Nomadic [Sense]scapes:
Bringing Sensory Healing for Cancer Patients in Rural Canada

by

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NOMADIC [SENSE]SCAPES

TIFFANY TSE

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Concept Photo (C1)

ABSTRACT ●●●●●

Canada is a vast country and home to a wide range of geographical landscapes, from the glacial to the mountainous. While a unique and amazing feature, the expansiveness creates an obstacle for a portion of the population in receiving sufficient treatment for long term health conditions such as cancer. Currently, people located in rural communities are unable to readily access required treatments and are forced to travel long distances, making it both stressful and a financial burden for many patients to receive the proper care. This thesis aims to design a mobile structure, which administers treatments despite the remoteness of location. Through interventions on various scales, the intention is to better service the Canadian rural population by providing a more accessible cancer treatment centre, which utilizes the landscapes of Canada to create a therapeutic and sensory structure that acts as the heart of the community.

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THE ROAD

01

THE ROAD

RURAL ACCESS TO CANCER TREATMENT

When the Canadian government envisioned a national health care system, they believed in a program that would provide the necessary services for all citizens. Canadian Medicare extends to all parts of the country regardless of health status, income, or location. The Canadian Health Act calls for quality care and universal treatment of its population. The nation works vigorously to continue to meet the needs of its people, offering the latest in medical advancements and high-quality treatment. While the overall system is operating successfully, there remains a certain population that requires more attention. The Canadian rural population is key to many industries, supplying the resources and labour that are integral to maintaining the economy. Access to healthcare for the rural community is equally as important for dwellers of cities, but far more difficult to accomplish. A majority of health clinics and hospitals are concentrated near urban centers along the southern regions of Canada, making distance from these the largest obstacle to attaining proper healthcare. A primary health concern is the rapid growth of cancer incidences and mortality. Despite the numerous regional cancer clinics, specialized treatment centres are lacking in rural regions. Certain communities are forced to travel across provinces, towards destinations located upwards of 250 km away. This extensive commute results in patients missing treatments, fatigue, travel expenses, and added stress. There is a need in Canada to bring cancer treatment closer to patients, making medical care

more accessible and comfortable. This thesis discusses the burdens of cancer travel, and design interventions from the extra-large to the small scale before presenting an architectural solution. How may a mobile clinic be designed to transport cancer services to the rural areas of the country? How may the landscapes of these communities be used as a source of therapeutic wellness?

1.1 | Cancer in Canada

The growing rate of cancer incidences and mortality is the nation's largest health concern. Cancer statistics conducted by the Canadian Cancer Society in the year 2017 found that there would be 206,200 new cases of cancer within the year, while 80,800 patients would lose their battle with their illness.¹ On average, 1 in 2 Canadians will develop cancer in their lifetime with 1 in 4 of these patients dying.² Cancer has become the leading cause of death in the country, citing 30.2% of deaths.³ Cancer is mainly a cause of age; however, the illness is not exclusive to the elderly. It is the leader in premature mortality, taking the lives of youth and children alike due to smoking, unhealthy lifestyles and environmental factors. Economically, it is costly for both the patient and government. It is estimated that \$3.8 billion are spent on cancer costs such as drugs, treatments, and medical personnel. An additional \$586 million would be spent for missed work, reimbursing patient costs, as well as death related costs.⁴ Fortunately, conducted research allows more to be known about the illness, and technological advances create more treatment options, providing Canadians with a better chance of survival. Newly implemented cancer screening programs and information seminars help with early diagnosis. The diagnosis of cancer is devastating but the Canadian healthcare system provides the necessary tools for recovery. Approximately 179,000 lives have been saved in Canada due to cancer medical care since 1988.⁵

Figure 1 details the cancer incidence rate.

Figure 2 details the cancer mortality rate within the nation.

▼ (pg 03)

Figure 1: Cancer incidence rate in Canada.

Figure 2: Cancer mortality rate in Canada.

Maps indicate that cancer incidence rates are spread evenly within individual province or territory but rate of mortality is lower in areas where more treatment facilities are located (urban centres). The territories and more northern locations have a higher rate of mortality.

1.2 | Treatment in Canada

Treatment in Canada is offered in a variety of ways. Every patient is given a personal treatment plan designed by their oncologist to suit their individual cancer case. The most common three types of cancer treatment are chemotherapy, radiation, and surgery. Some patients additionally turn to stem cell transplant, targeted therapy, hormone therapy, as well as precision medication.⁶ Apart from take-home medication, many of these treatments must be executed by medical professionals in specialized cancer centres.

1.3 | Canadian Rural Population

Canada facilitates a variety of the required cancer treatments, however gaining access to these procedures is often a long and difficult process. Most of these services are either exclusively located in urban centres, or offered in limited availability due to a lack of space, equipment, and specialized staff. Most graduates of health specialties prefer to work in large cities, making the distribution of physicians uneven. Figure 3 - 8 locates clinics and hospitals which offer treatment services across the country. Refer to appendix for further information on cancer statistics and treatment types.

*Figure 3 - 8 locate
places for treatment
across the nation
▼ (pg 05-10)*

Figure 3: Chemotherapy cancer treatment facilities in Canada.

Figure 4: Radiation cancer treatment facilities in Canada.

Figure 5: Stem-cell cancer treatment facilities in Canada.

Figure 6: Cancer drug pharmacy facilities in Canada.

Figure 7: Light therapy cancer treatment facilities in Canada.

Figure 8: Concentration of therapy locations in urban centres.
Arcs illustrate the movement and travel of patients to a different city in order to receive treatment.

Canada has a rural population of 6 million, with many of their patients seeking assistance in larger towns and cities.⁷ This problem is not limited to rural residences in the provinces, as most cancer treatment options are not offered at all in any of Canada's territories. Locals are forced to travel to neighbouring provinces for the required help. Patients living in remote locations can travel up to 200km one-way for specialized health services.⁸ Unfortunately, studies have shown that the gruelling commute has negative effects on the patients and their willingness to commit to treatment.⁹ In other words, the farther a patient must travel, the less likely they are to receive help and the more likely they are to miss appointments.¹⁰ In addition, the long travel burdens patients with concerns and stress for a means of transportation, time off work, accommodations, and other such considerations that are life-altering decisions. Generally, the greatest concern for all patients is the strain of expenses, meanwhile receiving less income due to sick days. Canadian studies have indicated that on average, cancer patients receive a drop of \$12,000 annually in their income but spend an increased amount of \$20,000.¹¹ A break down estimate of a rural family's expenses over a six-month period can be found in Figure 9. A comparison of the cost of cancer for a rural and urban patients is illustrated in Figure 10. It depicts the many costs which long distance patients must account for in addition to the limited bursaries and scholarships which the government offers for assistance. A major portion of the costs still fall on the patient and their families. While providing a means of more accessible cancer treatment may not dissolve a patient of all its problems, it offers a more convenient and comfortable way of recovery as it aims to reduce stress and allows the patient to focus simply on recuperating.

Figure 9 & 10
Found below illustrating
expenses for a patient
▼ (pg 12)

Figure 9: A list of the average rate of expenses for a patient. A proportional diagram of expenses over a six-month period between a rural patient on the left in green and an urban patient on the right in grey. The lightened area on the rural patient side illustrates the average percentage that the government / charities / organizations may financially assist with.

TRANSPORTATION	24 Trips (Treatment / Tests / Surgery) = 12 000 KM 12 000 X \$0.52/KM (National Average) = \$6240.00
PARKING	\$20 X 48 Days = \$960.00
ACCOMMODATION	48 Nights Accommodation Range \$30.00 - \$80.00 Average \$50.00 48 Nights X \$50.00 = \$2400.00
FOOD	Average of \$75.00/Day X 48 Days = \$3600.00
INCIDENTALS	\$17.30/Day X 48 Days = \$830.40
TOTAL EXPENDITURE	\$6240.00 + \$960.00 + \$2400.00 + \$3600.00 + \$830.40 = \$14 030.40
LOST WAGES	\$350.00/DAY X 45 Days = \$15 750.00

Figure 10: An example of a rural family's six-month expenses.

1.4 | Reaching The Rural

The problem of a large land mass is not unique to Canada. Many countries have dealt with this issue, and different governments present different alternatives to assist with the difficulties of distance. China, Australia, and England are just three examples of countries that made changes to bridge the gap for rural patients. In China, civilians noticed the suffering of their rural peers from the cost and exhaustion of travel, therefore prompting the rise of “cancer hotels”. Located close to urban hospitals, they offer rural families a place to stay during a patient’s treatment for an incredibly low rate.¹² Families are given a private room, but washrooms and kitchens are communal allowing neighbours to create a support network. These cancer hotels are in various urban cities and range in size.¹³ For many small-town patients, these accommodations are the only cost-effective option in receiving treatment outside their community. The government in Australia has also recognized the hardships of traveling and have began to implement pilots on tele-health.¹⁴ This new videoconferencing capability will be made available in rural clinics. It provides patients with the ability to speak to their doctors from their local health centre. Nurses administering treatment can also be in close contact with specialists.¹⁵ This new system has been thus far a success, with patients able to receive treatment locally, reducing their stress and travel. In England, an active solution has been implemented. A mobile chemotherapy unit was introduced in 2015.¹⁶ This truck travels on a specific schedule to certain regions of England, providing treatment within the vehicle. The truck parks at local

Figure 11 illustrating
alternatives which
other countries have
implemented
▼ (pg 16)

grocery stores, plazas, and health centres, and effectively reduces the travel time for many patients. With onboard staff, the vehicle is quickly becoming a popular way for patients in remote areas to receive the necessary treatment.¹⁷ These methods provide positive change and support to rural communities, prompting us to think about our own population. The three examples above illustrate how using architecture as a tool to creatively provide healing spaces and volunteer staffing can assist in making the road to cancer treatment easier. How can architecture and design be utilized as a facet of a suitable solution for Canadians? Is there a design which can not only address the issue of cost and distance but also be immersed in a healing environment and sensory space in itself?

Figure 11: Reaching the rural in other countries.

2

EXTRA-LARGE SCALE

02

EXTRA-LARGE

DEFRAGMENTING THE HOSPITAL

One goal of this research is to design an ease of access to cancer treatment for the Canadian population, who are at a geographic disadvantage from receiving essential medical care. As previously discussed, cancer treatment facilities are located in urbanized centres, and require some patients to travel to neighbouring provinces in order to receive the necessary care. Therefore, the first level of intervention occurs on the extra-large scale – to make healing mobile, allowing patients to remain at, or close to, their homes during this journey. This is accomplished through the defragmentation of the hospital centre, providing accessible treatment to the entire nation.

2.1 | Mobile Architecture

Mobility in architecture has long been explored, citing examples as early as the nomadic homes which allowed a flexible lifestyle for the indigenous people. Tents, teepees, and igloos are just some precedents that illustrate the consideration for mobility in design of the built environment. Since then, trailers, shipping container homes and recreational vehicles have created an entire typology of architecture for designers to explore. Jennifer Siegal, founder of O-MD (Office of Mobile Design) collected two volumes of exemplary mobile architecture to exhibit the many forms and programs which encompass mobility and elasticity.¹⁸ Projects such as the Wa-Sauna by goCstudio and the mobile research centre in Antarctica by Hugh Broughton Architects begin to suggest that mobility can be implemented with more than just residential architecture to adapt to our increasingly nomadic life.¹⁹

Figure 12 More Mobile

by Jennifer Siegal

Figure 13 Wa-Sauna

by goCstudio

▼ (pg 19)

Figure 12: Jennifer Siegal's publication "More Mobile" compiling the most intriguing forms of mobile architecture.

Figure 13: Wa-Sauna by goCstudio, a mobile sauna unit.

2.2 | Health and Mobility

The Canadian healthcare system has recently explored mobility in its design to make basic health services accessible to a wider population. Many mobile clinic concepts have been investigated and developed. However, due to funding, personnel and scheduling, most mobile health units are quite sterile and basic. They are commonly fit into existing vehicles and serve as an outer shell with the primary function of housing medical equipment, while responding to the space requirements mandatory for a clinic. For example, Vanguard is a British company that provides deployable health clinics for emergency use.²⁰ Each unit is a simple white shipping container and must remain in its location until disassembly. Their definition of mobile is limited and constricting. These clinics are mobile in the sense of being disconnected from the hospital, but they lack the ability to be mobile when completed and in use. This is the case for most “mobile clinics”. First, the units are designed to be easily shipped to one specific location, but cannot travel or be transported once they are in full form. Second, the feature of mobility often limits the design of healing spaces. The need to be a container of medical equipment creates lacklustre and banal designs. They are built without the benefits of architecture and design to create a sense of space while maximizing efficiency and functionality. A Danish firm, KHRAS Architects, conceptualized a mobile clinic for sub-Saharan Africa that is flexible for expansion and easy to move.²¹ This project, as well as other similar ones begin to consider the ability for mobile and healthcare architecture to be resolved together in order to mobilize health services.

Figure 14
Mobile health clinic
by Vanguard
▼ (pg 21)

Figure 14: An example of Vanguard's deployable health clinic.

Figure 15: The mobile mammography vehicle by the British Columbia Cancer Agency.

Figure 15
British Columbia mobile
mammography vehicle
▲ (pg 21)

In Canada, mobility in medical or health care architecture has been previously tested to solve the problem of distance. For example, in British Columbia, two digital mammography vehicles were deployed in 2016 to better service remote areas.²² The mammography equipment and clinic are placed onto a coach bus and travels to various communities on a set schedule. Women who want to be screened may book an appointment when the mobile coach is at the most convenient location.²³ The Canadian Red Cross also has a mobile health clinic that offers health assistance to regions in emergency conditions. In partnership with the French Red Cross, the clinic is designed to fit within a shipping container or a recreational vehicle.²⁴ The unit offers treatment of minor wounds, immunization, infections, chronic diseases, and preventative measures. This mobile clinic also provides some trained and experienced workers in order to operate.²⁵ In addition, some medical organizations have created a mobile medical unit within expandable buses and trailers in certain provinces. These units are for emergency purposes and treat minor health problems. These examples illustrate the problem of travel being solved functionally, but not using architectural design to its full potential to create a healing space. These different scenarios offer a basic foundation on which mobility and healing architecture can be incorporated with a cancer clinic.

Figure 16: An illustration of Canada's vast and rich landscape.

2.3 | Transportation

Canada is a vast country. The westernmost Canadian community is Beaver Creek, Yukon at $140^{\circ} 52' 46''$, while the easternmost community is St. John's Newfoundland at $52^{\circ} 39' 26''$. Additionally, the northernmost community is Alert, Nunavut at $82^{\circ} 29' 50''$. Many different modes of transportation are therefore required to get to Canada's furthest regions.²⁶ Currently, various forms of transportation and shipping are available and can be studied to develop a mobile cancer clinic. Existing highways and railroads will allow for the unit to reach mountainous and northern neighbourhoods, while planes and ships may provide access to communities presently inaccessible by roads. Through the use of these modes of transportation, many towns will be able to receive adequate care and treatment. An exploration study of four different landscapes and sites illustrates possible ways in which units are shared among communities and the different transportation methods that can be utilized to make the unit versatile and capable of reaching the ends of the country.

Bay D'Espoir Area, Newfoundland

A coastal region within the Coast of Bays Newfoundland, the group of small communities have a population of just over 2500 people.²⁷ These communities are inaccessible externally by roads, and can only be reached using ferries and boats, on nearby waterways. Residents are mostly retired, and those who are cancer patients are required to travel over 500 km to Saint John's to receive treatment.²⁸ Therefore, the transportation method to be explored in this region is a boat-like structure. The boat would be shared between certain towns and travel from community to community to offer necessary cancer treatment, reducing the amount of travel for patients. Figure 17 - 19 shows a site and a route map of the cluster of communities that could share this boat as well as an illustration of the boat's hypothetical formation.

Figure 17-19
Found in pages below
▼ (pg 26-28)

Figure 17: Map of shared unit routes, communities in Bay D'Espir, Newfoundland.

Figure 18: An illustrative study of communities in Bay D'Espoir, Newfoundland, shared unit location map.

Figure 19: An illustrative study of communities in the Bay D'Espoir, Newfoundland area, view of shared unit.

Inuvik Area, Northwest Territories

The Inuvik area is in the Northern Delta region of the Northwest Territories. The Northwest Territories does not house any cancer clinics, but has access to an airport, and is home to around 3500 people. Cancer patients must travel to the neighbouring provinces of Alberta, or Manitoba for any form of treatment, or procedure.²⁹ In this study, the transportation method of a unit on sled or wheel, weather-dependent, is to be implemented. The unit can be originally deployed by air but will allow for local transport as a sled, or car. This study illustrates the versatility of a unit that can provide treatment to even the most northern areas of Canada and across wintery conditions. Figure 20 - 22 is a map, which illustrates the communities sharing the mobile unit as well as the way the unit would possibly take form.

Figure 20-22
Found in pages below
▼ (pg 30-32)

Figure 21: An illustrative study of communities in Inuvik, Northwest Territories, shared unit location map.

Figure 22: An illustrative study of communities in Inuvik, Northwest Territories area to share a unit.

Tumbler Ridge, British Columbia

Tumbler Ridge, located in British Columbia, is a small region close to Chetwynd and Lone Prairie. The region holds close to 3000 people. Residents in this area must travel over three hours to Prince George to receive basic cancer treatment when needed.³⁰ For more specialized and rare procedures, patients must travel to Vancouver. A railway from the BC Pacific Railway runs through the community. Therefore, this study proposes the possibility for the mobile unit to be placed on a passenger car of a train. This would allow the unit to be accessible to all small towns with access to a connecting railroad. Figure 23 - 25 illustrates the Tumbler Ridge area which would share the mobile unit, but more importantly, that a passenger car is an option in delivering care to small communities.

Figure 23-25
Found in pages below
▼ (pg 33-35)

Figure 23: An illustrative study of communities in Tumbler Ridge, British Columbia, shared unit routes.

Figure 24: An illustrative study of communities in Tumbler Ridge, British Columbia, shared unit location map.

Figure 25: An illustrative study of communities in Tumbler Ridge, British Columbia, view of shared unit.

Blind River, Ontario

Northern Ontario is an area that suffers from a consistent lack of facilities to service its large population. For example, the Blind River region near Killarney, Ontario is facing a strain in hospitals due to a recent campus closure. The population of the area is around 15 000, and patients must frequently transfer to Toronto due to a lack of resources.³¹ The community has highway access, therefore the form of travel studied in this location is a mobile unit which can be shipped by truck. Units can fit on cargo trucks and can be transferred from town to town. Figure 26 - 28 is a site map, and a route map showing the evolution of form, and the mobility of a possible unit.

Figure 26-28
Found in pages below
▼ (pg 38-40)

The four sites and locations serve as an illustration of the various ways in which the mobile cancer clinic can be implemented using existing transportation methods, in order to reach the furthest and most inaccessible parts of Canada.

Figure 26: An illustrative study of communities in Blind River, Ontario shared unit map.

Figure 27: An illustrative study of communities in Blind River, Ontario shared unit location map.

Figure 28: An illustrative study of communities in Blind River, Ontario, view of shared unit.

3

LARGE SCALE

03 | LARGE COMMUNITY

When buildings are built in rural communities, it is customary for these communities to be involved for greater success. Projects have been proven to be more successful when the community can become a bigger part of its use. The mobile cancer clinic will draw from the abilities and skills of the community to facilitate its services. In addition, the hub will act as a central space to promote the collaboration and interaction of the community. This will allow residents to better understand issues of health and wellness, be a part of the healing process, and generate a less lonely cancer journey. The second intervention is at the large-scale. Community involvement is crucial in making the unit functional and in anchoring it at the heart of the community.

3.1 | Community Architecture

Providing a mobile clinic to smaller towns requires the active participation of the community with the purpose of being self-sustaining. Bringing in public programming to connect the people provides a sense of unity and communal strength. Additionally, the duration of cancer treatment can be a desolate time; the presence of peers reduces their loneliness and grants patients and their families opportunities to console and share in the experiences of others. The mobile unit further connects the many communities that share its facilities, producing a larger circle of peers. It allows architecture to be truly for the people and act as a catalyst for change, regenerating and bridging the various towns. Over the years, community participation has consistently been a part of creating architecture but not in its programmatic use. Many projects have failed to include more malleable environments to create spaces for less specific functions, enabling the community to shape it for themselves. The sense of community allows architectural projects to act as more than a simple building, but rather as a space for people to interact and partake in the narrative of others. The mobile cancer clinic acts as a bonding mechanism for linking communities and making cancer an experience where people may share in their hardships and burdens.

3.2 | Precedents of Community Architecture

In the past, various projects participated in community architecture, designing with and for the community to create functional and feasible built environments. When planning for a new library, a region in London, England recognized the importance of providing more than a simple library program to encourage use. They wanted a space for people to actively interact and socialize, therefore creating The Idea Store – mainly a library, which also possesses space for community programming, events, and activities as well as adult learning courses.³² The extensive programming constructs a communal heart, bringing in a wide range of visitors, connecting the neighbourhood and its people. The public may also be a part of running the facilities to create a sense of communal ownership, reducing the possibility of vandalism and ensure better maintenance. For example, the Rural Studio of the School of Architecture, Planning and Landscape Architecture at Auburn University holds a strong community relationship to create long-lasting and successful projects.³³ The studio, co-founded by Sam Mockbee has actively worked with its client, in small communities of Alabama, to develop and construct projects with the users offering up their skills and resources for the projects' benefit. One of Auburn University's Projects - the Akron Girls and Boys Club, completed in 2001 – is designed as a space for the townspeople.³⁴ The 1500 sq ft recreational space is a central hub for interaction and play. Beyond considering the people in the design of the space, the townspeople were organized by the studio into a committee to run, maintain and direct the club.³⁵ Today, the Girls and Boys club remain actively used and a beneficial architectural piece in the community. The space is flexible for multi-functional programming, and it is a core location for community events. Therefore, the proposed design project will involve the townspeople heavily in its use, from managing the facility to providing an environment, which welcomes local programming and invites the public to participate.

Figure 29
A sense of community
at the Idea Store
Whitechapel
▼ (pg 45)

Figure 30
A community event at
the Akron Girls
and Boys Club
▼ (pg 45)

Figure 29: The Idea Store Whitechapel hosting a community event.

Figure 30: The Akron Girls and Boys Club acts as a communal hub brining the community together for various activities.

3.3 | Community Architecture in Nomadic [Sense]scapes

In the application of a mobile cancer clinic, the townspeople will be included to create a centre for communal interactions as well as a unit, which connects neighbouring small towns. The primary goal is for the design of the unit to emulate a home, to include non-clinical spaces for family members and the mass public. This involvement will enable the unit to be more than just a clinical environment, but rather a centre for people to experience and communicate with others. These common household spaces such as a kitchen and a living room generate a sense of home, familiar and comfortable, which alters the general association with the heaviness of cancer treatment. This prevents users from feeling displaced, or experiencing the feeling of entering a foreign environment when going for treatment. Moreover, when visiting a clinic, conversations with fellow peers are frequently about health and wellness. Therefore, supplementary flexible spaces provide an opportunity for community events and public activity. It facilitates interaction and dialogue to be about more than health and treatment. The space will be in continual use and tailored for community involvement and programming to guarantee the participation of the people. Secondly, the community will be a part of running the facility and keeping the space functioning. This will include hiring qualified members of nearby communities for specialized personnel as well as training new members for additional positions. The townspeople can be organized to maintain the space, accompany patients, be directly a part of the process of healing, and offer community classes to better understand health. A large obstacle for more rural patients is the lack of physical contact due to the travel distance in reaching their next neighbour. Often, when one travels to a distant treatment

facility, being surrounded by strangers creates a sense of loneliness. Further, the mobile clinic is also networking all the communities, which share its facility to create one large neighbourhood. This enables areas to be connected to other regions, making it less isolating, more resourceful and providing a larger sense of comradeship. Townspeople have the ability to connect with people and communities close by. This final point of participation allows patients to feel less alone by interacting with familiar people when receiving their treatment. The dual programming will also allow the centre to be associated with a place of gathering, support and positivity, alleviating the process of receiving the cancer treatment, and contributing to their overall psychosomatic health. Through the various points of interaction and participation from the community, the treatment facility will be better integrated into the community and provide a form of regeneration to the townspeople.

An aerial photograph of a coastal town, likely in Norway, featuring a harbor with several boats, a small boat with the number 82, and a hillside with houses and trees. A large white number 4 is overlaid on the image, partially obscured by a yellow border and a series of vertical green bars of varying heights and shades. The text 'MEDIUM SCALE' is also visible in the lower right area.

4

MEDIUM SCALE

04

MEDIUM

THERAPEUTIC LANDSCAPES

The importance of nature in the process of healing has long been documented. Increasingly, architects and designers are creating environments which promote nature as a major component of good mental health and well-being. Examples such as large operable windows, living walls, and green spaces all contribute to making nature more accessible, granting people the chance to experience the natural environment even while spending large amounts of time indoors. Many studies have shown that the proximity to and interaction with nature is often beneficial to health.³⁶ In the mobile clinic, the use of therapeutic landscapes not only produces a calming environment but can create a dynamic space for the long treatment times, giving patients and users something else to focus on. The third intervention is on the medium scale, to blur the boundaries between interior and exterior, and use the landscapes of the nation as a form of therapy.

4.1 | Nature & Healing (Studies)

The exposure to nature can have quite positive effects on human health. Many studies have shown that proximity to nature can create a healing atmosphere, which is beneficial to all people. Dating back to 1984, environmental psychologist Roger Ulrich illustrated that gardens can improve healing.³⁷ His continual research in 1993 proved that heart surgery patients with views of nature utilized less pain medication and were less anxious.³⁸ Medical doctor and immunologist, Dr. Esther Sternberg, a Professor of Medicine and Founding Research, analyzes in her book *Healing Spaces* the many ways in which nature can provide a more regenerative environment.³⁹ First, the experience of nature can reduce stress. Stress can considerably decrease the body's

ability to fight harmful illnesses and bacteria, therefore creating a stress-free atmosphere encourages a place where health is cultivated.⁴⁰ Second, nature triggers a sensory experience, which causes positive mental and physical reactions, releasing endorphins and producing a sensory environment.⁴¹ Jain Malkin, a leader in healthcare design and former teacher at Harvard University, reiterates this concept, stating that healing is directly linked to human emotions, which are impacted by one's surroundings. Spaces which draw in elements of nature are better able to reduce stress and provide an "environment that is psychologically supportive."⁴² She further discusses the role of nature by including it in her points in creating a therapeutic environment, stating that "connecting patients to nature with views to the outdoors, interior gardens" as her second priority.⁴³ Similarly, Naomi Sachs and Clare Cooper Marcus, authors of *Therapeutic Landscapes*, list the various ways in which nature can contribute to a healing environment. They are clear to say that "Spending time interacting with nature in a well-designed garden won't cure your cancer, or heal a badly burned leg. But there is good evidence it can reduce your levels of pain and stress—and, by doing that, boost your immune system in ways that allow your own body and other treatments to help you heal."⁴⁴ Through these various evidence-based design research, it can be seen that the natural environment is a crucial component when designing an atmosphere of healing.

Figure 31: A framed view of natural landscapes to act as a form of therapy.

A close proximity to nature has been proven to contribute to healing and act as a distraction to calm patients.

4.2 | The Maggie Centre

A famous example of the use of nature in the process of healing are the Maggie Centres. Located in various locations in the United Kingdom and Hong Kong, and designed by notable architects across the world, the Maggie Centres act as “practical, emotional and social support” for cancer patients and their families.⁴⁵ Founded by a cancer patient, Maggie Jencks and her husband Charles Jencks, the idea stemmed from Maggie’s own experiences of health spaces. She believed that a beautiful space was necessary even in times of crisis.⁴⁶ The centre has programming that includes classes for understanding cancer, caring for cancer patients as well as exercise classes and cooking classes that cater to healthy living.⁴⁷ These centres provide a place of gathering and support for patients, allowing people affected by cancer to be in the presence of, and surrounded by their peers who understand their experiences. The architecture of the Maggie Centres revolves around landscapes, where nature holds a prominent role in its design. Norman Foster’s Manchester Maggie Centre engages the outdoors through a wood building, with an abundance of daylighting and an all-glass area to fully immerse in the pleasures of nature.⁴⁸ Both dRMM’s design for the Oldham centre and Frank Gehry’s Hong Kong design is based on the idea of a courtyard filled with nature.⁴⁹ The Oldham Centre utilizes undulating glass walls and lifts the building on stilts to focus on nature and daylight, allowing views and an immersion into nature all around. The outcome is an organic and powerful relation to nature instilling a sense of peace and serenity. In the Hong Kong Centre, the classical gardens of Suzhou inspire the space, with a central pond surrounded by trees and nature.⁵⁰ Various other Maggie Centres have used nature as a central scheme to their designs, illustrating the importance of the relation between the natural environment and healing.

Figure 32 Nature at the
Oldham centre

Figure 33 Garden at the
Hong Kong centre
▼ (pg 53)

Figure 32: Oldham Maggie Centre by dRMM builds the space around maximizing views to its courtyard.

Figure 33: Hong Kong Maggie Centre by Frank Gehry is inspired by the prominence of nature in the traditional Chinese courtyard space.

4.3 | Therapeutic Landscapes in Nomadic [Sense]scapes

Incorporating nature into medical facilities has increasingly become more widespread and popular. Many healthcare facilitators and designers have recognized its importance and contribution to a healing environment. However, as Cooper-Marcus has identified: “architects have become adept at introducing nature into health centre lobbies, but examples of it in treatment settings are rare indeed. Our ultimate goal in designing healing environments is to reduce stress.”⁵¹ Many design principles have been included into medical environments, but are generally not directly integrated into the stages of treatment. The goal of this medium scale intervention is to bring in elements of nature through design in environments of diagnosis, treatment, and recovery. In healthcare architecture presently, the greatest principle is the use of large windows for views to gardens and courtyards as the main connection to therapeutic landscapes. Due to location, courtyards, terraces, and gardens are implemented into designs to create therapeutic views. Additionally, other spaces use artificial plants, while digital screens are placed around the space to create the illusion of nature’s close proximity. The mobile unit will be aiming to maximize the landscapes and natural surroundings of the neighbourhood, while creating architectural moments which encourage healing through direct interactions with nature. The goal is to provide a low-stress environment focused on relieving anxiety and producing moments of reflection and serenity for its visitors. Creating atmospheres in the mobile centre that are therapeutic and promote a stable healing process, which is essential in order to provide a soothing and relaxing place for the treatment of cancer patients.

5

SMALL SCALE

05

SMALL

SENSORY ATMOSPHERES

The interior of clinics and health spaces are often sterile and barren to provide maximum functionality and practicality. Patients and their families enter into a strange and unfamiliar space, making it a depressing atmosphere. The goal of this intervention is to use appropriate materials in creating a familiar environment, making people feel more at home, resulting in an uplifting clinic which encourages the journey of healing. The purpose is to alter the stigma of receiving treatment, making patients feel less sick and normalizing the process. In addition, material selection will create a sensory environment, both heightening and reducing the sensorial stimulation as needed under the circumstances to make a comfortable and dynamic environment. The final intervention is on the small-scale, to use materiality and tectonics to create a treatment facility, which emulates a second home, and to create a sensory healing environment, making patients feel calm, less anxious and more at ease.

5.1 | Senses and the Built Environment

Design professionals have continuously called for designs to include a more personal and interactive connection between people and their built environment. Architecture should not just facilitate activities but “trigger physical, physiological and psychological wellbeing.”⁵² Buildings and installations have been implementing principles to create a deeper meaning to every building, triggering a narrative for individuals. A prominent call is to design for all senses; creating spaces which prompt feelings in all our senses will generate a more personal and connective atmosphere. Our senses are the conduits through which we perceive the world. In contrast, architecture is often designed exclusively for the visual experience. By designing for all the senses, architecture immerses visitors in a more comprehensive journey through the spaces. Sternberg highlights the importance of the senses in creating a sense of place. “Our perception of place is created by our emotions and memories. Each of these emotions triggers cascades of nerve chemicals and hormones, which are released through the outflow pathways of the brain. These in turn change immune cells’ ability to fight disease, or heal, and all affect our health.”⁵³ Therapy and healing are greatly affected by emotions and feelings, and the senses assist in producing these emotions, making them an essential component in design.⁵⁴ Sternberg outlines how various design components prompt the senses and can be altered to create a healing environment. In terms of sight, extreme lighting can create confusion, while direct light can make patients look tired. Specific colours can be disturbing, while others are calming.⁵⁵ Railings provide a touch of safety and material changes

allows patients to register the change in environment. Sounds have an affect on how nervous one is, while depending on the function, sounds should be enhanced and clear, or reduced and blurred.⁵⁶ Buildings are meant to provide both physical and mental stability, while providing a feeling of happiness, and reflecting a positive human environment.

5.2 | Sensory Architecture

Senses are becoming more relevant in architecture and design. Growing amounts of architects are considering the ways in which all of our senses perceive spaces, and creating atmospheres, which prompt more than visual stimulation. Finnish architect Juhani Pallasmaa, stressed the importance of the senses and architecture. His design of the Moduli 225 with Kristian Gullichsen, an industrial summer house, illustrates the effects of incorporating sensory triggers in design.⁵⁷ The use of wood creates a warm texture and odour in the environment, while the various ceiling voids offer a play on light, with the sun providing a choreography of shadows. Even in a small environment, and utilizing a basic form, Pallasmaa can create a dynamic and pleasant atmosphere through his selection of materials and the ways in which he applies them. Another highly sensory building is the Bruder Klaus Field Chapel by Peter Zumthor.⁵⁸ All senses are stimulated in the experience of this small building. The building includes many design details, which prompt emotions and memories through the senses. The oculus inviting the sun to cast shadows and rays, the rain streaming in, the rippled texture of the negative space created by the concrete cast of the logs, the burnt smell of the logs and the charcoal stained walls creates a unique atmosphere and experience.⁵⁹ Through these intricate details, the triggered senses will alter the emotions and in turn strengthen cells which affect our ability to heal, and the way we feel. For the mobile unit, it is vital to consider materials and spaces which can evoke the senses to encourage a healing atmosphere.

Figure 34
A warm atmosphere at
the Moduli 225
▼ (pg 59)

Figure 35
Oculus at the Bruder
Klaus Field Chapel
▼ (pg 59)

Figure 34: Moduli 225 by Juhani Pallasmaa and Kristian Gullichsen illustrates the difference architecture for the senses can create.

Figure 35: Bruder Klaus Field Chapel by Peter Zumthor creates an architectural experience for all the senses.

5.3 | Sensory Atmospheres in Nomadic [Sense]scapes

The goal of this thesis is to produce an accessible healing environment for all people. Therefore, the interior atmosphere, the emotions and feelings are vital to the success of the design. The unit will utilize materiality and tectonics to create an inviting and positive atmosphere to reduce stress and anxiety while producing a supportive and uplifting environment. In addition, it is important to create an environment that caters to the senses of a cancer patient. During the journey of cancer and treatment, certain senses become heightened and diminished. For example, a patient's sense of taste and smell is often altered, making certain scents smell and taste different. One's sense of touch can also change, sensitivity to heat and cold can become heightened, making one's touch become painful.⁶⁰ In these examples, selection of materials may be useful in order to create a more comfortable environment. Natural materials such as pine and birch may contain attractive scents that may be used to overcome the chemical and sterile scents associated with hospitals. It may also provide a sense of comfort and familiarity to those within the clinic. Soft materials such as cork can moderate temperatures, making it pleasant to the touch. The complementing of materials can create a lighter atmosphere, which reduces its clinical resemblance, and creates a more flexible environment utilized for both medical and community activities. Sound is also crucial, as excessive noises can generate feelings of anxiety. Therefore, installation of acoustic panels and felt can be utilized in certain areas to create a serene and peaceful space. The use of details to create a sensory atmosphere can give rise to a space for patients and their families to be comfortable as they spend long hours within its walls.

Figure 36: Nomadic [Sense]scape sensory levels diagram.

6

DESIGN PROJECT

The design proposal aims to achieve three main goals:

1. To create a treatment centre which is accessible to people in rural areas;
2. To create a space which is familiar and welcoming;
3. To use the architecture and the surrounding site itself as a form of healing and therapy.

One of the previous sites studied in chapter two, will serve as an example of the ways in which the many scales can be integrated into the mobile clinic. The selected site will be in Bay D'Espoir, Newfoundland. The design investigation takes place in the east coast, in a set of communities specializing in aquaculture.⁶¹ People who currently require cancer treatment and specialized services in this region generally must travel 550 km to Saint John's, Newfoundland. This causes fatigue, added expenses, and creates an additional burden to one's already difficult journey.

The design concept originated through dividing the various processes that take place over the course of cancer development. It was found that many of these procedures can be placed under three main stages: diagnosis, treatment, and recovery. These three phases will be served by different spaces and should be considered in not just medical terms as the design is meant to be more than a medical clinic. The design proposal is in part about altering the mentality of cancer treatment. Therefore, diagnosis is not only about the introduction of cancer, but about the discovery of the treatment phase as a journey, and the recovery phase as the regeneration of body, mind, community, and the therapeutic sensescapes. These three

The three stages and their dual meaning in concept diagram below
▼ (pg 63)

DISCOVERY

DIAGNOSIS

STATIONARY

DISCOVER NATURE

FLEXIBILITY FOR
PERMANENCY

Concept Photo (C2)

JOURNEY

TREATMENT

MOBILE

JOURNEY OF SPACES

TEMPORARY

REGENERATION

RECOVERY

STATIONARY

REGENERATION OF
COMMUNITY

FLEXIBILITY FOR
PERMANENCY

pieces come together to formulate the design. After several studies, it was determined that a small permanent environment was necessary to facilitate certain resources. The discovery and regeneration spaces are a part of this stationary location as they do not need to be visited as frequently by patients. They will hold clinics and interchangeably act as a gathering space, creating an environment where the community can come together, connecting local towns and creating a more positive environment. It is a place to discover cancer, but it can also become a place to discover the surrounding landscape, friendships, and new narratives. It creates an atmosphere where one regenerates its mind, but also where the idea of community can be re-established. The mobile unit will move from community to community to facilitate the townspeople in treatment. It is not only a journey of the treatment process but a journey between spaces and communities.

In this east coast example, the mobile unit will be designed based on a floating home, a houseboat, which travels in the coastal waters between neighbouring communities. The goal of being mobile entails that the unit needs to be accessible even during the winter. During the colder months, when the water does become frozen, the boat will become a sled, based on a glacial vehicle and ice fishing shanty. The unit will be motorized to allow for it to continue to journey throughout all seasons. This mobile unit will carry various treatment options, and will visit towns to allow patients to remain at home while they receive treatment. This scheduled houseboat can also act as a form of transportation method to bring people to the communal centre, allowing them to have access to diagnosis procedures and be connected to their peers, participating in various events.

The aim of the design for the treatment facility is to be home like, not only to create an atmosphere familiar to patients, but to create a space which encourages dialogue, facilitating activities between its visitors and community members. Programmed like the home, it holds such areas as the kitchen rather than a canteen, a living room rather than a waiting room, and a quiet discovery walk rather than a banal corridor. It aims at changing the association of cancer treatment with a sterile and barren environment. Instead, it aspires to promote an uplifting atmosphere, one which is about familiarity, positivity and journeying together. In addition, a big part of therapy and regrowth is the ability to be meditative. Contemplative spaces are present in the design to allow for staff, caregivers, and patients to be self-reflective as well as to allow for quiet conversation. In both the permanent and mobile unit, it offers environments, which maximize views and frames the landscapes beyond, to create a dynamic and controllable environment. Due to the long hours one may be at the facility, the relationship to nature and landscapes makes a compelling environment, which is captivating. Materials selected are warm and commonly found to better emphasize the idea of familiarity and home. These materials such as wood, bamboo and cork, are warm to the touch and offers various sensory stimulations in odour, tactility, acoustics and visuals, contributing to the overall warmth of the architecture. The news of cancer can be disheartening, but given a more inspiring and comfortable environment can make the process easier.

The following drawings and visuals, will help illustrate and explain the design and atmosphere of Nomadic [Sense]scapes.

A

**DRAWINGS
&
VISUALS**

Figure 37: Nomadic [Sense]scape exterior view.

Figure 38: Site Plan showing boat by the dock and community space.

Figure 38: Site Plan showing boat docking and permanent community space.

MOBILE CLINIC ●●●●●

Figure 40: Section of clinic

Figure 41: Section of clinic

0M 1 2

Figure 41: Section of clinic

Figure 42: Diagram of mechanism for transportation through all seasons.

Figure 43: Diagram of mechanism for transportation in water and on ice.

Figure 44: Nomadic [Sense]scapes mobile unit - entrance looking into the waiting space.

Figure 44: Nomadic [Sense]scapes mobile unit - entrance looking into the waiting space.

Figure 45: Nomadic [Sense]scapes mobile unit - interior portal looking through space.

Figure 45: Nomadic [Sense]scapes mobile unit - interior portal looking through space.

Figure 46: Nomadic [Sense]scapes mobile unit - interior treatment area (window louvre closed).

Figure 46: Nomadic [Sense]scapes mobile unit - interior treatment area (window louvre open).

Figure 47: Nomadic [Sense]scapes mobile unit - interior treatment area (closed)

Figure 47: Nomadic [Sense]scapes mobile unit - interior treatment area (open)

Figure 48: Nomadic [Sense]scapes mobile unit - interior examination room.

Figure 49: Nomadic [Sense]scapes mobile unit - treatment space.

Figure 49: Nomadic [Sense]scapes mobile unit - treatment space.

COMMUNITY SPACE ●●●●●

Figure 50: Community space plan

Figure 51: Section through community space.

Figure 52: Nomadic [Sense]scapes community area - interior entrance view.

Figure 52: Nomadic [Sense]scapes community area - interior entrance view.

Figure 53: Nomadic [Sense]scapes community living room.

Figure 53: Nomadic [Sense]scapes community living room.

Figure 54: Nomadic [Sense]scapes community kitchen space.

Figure 54: Nomadic [Sense]scapes community kitchen space.

Figure 55: Nomadic [Sense]scapes discovery passage.

Figure 55: Nomadic [Sense]scapes discovery passage.

Figure 56: Nomadic [Sense]scapes community discovery passage.

Figure 56: Nomadic [Sense]scapes community discovery passage.

Figure 57: Nomadic [Sense]scapes community regeneration space.

Figure 57: Nomadic [Sense]scapes community interior regeneration space.

Figure 58: Nomadic [Sense]scapes regenerative employee space.

Figure 58: Nomadic [Sense]scapes regenerative employee space.

Figure 59: Nomadic [Sense]scapes regenerative employee space.

Figure 59: Nomadic [Sense]scapes regenerative employee space.

Figure 60: Nomadic [Sense]scapes mobile unit in motion.

06

CONCLUSION

NOMADIC [SENSE]SCAPES

Large amounts of resources are directed to cancer research annually, and while better methods of treatment continue to be discovered, cancer remains to be a large health issue within the nation. Since cancer affects a significant amount of the population, it is important to provide aid in the journey of healing. While architecture cannot resolve cancer, it can serve as a supportive remedy to make the road more comfortable and less intrusive. One of the largest obstacles for cancer patients currently is the long distance they must travel to reach a treatment facility. The above design suggests assisting with this problem through interventions on various scales:

- Extra-Large Scale: Reducing the travel distance and expense through bringing treatment to patients;
- Large Scale: Integrating the aspect of community into the journey of healing;
- Medium Scale: Utilizing the surrounding natural landscape as a form of therapy;
- Small Scale: Making the treatment facility feel like a home, creating an atmosphere to provide sensory healing.

The use of multiple scales helps in addressing problems on various levels. Through these recommendations, patients and their caregivers can be immersed in environments, which promote a positive response. It creates the opportunity to alter the negative implementations of cancer treatment, dissociating it with banal and sterile clinics, but rather with uplifting and community spaces. Coming into contact with cancer patients and understanding the lengthy periods of time one may stay

in a medical space has made me realize the importance of creating environments, which are enjoyable and comforting. Spending on average six to eight hours sitting in the same space requires a dynamic and engaging atmosphere. Healthcare designs have continuously improved to provide healthier and more convenient places for patients and visitors. Therefore, the goal of this thesis is to make cancer treatment mobile and comfortable. The unfamiliarity of treatment facilities can be mitigated to provide a warmer space for the operations of the clinic. While this project is not a singular solution, and there could be many ways to address the design of the space to provide comfort and respite to patients and communities, it illustrates that architecture can be used as a powerful tool to assist in making spaces pleasant, altering the way in which visitors feel. Whether for highly specific, or for technical environments, architecture can make people feel a certain way. For healthcare programming, where people may already feel nervous, uneasy and in pain, design can make the transition easier, offering spaces of hope that are less intimidating and more enjoyable. Thoughtful spaces allows people to forget about their troubles ever so slightly. It is critical to strive to create atmospheres that are dedicated to healing people emotionally and physically.

7

APPENDIX

APPENDIX ●●●●●

RATES OF CANCER: FEMALE

APPENDIX ●●●●●

RATES OF CANCER: MALE

APPENDIX ●●●●●

CANCER TREATMENT ACCORDING TO CANCER TYPE

APPENDIX ● ● ● ● ●

CANCER TREATMENT TYPE

CHEMOTHERAPY

A common treatment option is chemotherapy, it targets cancerous cells. It aims to stop or slow down the rapidly dividing and multiplying cells. These drugs are used in combination, as some cancer cells may be resistant to certain drug families. These drugs are directly placed via a cream or ointment, as a pill, or through injection.⁶²

RADIATION

Due to the different reactions of both cancer cells and regular cells to radiation, this form of therapy uses the energy waves and particles to repeatedly damage the cancerous cells. As regular cells may regenerate daily, these cancerous cells will be unable to repair itself.⁶³

SURGERY

When the cancer has yet to spread, surgically removing the cancer is quite effective. In addition to the cancer, a tissue called the surgical margin will also be extracted to ensure complete removal of the cancer, reducing chances of reoccurrence.⁶⁴

IMMUNOTHERAPY

Biologically, our immune system can fight cancer cells however, the cancer may be able to disguise as a regular cell and cause the system to malfunction. Immunotherapy is the build up and restoration of one's immune system to better find and attack the cancer. The drug is taken as a pill, a vaccine, or topically applied at home or in a clinic and may be used with other forms of therapy.⁶⁵

TARGETED THERAPY

Cancer cells grow due to certain molecules that communicate signals to the cancer cells, instructing it to grow or multiply. Targeted therapy is the use of drugs to target these molecules to intercept their signals. It can be taken in the form of a pill or vaccine, however it is almost always utilized with another form of treatment as the molecule must accurately match the drug given.⁶⁶

HORMONAL THERAPY

Cancer cells often need hormones to grow, therefore hormonal therapy reduces, adds, or intercepts hormones to idle the growth of the cancer cells.⁶⁷

STEM CELL TRANSPLANT

For various forms of blood cancers, stem cell transfers are used to replace blood forming stem cells. In addition, this form of therapy may be used when the stem cells are damaged by other cancer treatments or the cancer itself.⁶⁸

PHOTODYNAMIC

For certain forms of skin cancer, a photosensitizer drug is used to attack cancer cells. The cells become sensitive to light causing them to be killed once they are exposed to red light or regular daylight.⁶⁹

PHOTOABLATION

Photoablation is the use of a laser to cut or vaporize cells. This is considered a form of surgery and can destroy cancer cells, remove tumours, as well as assist in relieving cancer symptoms such as blockages etc.⁷⁰

APPENDIX ●●●●●

STUDIES ON CHEMOTHERAPY

Appendix 4: Studies of chemotherapy.

APPENDIX ● ● ● ● ●

STUDIES ON CHEMOTHERAPY

Appendix 5: Studies of chemotherapy.

APPENDIX ● ● ● ● ●

STUDIES ON CHEMOTHERAPY

Appendix 6: Studies of chemotherapy.

APPENDIX ● ● ● ● ●

STUDIES ON CHEMOTHERAPY

APPENDIX ●●●●●

STUDIES ON RADIATION

Appendix 8: Studies of radiation.

APPENDIX ● ● ● ● ●

STUDIES ON RADIATION

MOBILE CONCRETE POD EXPANDS FOR PATIENT TO BE PLACED INSIDE.
EXTENDING GLASS ALLOWS PEOPLE TO VIEW THE INSIDE

PATIENT BED COME OUT FOR PATIENT TO ENTER

Appendix 9: Studies of radiation as a future pod.

APPENDIX ● ● ● ● ●

STUDIES ON RADIATION

PATIENT STANDS ON BED TO BE PLACED INSIDE MOBILE POD

PATIENT IS PLACED INSIDE THE MOBILE POD

CONCRETE BUNKER COLLAPSES BACK, RADIATION BEGINS, LINEAR ACCELERATOR ROTATES AROUND PATIENT

Appendix 9: Studies of radiation as a future pod.

APPENDIX ● ● ● ● ●

STUDIES ON RADIATION

Appendix 9: Studies of radiation as a future pod.

APPENDIX ●●●●●

STUDIES ON SURGERY

Appendix 10: Studies of surgery.

APPENDIX ● ● ● ● ●

STUDIES ON SURGERY

Appendix 11: Studies of surgery.

APPENDIX ●●●●●

STUDIES ON SURGERY

Appendix 12: Studies of surgery.

APPENDIX ● ● ● ● ●

STUDIES ON SURGERY

PATIENT LIES ON PATIENT BED

MOBILE SURGERY ARM ATTACHES TO PATIENT BED

PROTECTIVE SCREEN ENCLOSES SPACE, ALLOWS FOR OTHERS TO WATCH

Appendix 13: Studies of surgery as a future pod.

APPENDIX ● ● ● ● ●

STUDIES ON SURGERY

Appendix 13: Studies of surgery as a future pod.

APPENDIX ● ● ● ● ●

STUDIES ON SURGERY

Appendix 13: Studies of surgery as a future pod.

APPENDIX ● ● ● ● ●

STUDIES ON SURGERY

Appendix 13: Studies of surgery as a future pod.

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