
Site visits
Reports from teaching faculty members
Reports from chief residents
Meetings with individual residents
I don't have a fixed protocol
Other, please specify:……………….

How frequently do you receive input from trainers on residents' clinical training in your center?
Weekly
Monthly
Following each rotation
Yearly
Other, please specify:…………………….
Never

What is your satisfaction level with the performance of the teaching faculty members serving as trainers in your program?
Very unsatisfied
Unsatisfied
Neutral
Satisfied
Very satisfied

If you are unsatisfied, please explain your reason(s).

………………………………………………………………..

How compliant are your teaching faculty members in submitting trainee evaluations in time?
Very uncompliant
uncompliant
Neutral
Compliant
Very compliant

Do you apply an annual master rotation plan for residents in your center early on in the academic year?
No
Yes, please specify the time of distribution:……………………….

Do you have a structured process for trainees' evaluation of teaching faculty members?
No
Yes, please summarize method & frequency:………………………

Do you have a structured process for trainees' evaluation of the effectiveness of their rotations?
No
Yes, please summarize method & frequency:………………………….

Do you have an established training committee?
Yes
No

If you answered yes to Q10, how frequently does the committee they meet?
Monthly
Biannually
Quarterly
Annually

Do you have active records for the committee meeting minutes?
Yes
No

How do you describe the role of department head(s) with regard to the training process?
Supportive & enhancing quality training
Passive, not providing support
Negatively interfere with the training process (conflict of interest, other personal issues)
Other, please specify:………………………

What is the status of chief residents in your program?
There is a chief resident playing an active role as a leader, manager, supervisor, conflict manager, role model, counselor, and professional.
There is a chief resident playing an active role as an organizer of residents' affairs.
There is a chief resident with a passive role.
No chief resident, though it is highly needed.
No chief resident; I do not think it is needed.

Section 3: Educational Content
In which of the following settings do your residents have an opportunity to encounter patients? (allow for multiple selections)
Endorsement of patient care
Bedside teaching
Daily rounds
Simulation sessions
Operating room
Rarely
Never
Other, please specify:……………………………..

What source is available for your residents to understand the goals and objectives of individual rotations?
Program director
Assigned teaching faculty members
Curriculum
Chief resident
Peers
Self
Other, please specify:…………………………

In your opinion, do you find the educational content provided in the curriculum of your specialty appropriate to enhance the mastery level in the required competencies for your residents'/fellows' future practice?
Strongly disagree
Disagree
Neutral
Agree
Strongly agree

In your opinion, do you find the ability level of faculty members involved in training in your specialty appropriate to enhance the mastery level in the required competencies for your residents/fellows?
Strongly disagree
Disagree
Neutral
Agree
Strongly agree

How much of the curriculum's educational content is actually implemented in your center?
< 30%
30%–50%
51%–80%
> 80%
If your answer is < 80%, please mention the reason:………………………..

How many of the continuous assessment tools included in your curriculum are actually implemented?
< 30%

30%–50%
51%–80%
> 80%
If your answer is < 80%, please mention the reason:……………………………

What is the overall rate for compliance of teaching faculty with the weekly academic day or half day activities?
< 30%
30%–50%
51%–80%
> 80%
If your answer is < 80%, please mention the reason:………

What is the overall compliance rate with the resident's rotation distribution (i.e., compliance with master rotation set early in the year)?
< 30%
30%–50%
51%–80%
> 80%
If your answer is < 80%, please mention the reason.

Section 4: Resources & Support
Do you have a program administrator (secretary)?
Yes, full time
Yes, part time
No, I don't have one
Please select the level of agreement on the following:

		Yes	No	I don't know
	You have a system that monitors and prevents residents/fellows' burnout and exceeding the duty hours as stated by SCFHS regulations			
	Your institution creates an environment that enables residents/fellows to achieve their milestones of competencies by providing the necessary resources			
	Your institution has an established an electronic medical records system			
	You are satisfied with the support provided by the Academic and Training Affairs unit in your center			
	Your institution provides incentives for your faculty members in return for their contribution to education			
	Your institution allocates specific time for faculty members to contribute to education			
	Your institution provides and supports specific faculty development activities			
	Your institution fosters a culture that reinforces patient safety responsibility			
	Your institution fosters a culture that reinforces working in inter-professional teams			

	Your institution fosters a culture that reinforces quality performance improvement activities			
	You are aware that there is a system that allows residents/fellows to report fatigue and burnout during their training			
	You are aware that there is a system that allows residents/fellows to report harassment (sexual, physical, verbal)			
	You have an effective mentoring (mentorship, pairing juniors with seniors, etc.) process that improves the learning experience of residents/fellows			
	You are aware that your program contains policies to enhance residents' wellbeing			
	You are satisfied with the process that deals with residents/fellows' academic difficulties			
	Your program contains an educational activity that enable residents/fellows to manage fatigue, burnout and harassment			

While practicing your role as Program Director have you ever experienced burnout?
Never
Yes—rarely
Yes—occasionally
Yes—frequently

If yes, please specify:
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………
……………..
Do you feel motivated to continue playing your current role as a program director?
Yes
No

If no, please explain why not:
……………………………………………………………………………………………
…………………………………………………

Section 5: Overall Evaluation Process
Please select your satisfaction level regarding the following:

	Area	Very unsatisfactory	Unsatisfactory	Neural	Satisfactory	Very satisfactory
Program						
	Content					
	Implementation					
	Outcomes					
SCHFS services						
	Admission & matching process					
	Trainee's portfolio (One-45 system)					
	Trainer's support (TOT[414] program)					
	Exam services					
Administrative support						
	Specialty local supervisory committee					
	Specialty scientific council/committee					

[414] Train the Trainer program

Appendix 5: Recruitment Letter for Postgraduate Medical and Surgical Training Programs Program Directors

Dear Postgraduate medical & surgical Program Directors:

You are invited to participate in a focus group discussion of the Most important pressing issues in the postgraduate medical & surgical training programs.
As active participants in shaping the skills and knowledge of residents, your perspectives the issues that arose from a Program Director and Resident survey conducted is highly valued. As some of you may know, a survey was sent out to postgraduate medical & surgical Program directors and residents to narrow down the list of issues to the most important issues. This, by all means does not indicate that these are the only issues, but on the contrary, it indicates the most important issues in training that needs to be addressed currently and will have policy implications on training.
The aim here, is to improve the quality of postgraduate training to match international standards and requirements. This focus group is part of a study, Conducted by Mrs. Amal AlAmoudi who is a PhD Candidate at Carleton university, Ottawa Canada, this study aims to help the Saudi commission for health specialties better understand the strengths and weaknesses and areas of improvement of the training programs, which will entail training policy amendments.
The Department of Training and academic affairs supports this study and values your participation in the focus group as it will have a positive impact on a national reputation for postgraduate training quality health care research.

The focus group, to be held on November 12, 2019, will include program participants from various medical and surgical postgraduate training. During this meeting, you will have the opportunity to share your experiences with overseeing training programs in your institution and share your thoughts about the issues that arose from a survey as well as your general perspective of the training program as is, the focus group will take place in the SCFHS in a casual environment and with complete confidentiality. As a participant in the postgraduate medical and surgical training programs, your views and experiences are extremely valuable in helping the Saudi Commission Academic and training affairs improve Training processes and as a natural consequence Training outcomes. Your input will greatly help the SCFHS to better serve trainers and trainees during their journey in delivering your valuable experience, time and knowledge to our future physicians.
The focus group will be held on November 19,2019, from 10:00 am until 12 :00 pm at the Saudi Commission for Health specialties, first floor meeting room 1050(Continental breakfast/Lunch) will be provided.

You were randomly selected from a list of program participants. Although we hope you will join us, participation is voluntary. Please be assured that anything you say during the focus group will be kept strictly confidential, and that the SCFHS nor Mrs. Amal Alamoudi will not release any information that can be linked to you. The Training and academic affairs Coordinator will be contacting you by telephone to give you more details about this important event and answer any questions you may have about the study. You are also welcomed to call us toll free at +966 (11) 290-4400.

We hope that you will be able to join us for this important discussion

Sincerely,
Chief Academic Affairs
Dr. Wesam Abuznadah

Appendix 6: Recruitment Letter for Postgraduate Medical and Surgical Training Programs Residents

Dear Postgraduate medical & surgical Program Residents:

You are invited to participate in a focus group discussion of the Most important pressing issues in the postgraduate medical & surgical training programs.
As active participants in the training programs, your perspectives on the issues that you currently face in acquiring knowledge and clinical skills through your residency journey. The aim here, is to improve the quality of postgraduate training to match international standards and requirements. This focus group is part of a study, Conducted by Mrs. Amal AlAmoudi who is a PhD Candidate at Carleton University, Ottawa, Canada, this study aims to help the Saudi Commission for Health Specialties better understand the strengths and weaknesses and areas of improvement of the training programs, which will entail training policy amendments.
The Department of Training and Academic Affairs supports this study and values your participation in the focus group as it will have a positive impact on a national reputation for postgraduate training quality health care research.

The focus group, to be held on November 19-20, 2019, will include program participants from various medical and surgical postgraduate training. During this meeting, you will have the opportunity to share your experiences with and thoughts about issues as well as your general perspective of the training program as is, the focus group will take place in a casual environment and with complete confidentiality. As a participant in the postgraduate medical and surgical training programs, your views and experiences are extremely valuable in helping the Saudi Commission Academic and training affairs improve training processes and as a natural consequence training outcomes. Your input will greatly help the SCFHS to better serve trainers and trainees during their journey in delivering your valuable experience, time and knowledge to our future physicians.
The focus group will be held on November 19-20, 2019 from 10 am until 12 pm at the assigned meeting room in your institution. (Continental breakfast/Lunch) will be provided.

You were randomly selected from a list of program participants.
Although we hope you will join us, participation is voluntary. Please be assured that anything you say during the focus group will be kept strictly confidential, and that the SCFHS nor Mrs. Amal Alamoudi will not release any information that can be linked to you.
The Training and Academic Affairs Coordinator will be contacting you by telephone to give you more details about this important event and answer any questions you may have about the study. You are also welcomed to call us toll free at < +966 (11) 290-4400>.

We hope that you will be able to join us for this important discussion

Sincerely,
Chief Academic Affairs
Dr. Wesam Abuznadah

Appendix 7: Program Director Focus Group Consent Form

Research project title: Toward a Comprehensive Postgraduate Surgical Training Program in Saudi Arabia
Research investigator: Amal Alamoudi
Protocol #: 108561
CUREB-A Clearance # 108561.

You are invited to take part in a focus group discussion of the issues that you may have as a program director. This focus group is estimated to last 1-2 hours. You are not obliged to answer any questions during the focus group may leave it at any time, without penalty.
Your data will be treated as confidential and you will not be identified in any published reports. The data collected will be stored securely and in accordance with the Saudi Commission regulations concerning data security.
The focus group will be audio recorded and later transcribed. We will forward to you a copy of the transcribed discussions and you may edit the transcript once it has been completed

I agree to participate in the (postgraduate medical & surgical training) carried out by (Mrs. Amal Alamoudi) of Carleton University, to aid with the research of (Toward a Comprehensive Postgraduate Surgical Training Program in Saudi Arabia).

____
Printed Name

____________________________________ ____________________
Participants Signature Date

____________________________________ ____________________
Researchers Signature Date

Contact Information
This research has been reviewed and approved by the Carleton University Research Ethics Board. If you have any further questions or concerns about this study, please contact:
Name of researcher: Mrs. Amal Alamoudi
Full address: Saudi Commission for Health Specialties P.O. Box: 94656, Riyadh 11614 Kingdom of Saudi Arabia
Tel: +966 (11) 290-4400
E-mail : a.alamoudi@scfhs.org
If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair by phone at 613-520-2600 ext. 2517 or by email at ethics@carleton.ca.

Appendix 8: Resident Focus Group Consent Form

Research project title: Toward a Comprehensive Postgraduate Surgical Training Program in Saudi Arabia
Research investigator: Amal Alamoudi
Protocol #: 108561
CUREB-A Clearance # 108561.

You are invited to take part in a focus group discussion of the three issues that you may have as a resident in postgraduate medical or surgical program. This focus group is estimated to last 1-2 hours. You are not obliged to answer any questions during the focus group may leave it at any time, without penalty.
Your data will be treated as confidential and you will not be identified in any published reports. The data collected will be stored securely and in accordance with the Saudi Commission regulations concerning data security.
The focus group will be audio recorded and later transcribed. We will forward to you a copy of the transcribed discussions and you may edit the transcript once it has been completed

I agree to participate in the (postgraduate medical & surgical training) carried out by (Mrs. Amal Alamoudi) of Carleton University, to aid with the research of (Toward a Comprehensive Postgraduate Surgical Training Program in Saudi Arabia).

____

Printed Name

____________________________________ ____________________

Participant's Signature Date

____________________________________ ____________________

Researcher's Signature Date

Contact Information
This research has been reviewed and approved by the Carleton University Research Ethics Board. If you have any further questions or concerns about this study, please contact:
Name of researcher: Mrs. Amal Alamoudi
Full address: Saudi Commission for Health Specialties P.O. Box: 94656, Riyadh 11614 Kingdom of Saudi Arabia
Tel: +966 (11) 290-4400
E-mail : a.alamoudi@scfhs.org
If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair by phone at 613-520-2600 ext. 2517 or by email at ethics@carleton.ca.

Appendix 9: Program Director Focus group questions

Educational Content

Is there are process for faculty to work with residents on scholarly projects?
Do trainees see patients across a variety of settings?
Is there achievement milestones for graduating trainees?
Supervision/ Teaching:
What is the appropriate number in your opinion of trainers to be available to ensure high quality of training and exposure to sub specialties?
Do you have sufficient time to supervise Trainees?
Do you have a system for faculty evaluation?
Resources
Two Part Question:
Do you have sufficient number of patients to ensure exposure of trainees?
In your opinion do you have the overhead and logistics required to ensure high quality of training?
Does the Trainee workload exceed capacity to do the work?
Do you have a process that prevents excessive reliance on trainees to provide clinical services?

Evaluation of faculty

Are you satisfied with faculty development to supervise and educate residents?
Are you satisfied with faculty process to deal with trainees' problem and concerns?
Do you have a system for evaluating faculty members?
Are you satisfied with the quality of trainers available in your program?
Residents and their Evaluation
What is the acceptable number of residents per year that ensures high quality of training without diluting the exposure and experience of the training quality?
Patient Safety
Do residents participate in quality management and patient safety activities?
Overall evaluation of the Program
Is the program effective in teaching and transferring knowledge clinically and OR?

Appendix 10: Residents Focus group questions

Educational Content

Do you have sufficient academic time devoted for teaching?

Do you think the quality and number of cases are sufficient for exposure and gaining confidence to move on to the next level?

Are you getting sufficient teaching time in the clinics?

Multidisciplinary meeting /ground rounds are regularly held? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

Cases/ topic presentations are regularly held in addition to daily business? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

Faculty

Do you think that you are gaining the appropriate level of supervision?

Are you getting sufficient instructions by your immediate faculty member clinically and in OR if applicable?

Do you feel that your environment supports and creates a safe haven for inquiry?

Most of my learning is from the Faculty? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

My consultant is accessible in OPD for discussing patients? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

My senior/consultant is available for supervision during surgery or procedures? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

Do you think that the number of faculty is appropriate to give you the knowledge required?

Resources

Do you feel supported by the center and program? Yes/No and why?

Financially speaking: do you feel secure throughout your training journey? (This affects dropout rate in programs as some centers require sponsorship from a certain area)

Do you have access to needed resources?

Are you satisfied with opportunities for scholarly activities?

Evaluation of faculty

Do you have the appropriate channels and tools to evaluate faculty members?

Are you satisfied that the evaluation of faculty are confidential?

My consultant gives me regular feedback? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

Evaluation of residents

Do you feel that you are evaluated objectively and fairly?

Do you receive your evaluation within the agreed-on time?

Do you feel that education is compromised by other trainees?

Can residents raise concerns without fear?

I regularly sit with my consultant to discuss my progress? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

My consultant is a good role model for me? (Strongly agree/ Agree/ strongly disagree/ disagree/ neither agree or disagree/ Not answered)

Patient Safety

Does the institution foster and reinforces a culture of patient safety?

Overall evaluation of the Program

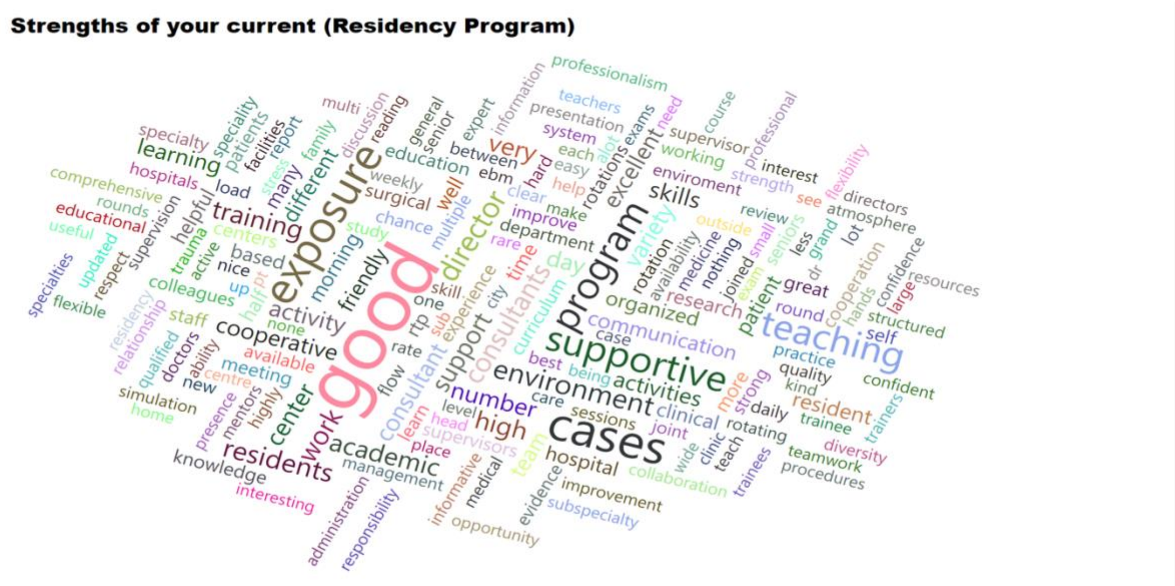
Are you provided with goals and objectives for assignments?

How to evaluate the program over all?

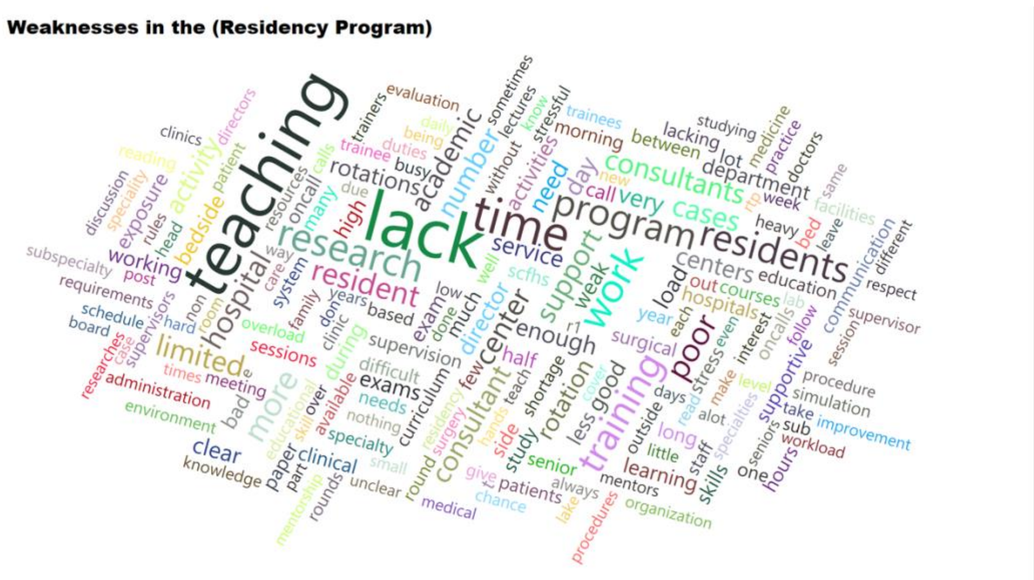
Are you satisfied that the program evaluation is used to improve its processes?

I am undergoing a structured residency program?

Appendix 11: Themes generated from resident survey (Strengths)



Appendix 12: Themes generated from resident survey (Weaknesses)



Appendix 13: Themes generated from resident survey (Suggestions to improve)

Appendix 14: Comparative TQ frame works between countries

	Scotland	CANADA (RC)	ACGME	GMC (UK)
Name of framework	Quality management of postgraduate Medical Education and training	CanERA (Excellence in residency Accreditation)	CLER	Promoting Excellence: Standards for Medical Education and training
Year developed	2007	2018 (Updated)	2012	2015
Where is the TQ located	Within the Training Governance executive group (Regulator Body)	Within the Royal college	Part of ACGME	Within the GMC (UK)
What is the TQ framework consistent of	It incorporate 5 elements: Standards[415] Shared evidence[416] Surveys[417] Responses to concerns[418] Visits[419] Reports[420]	Standards Shared evidence	Its purpose is to evaluate, encourage, and promote improvements in the CLE. The CLER Program provides sites with three types of formative feedback: (1) an oral report at the end of the site visit; (2) a written narrative report summarizing the observations of the CLER Field Representative(s); and (3) reports that provide national aggregated and de-identified data displayed along a continuum of progress toward achieving optimal resident and fellow engagement in the CLER Focus Areas.	Standards

[415] Against which the other elements are developed and measured
[416] Shared evidence aims to ensure that data required from defined and transparent, with minimum set of data requirements identified. This will require an annual submission of self-evaluations against the generic standards for training, as well as data from surveys.
[417] National surveys of trainees and trainer
[418] Future visits will be risk based, identified through the self-evaluation and the evidence based processes. They will be targeted and proportionate in keeping with better principles of regulation. Visits could be thematic or focused on a special program in its entirety.
[419] This involves independent and impartial advisors; the number of the external advisors depend on the size of the institution and the number of specialty programs available. They will verify standards are being attained by trainees and to help maintain the quality of the training program. They also has what they call Routine visits, where there will be regular visits to training providers with the intention of verifying the routinely collected data (INFREQUENT VISITS). The other would be **Targeted** visits: this follows the risk base visit (Red flag), so it will target the area of concern.
[420] Annual reports are required to be submitted to the training quality in the required time and structure; this report will include 1- a self-assessment against the generic quality standards for training that requires to analyze and assess their progress against standards. 2- an action plan that identifies action taken to resolve areas of concern or Notable areas of practice that they should be commended on.

	Scotland	CANADA (RC)	ACGME	GMC (UK)
Type of standards	Generic standards[421] Standards for deaneries Standards for curricula and assessment systems The new doctor- guidance on foundation training	Excellence standards for residency programs	The CLER Program is separate and distinct from nearly all accreditation activities. Two essential elements connect the CLER Program with the rest of the accreditation process: (1) each Sponsoring Institution is required to periodically undergo a CLER site visit every 24 (±6) months; and (2) the chief executive officer and the leader of GME (specifically the designated institutional official) of the clinical site must attend the opening and closing sessions of the CLER site visit	The standards and requirements are organized around five themes. Some requirements – what an organization must do to show us they are meeting the standards – may apply to a specific stage of education and training.
Purpose	To demonstrate adherence to the standards and requirements that it sets[422], this is to be accomplished by close working with specialties through training boards and other local educational providers.	The standards aim to ensure residency programs adequately prepare residents to meet the health care needs of their patient population(s), upon completion of training.	The CLER Program is built on a model of continuous quality improvement.	Promoting excellence: standards for medical education and training sets out ten standards that we expect organizations responsible for educating and training medical students and doctors in the UK to meet.
# of Domains	9	5	6	5
Domains that are not covered in this system Compared with other countries	Teaming Professionalism	Patient safety Outcomes Resident wellbeing Professionalism	Residents Recruitment and selection. Outcomes Educational Resources and capacity	Quality Management Residents Recruitment and selection. Educational Resources and capacity Outcomes Resident wellbeing Professionalism

[421] This is the training quality standards that are applied to postgraduate medical and health training.
[422] The unit of the analysis for the approval of the organization by the PMETB is the program and the way it delivers quality management of training.

Data gathering process	Training program directors' reports Local visits Trainee and trainers' surveys Audit- external and internal	Shared evidence through reports Local visits Trainee and trainers' surveys Audit- external and internal	Shared evidence through reports Local visits Trainee and trainers' surveys	Local Education and training providers reports Audit- external and internal Training program directors' reports

	Scotland	CANADA (RC)	ACGME	GMC (UK)
Responsibility of application of these standards	Training governance executive committee Specialty training committee Training and academic affairs in the institutions Program directors Local Training Quality Leeds	Training and academic affairs in the institutions Program directors	Training and academic affairs in the institutions. All program directors	Local Education and training providers reports Audit- external and internal Training program directors' reports
Covers both undergraduate Medical schools and post Graduate training (Yes/ No)	Yes	Only Postgraduate medical training.	Only Postgraduate medical training.	Yes
# programs	61 specialty leading to certificate of completion of training (CCT)	Information not available in the document	Information not available in the document	Information not available in the document
# subspecialty covered	40	Information not available in the document	Information not available in the document	Information not available in the document

	Scotland	CANADA (RC)	ACGME	GMC (UK)
# Boards	14 Territorial NHS boards	Information not available in the document	Information not available in the document	Information not available in the document
Total Expenditure on medical training (Countries currency	205.8 M UKP	Information not available in the document, for local but for international residents 1.3 MCAD/YEAR	Information not available in the document	Information not available in the document

Appendix 15: Postgraduate medical and surgical Excellence standards proposed to SCFHS

Excellence in Training Standards' Weighing Definitions:	
ETS1	**These are the minimum Excellence requirements that would ensure quality in training delivery (Quality Assurance)**
ETS2	**These standards when implemented would ensure that the organization is transitioning from quality assurance to quality management**
ETS3	**These standards when implemented would ensure a total quality management system is implemented**

I. **Structure (Governance)**
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
2. The educational governance system continuously improves the quality and outcomes of education and training by measuring performance against the standards, demonstrating accountability, and responding when standards are not being met.				• Training governance policy. • RACI matrix • Policies & procedures (Training delivery) • Training Quality matrix results.	• % Healthcare Facilities reporting comprehensive Performance and Quality measures (NTP) • %Satisfaction with the timeliness and accuracy of reports requested.
1.1. Training centers MUST have effective, transparent, and clearly understood educational governance system and processes to manage or control the quality of medical education and training.				• Evidence of annual program review that includes effectiveness measures of curricula, curricula review documentation • Training governance policy.	• % Program objectives met annually. • % Pd satisfaction with training policies • #Training policies reviewed according to schedule. • % Adherence to training governance system.

1.2. Training centers MUST consider the impact on learners' policies, systems, or processes. They must take account of the views of learners, educators and, where appropriate, patients and the public.				• Evidence of annual program review that includes effectiveness measures of curricula, curricula review documentation • Training governance policy. • Training Governance Committee charter	• #Trainees demonstrating their understanding in verity of ways. • %Patient satisfaction with trainee interaction
1.3. Training centers MUST regularly evaluate and review the curricula and assessment frameworks, education, and training program placements. They are responsible to ensure that standards are being met and to improve the quality of education and training.				• Evidence of annual program review that includes effectiveness measures of curricula, curricula review documentation • Training governance policy.	• # Performance improvements projects resulted from curricular and assessment annual review • % PI projects successfully implemented. • #Curricular components were changes based on annual review
1.4. Training center MUST have a system to make sure that education and training comply with SCFHS legislative bylaws.				• Accreditation survey reports.	• #Training center citations included in accreditation reports. • %Center accreditation status change as a result of accreditation survey

NEHT2.0 Excellence in Training Standards

Standard	ETS1	ETS 2	ETS3	Key evidence	
3. There MUST be a clear accountability, description of roles and responsibilities, and adequate resources available for those who are involved in administrating and managing training and education at an institutional level.				• Trainer surveys. • Program Director surveys. • Training governance policy.	• %Trainer satisfaction • %PD satisfaction • % Adherence to training governance system. • % Addition of new equipment's and services.
4. Centers MUST have evidence that they are demonstrating their Capacity for quality management review and evaluation to meet the NHET 2.0 Excellence and Quality framework.				• Training Center Policies. • Training program Quality reports (Including Identification of OFI and their mitigation plans). • Accreditation reports and status (Gold, Silver, Bronze). • Scientific committee quality reports, including Educational code blue.	• % Satisfaction with the timeliness and accuracy of reports requested.
5. Education on quality improvement 4.1. Training Centers MUST show evidence that they Provide the clinical care team, including residents, fellows, and faculty members with ongoing education and training on quality improvement that involves experiential learning and interprofessional teams.				• QI training schedule, QI plans initiated with clear timelines. • Best practices evidence shown in training policies. • Evidence of ETS implemented. • Training center policies	• # Participants in QI training sessions. • % Participants completed the training sessions • #QI projects initiated as a result of Training sessions. • #Multidiciplinary teams for PI projects
4.2. Training Centers MUST show evidence that they Ensures the integration of quality improvement processes and lessons learned into the daily workflow of clinical care.				• Curriculum defined by specialty and approved by scientific committee and the concerned training department.	• % Daily workflow processes improved as a result of quality improvement integration.

				• Training capacity of program established and documented and validated by the accreditation survey report. • Trainee surveys on adequacy of clinical experience in quality management • Program specific trainee feedback forms collected.	
6. The overall training capacity of the institution MUST be adequate to accommodate the practical experience required by the curriculum, along with the educational requirements of all trainees in the program.				• Center website • PD Surveys • SCFHS website • Trainer feedback form on trainee ability to carry out program requirements.	• % Trainer satisfaction with trainee ability to carry out program requirements.
7. Information about training programs, their content and purpose MUST be publicly accessible on their center website.				• Curriculum available to all trainees, trainers, and service providers- include reference to audit activities. • Available training program profile for each unit contributing to the program (identification of audit opportunities and arrangements (service))	• Trainee effort score to obtain program information.
8. Trainees MUST regularly be involved in the audit process, including personally participating in planning, data collection and analysis.				• Evidence of trainee involvement in audit process of the program.	• #Trainees participating in process audit annually.
9. Trainees MUST be able to access and be free to attend training days, courses, resources, and other learning opportunities that form an intrinsic part of the training program				• Study leave policy determined nationally and published on SCFHS website. • Audit of requests for approval for study leave by trainees.	• %Trainee satisfaction with availability of learning opportunities. • %Trainee Satisfaction with ease of resource obtainment.

				• Trainee survey on adequacy of access to courses. • Training program audit of requests and approval of study leave of trainees. • Aggregate data published on SCFHS website.	
10. Trainees MUST be able to take study leave up to the maximum permitted in terms and conditions of the program.				• Study leave policy determined nationally and published on SCFHS website. • Audit of requests for approval for study leave by trainees. • Trainee survey on adequacy of access to courses. • Training program audit of requests and approval of study leave of trainees. • Aggregate data published on SCFHS website.	• #Approved trainee study leaves requests annually. %Trainee satisfaction with adequacy of access to required courses.

I. Structure (Matching)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. Selection panels within the training centers MUST consist of persons who have been trained in selection principles and processes.				• Policy on membership of selection panels determined nationally. • Training center selection panel members list, which includes their training in selection processes and principles.	• #Training courses provided to the selection panel. • %Adherence to selection criteria. • %Trainee satisfaction with their center placement.
2. The matching process MUST show evidence of the following: 2.1. Clear processes that demonstrate that the selection criteria treated candidates fairly.				• Trainee matching surveys. • Matching Policies	• %Trainee satisfaction with matching results
2.2. Trainee Satisfaction with matching results				• Trainee Satisfaction survey results.	• %Trainee satisfaction with matching results • #Trainees who were place in centers of their first choice.
2.3. Have an Appeal system				• Appeal policy • Appeal system documentation • Appeal documentation forms that include resolution plans and outcomes	• #Matching Appeal requests. • %Matching appeal requests closed within SLA. • %Trainee satisfaction with appeal process.

I. Structure (Curriculum)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. The purpose of the curriculum MUST be stated including linkages to previous and subsequent stages of the trainees training and education.				• Training capacity of program establishment that is validated through accreditation reports.	• %Trainer satisfaction with trainee ability to carry out program requirements. • #Trainee improved competencies as a result of completing required previous stage.
2. The appropriateness of the stated curriculum to the stage of the learning and to the specialty MUST be described.				• Trainer approval documentations, Service profile for each training unit that covers staffing, clinical activities, and resources available within the center. • Trainee surveys	• %Trainees completed program requirements as per curricula annually. • %Trainee satisfaction with curricula at their current training level.
3. The curriculum MUST set out the general, professional, and specialty specific content to be mastered by trainees.				• Results from trainee assessment and review that is collected annually to show progress	• #Trainees demonstrating their ability to Master program specific content requirements.
4. Indication on how curriculum will be implemented, managed, and assured within the training center must be stated clearly.				• Trainee logbook data collected relevant to the specialty • Specialty specific trainee feedback forms.	• #Trainee's skills improved as a result of current Curricula administration. • Trainee Progression Ratio
5. The curriculum MUST describe the model of learning appropriate to the specialty and the stage of training.				• Training program profile developed by the scientific committee, Program director, outlining units and posts contributing to	• #Assessment tools used at each training stage. • #Approved assessment blueprints.

				program and mapping to the SCFHS approved curriculum.	
6. Each program within the training center MUST show how posts within it, taken together will meet the requirements of the curriculum and what must be delivered within each post.				• Program information profile on SCFHS website.	%Trainee satisfaction with program content

I. Structure (Trainers)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. Trainers must be selected against suitable criteria and receive an appropriate induction to their role.				• Educational governance in SCFHS & Training center. • Program level data on trainers who have been selected and trained as trainers. • Data on resources available for educational supervision activities. • Service data on inclusion of time for educational supervision activities in trainers job plans. • Service data on appraisal of educational supervision undertaken by Trainers.	#Trainer who have medical education background. %Trainer who have completed TOT program. %Trainer satisfaction with onboarding process
2. Training systems must make sure that recruitment, selection, and appointment of Trainers are open fair and transparent.				• Trainer selection policy. • Training program profile available for each training unit contributing to the program, covering staffing, clinical activities	• %Trainer satisfaction with selection criteria. • Trainer Attrition rate.

				and facilities based on the understanding of sufficient practical experience required.	
3. Sufficient Practical Experience MUST be available within the Program to support the training competencies as set out in the approved curriculum.				• Evidence of adequate clinical experience. • Training capacity of program established and documented by the training committee and validated by the central training committee. • Specialty trainee feedback forms collected/ analyzed at annual trainee review. • Trainee logbook data collected/ analyzed/ published for relevant specialties. • Trainee examination attempts/ pass rates collected/ analyzed and published. • Results of trainee assessments and review collected annually as evidence of progress.	• %Trainers with five or more experience in program. • Trainer to Trainee Ratio • #Trainer holding medical education certificates within a program. • Average trainer years of experience.
4. Trainers MUST be supported in their role by the postgraduate education team and have a suitable job plan with the appropriate workload and time to develop trainees.				• List of allocated educational program directors maintained by the training center. • List of service data on resources available for educational supervision activity. • Service data on inclusion of time for educational supervision in trainer job plans. • Service data on appraisal of educational supervision taken by trainers.	• %Trainer job satisfaction. • Trainer turnover rate
5. Training centers MUST have structures and processes to support and develop trainers.				• Proof of access to various opportunities for professional development and training that would support them in their educational responsibilities.	• %Trainers participating in professional development activities annually.

				• Program data on trainers who have been selected and trained as educational trainers. • Service data on resources available for educational supervision activity.	
6. Trainers Must understand the structure and purpose of their role in the training program of their designated trainees.				• Service data on trainers who have been selected and trained with evidence of training, regular updating, and definitions of responsibility.	•
7. There must be a suitable ratio of trainers to trainees. The educational capacity in the department or unit delivering training must take account of the impact of the training needs of the others, including clinical supervision, adequate time for training MUST be identified in their job plans.				• Service data on trainee/trainer ratios. • Trainee surveys • Trainer serves.	• Trainee to FULL Time trainer ratio

I. Structure (Assessment)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. Assessment regulations MUST clearly specify requirements for: 1.1. Trainee progression and achievement within the approved program.				• Trainees' continuous assessment results. • Trainee board examination results.	• %Trainees who progressed according to their training schedule. • Trainee annual progression ratio (#trainees in a given year as a percentage of total # trainees in the program) • Trainee Completion ratio (#Successful trainee completion program elements / attempted completion times) X 100
1.2. There is a clear procedure for the right to appeal for trainees.				• In Extreme cases (Educational Code blue PI plans and outcomes).	• # Assessment appeals per program annually • % Trainee satisfaction with assessment processes
2. The overall purpose of the assessment system MUST be documented and available.				• Curricula and assessment are defined by program and approved by the concerned scientific committee and concerned SCFHS training department is documented and available to all trainees and trainers and centers.	# Trainers receiving professional development in writing assessment.

3. The choice of the assessment methods **should** be appropriate to the content and purpose of that element of the curriculum				• Trainee assessment forms collected/ analyzed at the trainee annual review.	• # Assessment tools available to accommodate curriculum content requirements.
4. The sequence of approved assessments MUST match the progression through career pathways.				• Trainee surveys. • Trainer surveys.	• % Successful trainee progression from one year to another. • % Trainee Dropout rate • % Trainees mastering 90% of program competencies.
5. Trainers MUST understand and demonstrate ability in the use of the approved in-work assessment tools and be clear as to what is deemed acceptable progress.				• Curricula available to trainers through SCFHS website. • Recording of trainer training in appropriate assessment tools.	• # Trainers trained on various assessment tools.

II. Process (Matching)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. The selection process (which may be conducted by interviews or by another process) MUST: 1.1. Ensure the information about places on training programs eligibility and selection criteria and the application process is made widely available in sufficient time to trainees who are eligible to apply to the program.				• Full details of matching and selection process available through SCFHS & Training Center website that includes; • Details of the program. • Detailed specification and eligibility criteria. • Selection processes and appeals procedures are set out in the applicant guide. • Trainee satisfaction surveys.	• %Trainees Satisfaction with matching processes. • #Matching appeals received. • %Trainees who got accepted in centers as their first choice. • % Trainee acceptance rate.
1.2. Use selection criteria and processes which treat eligible candidates fairly.					
1.3. Select the candidates based on open competition.					
1.4. Have an appeal system against non-selection on the grounds that selection criteria were not applied correctly.					

II. Process (Curriculum)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. Indication should be given of how curriculum implementation will be managed and assured locally and within approved programs.				• Evidence should include the following: ○ Intended use of curriculum document by program director, trainers, and trainees. ○ Evidence pf means ensuring curriculum coverage; ○ Documentation of Recommended roles of the local education provider in curriculum implementation ○ Documentation of trainee responsibilities for curriculum implementation. ○ Curriculum management posts and attachments within approved programs. ○ Curriculum management plans across programs within the center as a whole.	• Average time required for trainees to complete their program.

2. Curriculum MUST describe the model of learning appropriate to the specialty and stage of learning.				• Evidence on general balance of work-based experiential learning, independent self-directed learning.	• #Outcomes to assess Trainee development at a particular stage.

II. Process (Training)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. **Induction**: Every trainee starting a post MUST access a departmental induction to ensure they understand the approved curriculum; how their posts fit within the program; and their duties and reporting arrangements to ensure they are told about departmental policies and to meet key staff.				• Availability of generic induction materials • Availability of training center led general and specialty specific induction programs for new trainees, and recording of attendees – • Availability of departmental (service) led induction program for new trainees, and recording of attendance- to include duties, reporting arrangements, departmental; policies, key staff services. • Trainee survey data on adequacy of induction. • Annual PD reports.	• %Trainee satisfaction with induction process
2. At the start of every post within a program, the program director (or representative) MUST discuss with the trainee the educational framework and support system in the post and the respective responsibilities of trainee and trainer for learning. This discussion should include the setting of aims				• Records of PD/ Trainee meeting minutes. • Trainee surveys • Annual Quality reports. • Program accreditations visit reports.	• % Delivering admission information to prospective trainees.

and objectives that the trainee is expected to achieve in the training post.					
3. Trainees MUST be enabled to learn new skills under supervision, such as skills required for surgical specialties, ward rounds and outpatient clinics.				• Evidence that all trainees are allocated and appropriately trained educational supervisor. • Specialty trainee feedback forms collected/ analyzed/ at annual trainee review. • Trainee survey data. • Annual program reports. • Details of relevant, timetabled, organized educational meetings made available to trainees.	• % Trainees mastering 90% of program competencies.
4. Trainees MUST be able to attend relevant, timetabled, organized educational meetings or other events of educational value to the trainee, as agreed with the program director, and have time protected activities.				• Trainee survey on adequacy of access to timetabled, organized educational meetings. • Annual program reports.	• %Trainees attending relevant educational activities annually.
5. Trainees must be able to access training in generic professional skills at all the stages of their development.				• Data on provision of training in generic professional skills as determined by the program.	• %Trainees participating in developmental programs.
6. Trainees Must have the opportunity to learn with and from other healthcare professionals.				• Evidence of multi-professional courses provided.	• % Trainees engaged in inter-disciplinary activities.

7. The process for applying for a study leave MUST be fair and transparent and information about the appeal process must be readily available.				• Study leave policy.	• %Trainee satisfaction with study leave process. • # Trainee study leave request Appeal request.
8. Trainees must have access to resources to support their health and wellbeing, including; 8.1. Confidential counseling services. 8.2. Career's advice and support. 8.3. Occupational health services.				• Well-being policy within the center. • Evidence of cases that have been counselled. • Evidence of well-being counseling training session provided to councilors.	• #Trainees counselled. • %Trainee satisfaction with wellbeing. process outcome.

II. Process (Supervision)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. Trainees Must have a designated educational supervisor.				• Program statement to define "appropriate clinical supervision by specialty.	•
2. Trainees MUST be appropriately supervised according to their experience and competencies.				• Surveys on adequacy of clinical supervision from the following: ○ Trainee surveys ○ Trainer surveys ○ PD surveys.	•

3. Trainees in training centers MUST have well-organized handover arrangements ensuring continuity duties and patient safety.				• Written handover protocols and audit compliance develop by training units. • Written handover protocols available to all trainees. • Trainee, trainee surveys. • Accreditation program survey reports.	•
4. Trainees **should** be exposed during their training to the academic opportunities available in their specialty.				• Guidance on academic exposure made available by specialties and included in curricula. • Trainee survey on adequacy of academic exposure. • Visit validation reports (Accreditation) on academic exposure.	•
5. Access to confidential counseling services **should** be available to all trainees when needed.				• Information on counselling support on training center & SCFHS website	•
6. Trainers MUST enable trainees to learn by taking key responsibilities for patient management within the context of clinical governance and patient safety.				• Information on counselling support on training center & SCFHS website	•
7. Trainers MUST regularly review trainees progress through the training program, adopt constructive approach to giving feedback on performance and advise on career progression and understand the process for dealing with trainee whose progress gives a cause of concern.				• Trainee survey data on adequacy of feedback. • Annual Program reports. • Trainer survey data on feedback. • Policy supporting trainees in difficulty. • Service policy on supporting trainees in difficulty.	•

8. Trainers MUST liaises as necessary with other trainers both in their clinical departments and within the training center to ensure a consistent approach to education and training and the sharing of good practice across specialties and professions.				• Implementation of educational governance arrangements: educational governance committee.	•

II. Process (Assessment)
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards **ETS1** are implemented and maintained

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
1. Trainees MUST have regular feedback on their performance within each post.				• Record of identifiable trainer time per specialty provided. • Trainee survey data on adequacy of feedback. • Trainer survey data on feedback • Annual program reports.	•
2. Trainees Must have a means of feedback in confidence their concerns and views about their training and education experience to an appropriate member of local faculty.				• Inclusion of feedback information in specialty specific induction sessions.	•

3. Trainers MUST understand and demonstrate ability in the use of the approved in-work assessment tools and be clear as to what is deemed acceptable progress.				• Curricula available to trainers through the training center and SCFHS website. • Assessment tools available for trainers through the training center and the SCHFS. • Recording of trainers training in various assessment tools.	•
4. Assessment MUST systematically sample the entire content appropriateness to the stage of training, with reference to the common and important clinical problems that the trainees will encounter in the workplace and to the wider base of knowledge, skills, and attitudes demonstrated through behaviors that the trainees require.					
5. The choice of assessment methods should be appropriate to the content and purpose of that element of the curriculum.				• Evidence of method choice was considered based on validity, reliability, feasibility, cost effectiveness, opportunities for feedback and impact on learning.	•

III. Outcome
The Institutionally-Accredited Training Center Assumes the ultimate responsibility for ensuring that the minimum Excellence standards in at least **ETS1** are MEASURED and evidence of outcome documentation/ or systems are maintained and regularly reported to SCFHS.

Standard	ETS1	ETS 2	ETS3	Key evidence	KPI
				•	• % Trainees recruited within 6 months of graduation. • % Employer satisfaction with hired trainees • Ratings of the institution and its programs by external accreditors. •

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