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Academic Center Tiered Operating Room Strategy (ACTION): Comparing a High Efficiency OR to the Conventional OR

Moaz Bin Yunus Chohan, *The University of Western Ontario*

Supervisor: Sanders, David, *The University of Western Ontario*
Joint Supervisor: Lawendy, Abdel-Rahman, *The University of Western Ontario*
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ABSTRACT

Canadian healthcare system is under immense economic pressure. In an attempt to resolve the problem, outpatient surgical services were offered to patients presenting with orthopaedic surgical complaints. An observational cohort study was carried out, comparing the conventional surgical setup to the newly designed high-efficiency setup that provided similar care, with a significantly lower operating cost. A total of 200 patients were enrolled in the study. Standardized and unstandardized questionnaires were used to evaluate pre-operative and post-operative patient data that reflected quality of life outcomes. Data was collected at enrolment and during post-operative follow-ups of up to 6 months. Results indicate that the equivalent patient outcomes were successfully achieved between the two patient groups; significant reduction in the cost of orthopaedic surgical services was obtained in high-efficiency surgical setup.

Keywords: *surgical services; orthopaedic surgery; ambulatory surgical care; operating room efficiency; conventional operating room; high-efficiency operating room.*

SUMMARY FOR LAY AUDIENCE

Canadian patients face significant delays in access to many specialist healthcare services, primarily due to the significant increase in demand not matched by additional funding. Orthopaedic surgery has been one of the most highlighted specialties for prolonged wait times. The study summarizes a strategy that can be utilized to provide expedited healthcare services, making use of a high efficiency operating room setup. Cost efficiency of the high efficiency OR system, coupled with assessment of patient health and satisfaction outcomes were evaluated; while no differences in patient outcomes were found, significant cost savings were realized in the high efficiency operating room setup.

THE CO-AUTHORSHIP

While each of the co-authors listed below made important contributions to this work, I am the principal author who designed all the projects, performed all of the experimental data acquisition, collection and analysis. The manuscript presented in this thesis was prepared by me, with the consultation and critical review by the co-authors.

David Sanders, MD, FRCSC, in his role as my project supervisor and orthopaedic surgeon, assisted with the study design, providing guidance on statistical requirements and a much-appreciated critical review of the manuscript.

Abdel-Rahman Lawendy, MD, PhD, FRCSC, in his role as an orthopaedic surgeon and the study principal investigator, provided strong leadership on the project, carrying out the pilot study that had formed its basis. He provided all particulars of the statistics and financials, as well as a critical evaluation of all work.

Emil Schemitsch, MD, PhD, FRCSC, in his role as an advisor and an orthopaedic surgeon and the study co-investigator, participated in the pilot project that had formed the basis of this study.

Christina Tieszer, in her role as a research coordinator, provided help with patient recruitment, forms creation, data collection and data compilation.

DEDICATION

I dedicate this work to my mother. She was the foundation of my ambitious dreams, providing the guidance in the initial years of my life, counselling me, not just as my parent, but also as a friend. She told me to dream big because only then will I find the means to fulfill them. Without her unwavering support, I would have not been able to pursue my goals in life.

To my father: only after becoming a parent myself did I realize his silent heroism. A man of few words, he never spoke about his sacrifices and walked the talk. He showed me what it means to ‘be a man’. His honesty has been my guide in difficult times.

I dedicate this to my wife: my friend and my advisor. She supported me at every aspect of our life, never questioning my intent in the face of difficulties that stood ahead, walking with me all along. I could not achieve this without her support.

I dedicate this to my children, Kabeer and Zara, the two sparkles of light that make the world colorful and complete with their smiles.

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LIST OF ABBREVIATIONS

ACL, anterior cruciate ligament

ACS, American College of Surgeons

ACTION-in-the-OR, Academic Centre-Tiered Initiative Strategy in the OR

ASA, Americal Society of Anesthesiologists

ASC, ambulatory surgical centre

BMI, body-mass index

CAHPS, consumer assessment of healthcare providers and systems

CCI, Charlson Comorbidity Index

CI, confidence interval

CIHI, Centre for Health Information

CQI, continuous quality improvement

EBCE, evidence-based care efficiency

EBM, evidence-based medicine

ECG, electrocardiogram

HSREB, health sciences research ethics board

ICU, intensive care unit

IHI, Institute for Healthcare Improvement

LHSC, London Health Sciences Centre

NSAIDs, non-steroidal anti-inflammatory drugs

NSQIP, national surgical quality improvement program

OECD, Organization of Economic Cooperation and Development

OARA, outpatient arthroplasty risk assessment

OR, operating room

OSA, obstructive sleep apnea

PAC, pre-admit clinic

PACU, post-anesthesia care unit

PRO, patient-reported outcomes

PROMIS, patient-reported outcomes measurement information system

PSESS, patient surgical experience satisfaction survey

QALY, quality adjusted life years

QOL, quality of life

RCRI, revised cardiac risk index

SD, standard deviation

SEM, standard error of the mean

VAS, visual analogue scale

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

CHAPTER 1. INTRODUCTION AND LITERATURE REVIEW

All medical specialties can be broadly divided into two categories: medicine and surgery. As such, the term ‘physician’ is used to describe doctors who practice medicine, while those who practice surgery are called ‘surgeons’. Generally, very little specialized equipment beyond the basic medical standard is necessary to set up a physician practice; on the other hand, all surgical work requires a dedicated space staffed with many specialists, to work in concert with the surgeon. Such a specialized place is called an ‘operating room’ (OR).

1.1 THE OPERATING ROOM

OR is a set of purpose-built rooms within a hospital, committed to the performance of surgery (Brunicardi et al. 2014). As such, their construction requires specialized expertise from the engineering industry, particularly those servicing healthcare facilities. One of the main features of an OR is the use of sophisticated technology to maintain an aseptic environment.

ORs are spacious, cleanroom-like chambers, generally windowless, with controlled temperature and humidity; they must be easy-to-clean after each procedure (Brunicardi et al. 2014). ORs are well lit, usually with overhead surgical lights, and may have several viewing screens and monitors present. Special air handlers filter the air and maintain a positive air pressure. Electrical backup systems are a must, in case of a power blackout. Each room is supplied with wall suction, oxygen and other anesthetic gases.

The key equipment within an OR consists of the operating table and the anesthesia cart (Brunicardi et al. 2014). In order to set up various instruments necessary during the procedure, additional portable tables are also present. Common surgical supplies are kept in a dedicated storage space, while all disposables are placed into specialized bins/containers. Outside the operating room, a dedicated scrubbing area is provided for the surgeons, anesthetists, operating room staff and nurses to be used prior to surgery.

Several operating rooms form a part of the operating suite that is localized in a distinct section within a healthcare facility. It is normally separated from other departments in order to ensure that only authorized personnel have access.

All work inside an operating room is carried out with the assistance of an OR team (Brunicardi et al. 2014). The team, with a surgeon as its leader, consists of anesthetists, nurses, OR aides, surgeons-in-training (surgical residents) and medical students. Various dedicated and specialized tools are necessary to perform surgeries; these are usually not available in any other areas of the hospital.

1.1.1 Evolution of Surgery as Medical Specialty

Surgery, as a specialized field of medicine, did not exist at the beginning of history of medicine. The origin of surgery began as that of a theatre where human bodies were dissected (Clendening 1947). Therefore, the foundation of anatomical dissection, as known today, was not necessarily laid by medical doctors.

Initially, teachers interested in anatomy undertook the job of dissection. Literature points out that the earliest recorded instructions given on anatomy date back to Italy, before 1113A.D. These were normally given at the house of anatomy teachers; only later the anatomical dissections were moved to an educational institution (Clendening 1947).

Several centuries later, permanent theatres were being built across Europe. Mundinus, in 1316AD, was the first person to pursue a public dissection of human body at a university in Bologna, Italy (Riley and Manias 2005). The public dissections laid the foundation of creating spaces where these teachings could be conducted. As such, these spaces would, in time, transform into modern operating theatres and operating rooms. The phrase 'Operating Room' was coined by the American surgeons of the 20th century, replacing that of 'Operating Theatre' (Riley and Manias 2005).

The oldest remaining structure that served as an operating theatre was built in 1594 in Padua (Riley and Manias 2005). Temporary structures, to show dissection of human body, were erected at the time. The new anatomical discoveries made were of interest to people of high class and stature; as such there was a premium price paid for this kind of theatre (Riley and Manias 2005).

The 'ownership' of the field of surgery created many conflicts right from the beginning. In Paris, dissections were carried out by medical doctors, with surgeons and barbers (who were considered sub-ordinates to doctors) working under their directions (Brockbank 1968). Violent disputes frequently broke out between the College of Medicine in Paris and the Surgeons of St. Côme. Similar

disputes also arose in London, between Surgeons and Barbers: Surgeons wanted to separate themselves from Barbers, keeping the field of work to themselves. Initially, therefore, the field of surgery employed people who called themselves Barber-Surgeons (Brockbank 1968). As a consequence, however, very little progress was achieved in promoting the field of surgery; as such, the evolution of the OR suite did not start until much later.

Paradoxically, wars have always provided one of the greatest advancements towards the development of new technologies; this was particularly true in the field of surgery. It was recognized early on that injured soldiers needed specialized care. This attitude met with lots of challenges and resistance when presented to the society leaders: rulers in general did not want to invest money into human capital, seeing it as readily replaceable. As such, surgeons faced one of the worst financial and professional conditions of all medical professions. This is clearly illustrated by the case of the 16th century French military surgeon, Ambroise Paré (Clendening 1947). Paré is considered one of the fathers of surgery, as well as a pioneer in surgical techniques and treatment of wounds, particularly in the battlefield medicine. He reintroduced the technique of ligating arteries (first used by Galen) instead of cauterization during limb amputation. Unfortunately, due to the neglect of the sovereigns towards the field of surgery, his technique fell into oblivion for another two hundred years. However, as the attitude of rulers towards the health status of their soldiers evolved, an 18th century English surgeon, Robert Wiseman, picked up on Paré's

technique and made it into a routine practice that is still used today (Laboratories 1980).

The field of surgery made a tremendous leap forward during the 19th century: the medieval distinction between medicine and surgery was abolished, leading to the social rehabilitation of the surgeon as a medical professional (Wagensteens and Richardson, 1964). Three factors were instrumental in this process: localism, anesthesia and asepsis. Unlike in the medieval times, the surgeons stopped being 'knife-shy'; their activity greatly increased, owing to the development of localistic pathological anatomy (Wagensteens and Richardson, 1964). The discovery of adequate pain-control methods and surgical anesthesia, particularly by ether, nitrous oxide and chloroform allowed surgeons to attempt procedures otherwise not possible (Faulconer and Keys, 1965). Later, various forms of local anesthesia (e.g. cocaine, conduction anesthesia by Halsted, infiltration anesthesia by Schleich) were added (Kelly, 1936). Finally, discovery of asepsis by Ignaz Semmelweis (which was later improved on by Joseph Lister and Louis Pasteur) significantly diminished the rate of wound infection (infections were especially rampant in hospitals of that time, with surgical patients frequently dying of 'hospital gangrene'), rejuvenating the field of surgery and transforming surgical wards (Clendening 1947).

1.1.2 Evolution and Development of Operating Room Design

Similarly, the poor conditions experienced by the barber-surgeons were also found in the operating theatres associated with hospitals where surgeries

could take place. The hospital in Beaune, Burgundy serves as a great example of the overall lack of interest in building surgical spaces: the original hospital was built in 1443AD, yet without any major changes or upgrades to its OR area until 1955 (Hudenburg 1960).

An industrial efficiency expert, Frank Gilbreth had investigated the optimization of scientific management in 1910 (Gainty 2016). Gilbreth believed that many processes could be made more efficient by reducing the number of motions involved in performing the task. He emphasised the use of ‘one best way’ in many industrial or scientific processes, laying the foundation for the development of continuous quality improvement (CQI).

Based on Gilbreth’s ideas, organizations showed interest in the development of manuals for construction of an ideal operating complex. As such, the first handout of its kind, called the Health Building Notes, was released in 1957. With rapid advances in the fields of surgery and anesthesia post-World War II, improvements were needed to accommodate the growing demand for surgery; this led to the concept of centralized sterilization room and post-operative recovery rooms, both of which did not exist before (Johnson 1994).

1.1.2.1 Physical Considerations

The actual design of OR suites has been constantly changing since the time of its inception. Before 1919, all ORs were built on rooftops of the hospitals; it was only later that the OR suites were moved from the hospital roof to the lower levels, also allowing for an increase in their size (Hudenburg 1960). The

changes that occurred were due to developments in the logistical setup, construction material and advancement of building designs. The initial choice for a rooftop occupancy for an OR suite was due to its requirement for a high-intensity light source, not available artificially, because of insufficient capacity of electrical wires. As such, big windows allowing the sunlight to enter the rooms were installed in the top-floor ORs (Hudenburg 1960).

With the transfer of the OR suite to the lower levels of the hospital, single corridor suites became common practice. This would greatly aid with the logistical support necessary for transporting patients to the OR from the close-by surgical inpatient units; as such, it significantly altered the structure of how hospitals were being constructed. Unfortunately, the single corridor introduced infections, mainly due to the lack of sterility caused by the passage of all traffic through it (Hudenburg 1960). Therefore, the next redesign proposed to replace the single corridor with the concept of a loop: one corridor could be used for patient transfer, while the other would be used for non-sterile equipment transfer (Hudenburg 1960).

Another requirement that drove the changes to OR design was that of patient waiting rooms, recovery rooms, and particularly the ventilation systems and powerful wiring needs (Hudenburg 1960). The development of the air-ventilation system by Howorth Industries led to a reduction of post-op infection in hip arthroplasty patients from 2.2% in 1963 to 0.05% in 1992. At the same time, the company also created facemasks and gowns to be used by the surgical team (Howorth 1993). Recently, the design teams are developing full-scale operating

room mock-ups, which can increase the yield of the construction team in the same amount of time, by evaluating the development of new operating room setups that are better-suited for today, as well as designs that can accommodate the future needs (Bayramzadeh et al. 2018).

1.1.2.2 Economic Considerations

Change and evolution are always inevitable. In the days of yore, the presence of hospitals was all that was expected; today, as with all publicly funded projects, there is a shift towards the requirement of those hospitals being efficient and transparent with their budget management. The historical lack of accountability in the field of medicine in Canada, up until the 1980s, compelled the health administration to pursue evidence-based medicine (EBM) and evidence-based care efficiency (EBCE). However, an interest in hospital efficiency is not a recent strategy, nor is it solely related to economic downturns experienced over the past thirty years.

Over the years, both the quality of patient care as well as the economics has always been the prime focus of research and development. All the ideas discussed so far had a patient care component to them, but at the same time, the economic component cannot be discounted. For example, a reduction in infection rates would lead to a reduction in patient readmission and complications; this, in turn, would save public healthcare funds.

Development of the surgical specialty has always carried a price tag. While progress is inevitable, the swing in economic conditions at-large dictates

the direction of development. In the current environment, the pursuit of cost efficiency is absolutely imperative, keeping in mind that this will lead into an evolution of current practices (Gallagher and Smith 2003). The explosion of Minimally Invasive Surgery in the 1980s was a *revolution* (not an evolution); due to its rapidity, its success was delayed, even when the surgical community had accepted it. As such, proper training and acceptance by the surgical community is a very important factor to consider, for any innovation or idea to succeed (Gallagher and Smith 2003).

1.1.3 Anesthesia Equipment

Anesthesia enables the painless performance of medical procedures that would otherwise cause severe or intolerable pain to an unanesthetized patient, or would not otherwise be technically feasible (Dobson 2018). There are three main categories of anesthesia: general – suppression of central nervous system activity resulting in unconsciousness and total lack of sensation, sedation – suppression of the central nervous system that inhibits anxiety and creates long-term memories without unconsciousness, and regional – block the transmission of nerve impulses from a specific part of the body (Dobson 2018).

The most common approach to general anesthesia is through the use of inhaled general anesthetics (halothane, isoflurane, sevoflurane, enflurane or desflurane). Each anesthetic has its own potency, correlated to its solubility in oil (Dobson 2018). The core instrument in an inhalational anesthetic delivery system is an anesthetic machine, consisting of vapourizers, ventilators, an anesthetic

breathing circuit, waste gas scavenging system and pressure gauges. The anesthetic machine needs to provide anesthetic gas at a constant pressure, together with oxygen for breathing and removal of carbon dioxide or other waste anesthetic gases. Intravenous anesthetic is delivered either by bolus doses or an infusion pump. There are also many smaller instruments used in airway management and monitoring the patient. The common thread to modern machinery is the use of fail-safe systems that decrease the odds of catastrophic misuse of the machine (Dobson 2018).

Patients under general anesthesia must undergo continuous physiological monitoring to ensure safety (Dobson 2018). These include electrocardiography (ECG), heart rate, blood pressure, inspired and expired concentrations for oxygen/carbon dioxide/inhalational anesthetic agents, blood oxygen saturation (pulse oximetry), and temperature. For more invasive surgery, monitoring may also include urine output, central venous pressure, pulmonary artery pressure and pulmonary artery occlusion pressure, cardiac output, cerebral activity, and neuromuscular function (Dobson 2018). In addition, the operating room environment must be monitored for ambient temperature and humidity, as well as for accumulation of exhaled inhalational anesthetic agents, which might be deleterious to the health of operating room personnel (Dobson 2018).

1.1.4 Surgical Instruments

Surgical instruments can be generally divided into different classes by their function. These include the cutting/dissecting instruments (scalpels, scissors,

saws, curettes), grasping or holding instruments (surgical forceps, towel clamps, vascular clamps, organ holders), hemostatic instruments (hemostatic forceps, Deschamp's needle, Höpfner's hemostatic forceps), retractors (hooks, probes, tamp forceps), and tissue unifying instruments/materials (needle holders, surgical needles, staplers, clips, adhesive tapes). Electrocautery, diathermy and suction are also present.

Not all surgical procedures require the use of all available instruments; as such, specific equipment trays containing the instruments necessary to carry out the given surgical procedure are assembled prior to surgeries. These are sterilized between each case, to ensure aseptic incision and post-operative wound management.

1.2 AVAILABILITY OF SURGICAL CARE IN THE CANADIAN HEALTHCARE

The provision of affordable, quality health care is a necessity in every society. After all, a healthy population is a driving force for a country's productivity and success; as such, all developed countries in the world make it one of their top priorities to provide health care to their citizens. Any delay in timely healthcare delivery may cause a significant decrease in quality of life (QOL), with pain being one of the most important factors. Continuous pain is known to lead to depression and anxiety, necessitating more financial resources being expended to help the patients.

Canada offers universal healthcare to all its residents. While the federal government oversees different performance indices for provincial bodies, healthcare is a provincial government subject (Government of Canada 2018). As a result, there is little difference in access to treatment between different socio-economic classes. The healthcare system covers access to expensive treatments such as hip replacement, liver transplants, cancer medication, as well as inexpensive treatments such as a visit to a family physician and vaccinations.

The single-payer, universal, publicly funded system, however, has an inherent deficiency: the system is very costly to maintain. With the lack of funding, wait times become longer. The longer wait times, paradoxically, further increase the cost, as patients on wait lists frequently need emergency care (Ackerman, Bennell et al. 2011, Desmeules, Dionne et al. 2012). The hospital resources are, then, wasted on unnecessary hospital visits instead of providing definitive care that would reduce wait times.

1.2.1 Population Considerations in Canada

Canada is in a unique situation with its population. Among G7 countries, Canada has the lowest proportion of the population older than 65. On the contrary, the median age of the population has gone up by ten years to 40.6 years since 1984. For every 100 working people, Canada has 49 individuals between age 0-14 years or 65 and older. The largest demographic by far is the “Baby Boomers,” born in 1946-1964 (Information 2017). Given that they will soon

become senior citizens, increasing the need for further healthcare resources becomes a priority.

The Canadian healthcare system is one of many examples of the public funded single-payer health care system, with a small component of the privately funded healthcare system. Among the Organization of Economic Cooperation and Development (OECD) countries, Canada lies close to the mean for its spending on healthcare. Canada spends 10.4% of GDP on healthcare which makes it the ninth highest spender of GDP on health care in the OECD countries (Information 2016). 70% of this funding is by the public sector, and the rest is private (Information 2017). This proportion of public sector funding is lower than the OECD average of 72% (2017). Canada ranks twelfth out of thirty-five in GDP spending to Life Expectancy Ratio among the OECD countries. This performance is still better than that of the USA, which ranked last in a study published by the Commonwealth Fund. The study evaluated healthcare systems on five parameters. These parameters were the Care Process, Access, Administrative Efficiency, Equity and Health Care Outcomes (Schneider 2017). In the same study, Canada was ranked ninth out of a total of eleven. The top-performing countries were the UK, Australia and Netherland (Schneider 2017).

1.2.2 Economic Considerations and Canadian Healthcare

In 2005, people ≥ 65 years formed 13.1% of the Canadian population, compared to 16.1% in 2015. Similarly, health spending on population ≥ 65 years was 44.3% of healthcare spending in 2005. This health spending increased to

46% in 2015 (Information 2016). In contrast, the number of people in age 1-64 years went down from 85.9% in 2005 to 82.8% in 2015. Healthcare spending on this group also dropped from 52.9% to 51.1% (Information 2016). The increase in healthcare spending on the elderly cost $11,758 per capita in 2015 compared to $5782 per capita for an average Canadian. The overall average is still higher than the average per capita spending of the OECD countries, which is $4826. Ontario's per capita health care spending in 2017 stood at $6367, which is less than the Canadian per capita average (Information 2017).

The total healthcare budget for Canada in 2017 was $242 billion dollars; this equaled an increase of 3.9% compared to 2016. It accounted for 11.5% of GDP of Canada and cost $6,604 per capita. The projected change in elderly population will require an increase in healthcare spending by 0.9% per year, or $2 billion annually (Information 2017).

Ontario provincial government spends approximately 50% of the provincial health care budget on patients over 65 years of age, although only 20% of the population is elderly (≥65 years). An increasing elderly population is predicted to cost an extra $2 billion annually (Information 2017). Hospitals accounted for 28.3% of healthcare spending in 2017 in Canada (Database 2017).

1.2.3 Access to Surgical Services

All Canadians have equal access to surgical services, as necessitated by their health condition. In general, the treating surgeon assigns the priority to each case, usually dependent on the urgency and the surgeon's workload. Given the

limited number of surgeons and resources available, this creates wait times. As Canadian population ages, there will be a significant rise in the demand for surgeries, further increasing already-long waitlists for surgical services.

Using orthopaedic surgery as an example: the current wait times for joint replacement in at London Health Sciences Centre (LHSC) in London, Ontario is 51-81 days for an initial consult with an orthopaedic surgeon (CIHI 2017). Patients must then wait another 64-134 day from their first orthopaedic appointment to get surgery (CIHI 2017). These wait times apply to all patients, regardless of the severity of their health care issues or the nature of operation required, with patients needing emergency surgical care being excepted, as these patients are operated on within one week. Although only one procedure is included in this illustration, similar wait times exist for all orthopaedic subspecialties.

As such, the development of a parallel surgical strategy to take care of lower complexity surgical procedures becomes obvious. Many surgical patients are relatively healthy and come to the hospital on the day of surgery, and have low post-operative requirements. For these individuals, performing operations in an outpatient ambulatory surgery centre, using a high efficiency, streamlined strategy, may save significant resources while improving care.

One inpatient day can cost between US$2,000-$6,000 (CIHI 2017). Multiple authors have established the cost difference in performing the same surgery in an inpatient hospital setup compared to an outpatient ambulatory surgery centre. It has been suggested that overall savings of 17-57% can be

achieved in this this type of system, depending on the type of procedure (Small et al. 2013), freeing resources that can then be devoted to other, more complex cases.

1.3 CURRENT SURGICAL WORKFLOW AT VICTORIA HOSPITAL

1.3.1 Operating Room Time Allocation

Time allocation for surgeries is carried out in blocks. Each surgical specialty is assigned a block of time, based on their historical requirements over the years. Each block is further divided into smaller units of time for individual surgeons and their patients, based on the surgeon's schedule at any point in time between elective and emergency cases.

Time allocated starts at 8am and ends at 3pm. Since any overtime or under-utilization results in financial loss (e.g. overtime pay, full-time pay for part-time hours), attention must be paid to balancing/maximization of the number of cases in the given time. This can be achieved by planning similar cases close to each other, removing the necessity of major equipment changeover after every case. Not only can significant savings in time be achieved (Skarda, Rollins et al. 2015), but also wastage of disposable equipment is reduced or fewer equipment packs are opened due to lack of communication (Avansino, Goldin et al. 2013, Guzman and Gitelis 2015).

1.3.2 Operating Room Setup

Guidelines for operating room staff and equipment have established the minimum number for the required staff. While every institution has their own version, the principles used at Victoria Hospital of LHSC are summarized in the following sections.

1.3.2.1 Patient Intake

Patients presenting with various surgical problems can be admitted or discharged after initial consult with the emergency physician. If the patient is admitted, it is usually due to him/her having a higher complexity injury, socioeconomic conditions justifying inpatient status or medical co-morbidities needing stabilization before the patient can be operated upon.

There is also a second group of patients (elective), i.e. those who do not need an immediate surgery (Figure 1.1). These present after referral from the emergency department, or on the basis of a referral from a general practitioner (e.g. general practitioner will request a consult at the orthopaedic surgery outpatient clinic). From this point, they can follow one of three pathways:

(a) Get admitted to the hospital and undergo surgery;

(b) Return at a later date, to be medically assessed in the pre-admit clinic (PAC), to be medically assessed as fit for surgery. As this group of patients usually suffers from multiple co-morbidities, clinical evaluation by medicine and anesthesia teams is required;

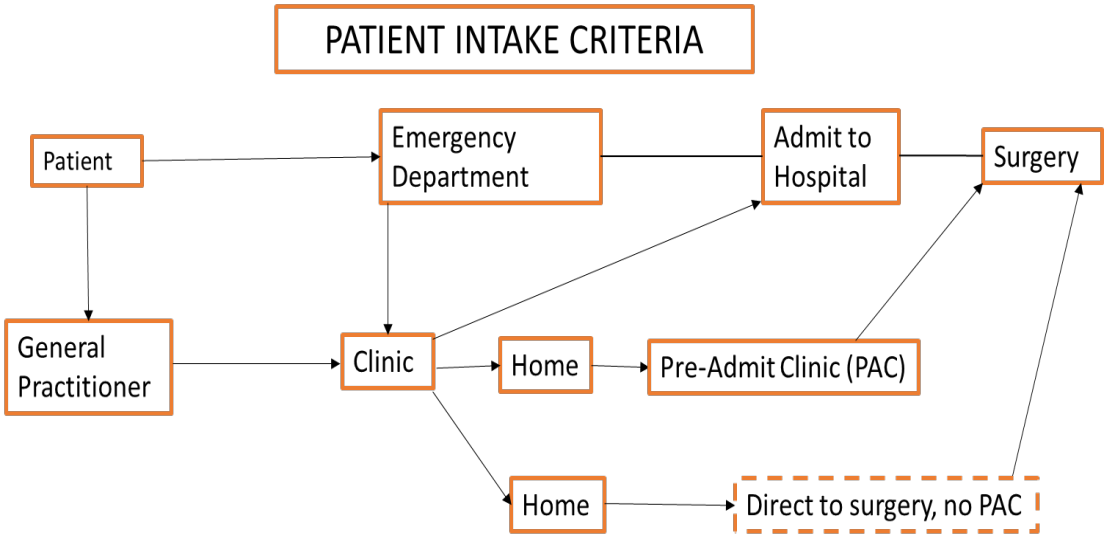

Figure 1.1. Patient intake criteria for patients going to the operating room.

(a) Return directly to the Day Surgery department, which then prepares the patient for surgery. Usually, these patients are cleared as clinically stable and medically fit by the surgeon.

All outpatients are requested to present at the pre-operative registration counter a minimum of 2 hours before their scheduled surgery. After check-in, they are brought to the Outpatient Day Surgery check-in area, where they are assigned a bed and a nurse to prepare them for the OR. An IV line is placed at this time, for the purpose of hemodynamic control and drug administration during the surgery and recovery.

One member of the surgical team (usually, an attending surgeon, fellow or resident) meets with the patient and marks the correct extremity for the operation. Patient is either shifted to the block room or straight to the OR, depending on the preference of the attending anesthetist. Patients who are selected to receive the general anesthetic or the nerve block can be switched to the other group on the request of the patient.

1.3.2.2 Patient Classification

The American Society of Anesthesiologists (ASA) established a standard classification system, used for the pre-operative assessment of patients (Committee 2014). The system is based on the evaluation of the health conditions of the patient, allowing for flexibility in the management of the patient

in the OR. The classification system assigns the patient into one of the six categories (Committee 2014):

- ASA 1: Healthy patient.
- ASA 2: A patient with mild systemic disease.
- ASA 3: A patient with severe systemic disease.
- ASA 4: A patient with systemic disease that is a constant threat to life.
- ASA 5: A moribund patient who is not expected to survive without the operation.
- ASA 6: A declared brain dead patient whose organs are being removed for donor purposes.

The system allows for the evaluation of the patient by non-anesthesia specialists; however it is not without a weakness: it does not account for the gaps between two classes (e.g. a patient with moderate systemic disease cannot be properly classified). As such, it has been reported that an underestimation of patient health of 20% by anesthetists, and up to 40% by non-anesthetists results (Eakin and Bader 2017), creating serious problems in addressing patient health concerns during surgery. Although the recent addition of examples for each class has increased the ASA validity, the system is still questioned, given that it no longer properly correlates with the Charlson Comorbidity Index (CCI), Revised Cardiac Risk Index (RCRI) and hospital length-of-stay; therefore, the current ASA classification guidelines need further rigorous evaluation before making their use more widespread (Sweitzer 2017).

1.3.2.3 Classification of Board Cases

Patients are classified into elective and non-elective categories. Elective patients are those who can be treated without a sense of urgency. Non-elective, or emergency patients are further sub-classified as:

- “A” case: patients are in urgent need of treatment.
- “B” case: patients need to be treated with in 2-8 hours.
- “C-1” case: patients need to be treated within 8-12 hours.
- “C-2” case: patients need to be treated within 12-48 hours.

1.3.2.4 General Pre-Operative Care

On average, it takes 30 minutes to prepare a patient who is ASA 1 or ASA 2, with additional15 minutes required if the patient is an ASA 3 or ASA 4. Preparation process involves measuring vitals, weight and height, initiation of an IV line (with a saline drip on hold).

Anesthesia team usually requests the administration of Acetaminophen or Gabapentin for pain control. Antibiotics, as prescribed by the surgery team, are also hung with the saline drip but not initiated if the patient is going to the block room. If the patient is going straight to the OR, and if required, antibiotics can be started by the nurses in the day-surgery area. In the block room (spinal or nerve block), antibiotics are initiated by the block room nurse within an hour of the surgery. If a patients is undergoing general anesthesia, antibiotics are initiated by the OR nurses within an hour of the surgery.

If required and time allows, the patient may get a pre-operative physiotherapy assessment, teaching him/her them how to use crutches, walkers or any additional assistive devices the patient will be required to use.

1.3.2.5 Anesthesia Care

Patients have a choice of three different levels of anesthesia care:

(a) General anesthesia: employed for patients requiring deep sedation. It is chosen in situations where nerve block and spinal anesthesia would not provide sufficient anesthetic coverage to the patient.

(b) Regional spine anesthesia: epidural/spinal anesthesia is provided to patients in order to avoid post-operative side effects of the general anesthetic. This type of anesthesia is frequently employed in cases where adequate pain control and muscle relaxation are needed (e.g. minor orthopaedic procedures).

(c) Regional nerve block: This type of modality is provided to patients requiring localized sensory and motor anesthesia. It is combined with deep sedation, which allows the patients to be unconscious yet not in deep enough sleep characteristic of general anesthetic.

1.3.2.6 Block Room

Block room is a dedicated area for administration of regional nerve block. A sterile environment is compulsory; the room is always staffed by two specialized nurses who have extensive experience in anesthesia and

management of patients in PACU, one anesthesia attending physician, and a maximum of two training doctors (fellows, residents, students). Eight bays that can be used simultaneously for anesthetic administration are available at LHSC.

Patients from the Day Surgery area are sent to the block room at least one hour prior to their surgery. No pre-determined drug combination is used; each anesthetist chooses his/her own combination. Benzodiazepines as anxiolytics may be employed; these can be administered in the Day Surgery area or the block room. Intravenous anesthetic agents (Propofol, Thiopental) or volatile anesthetic agents (Nitrous oxide, Desflurane, Isoflurane) can also be used; the concentration required is left to the discretion of the anesthetist.

Choice of local anesthetic for the regional block is largely dependent on the desired outcome for intra-operative muscle relaxation during anesthesia and post-operative pain control (Figure 1.2). If a patient is to be discharged home right after the surgery, pain control is required for the first 24 hours; as such, an anesthetist uses a combination of drugs with faster absorption rate, achieving a quick onset of action, along with a long half-life, for extended coverage.

1.3.2.7 Post-Operative Care

There are three different pathways that a patient can follow in post-operative care (Figure 1.3):

(a) Discharge to an intensive care unit (ICU): reserved for patients requiring intensive and invasive monitoring post-operatively following their surgery. This category is reserved for multi-trauma patients, and/or patients who

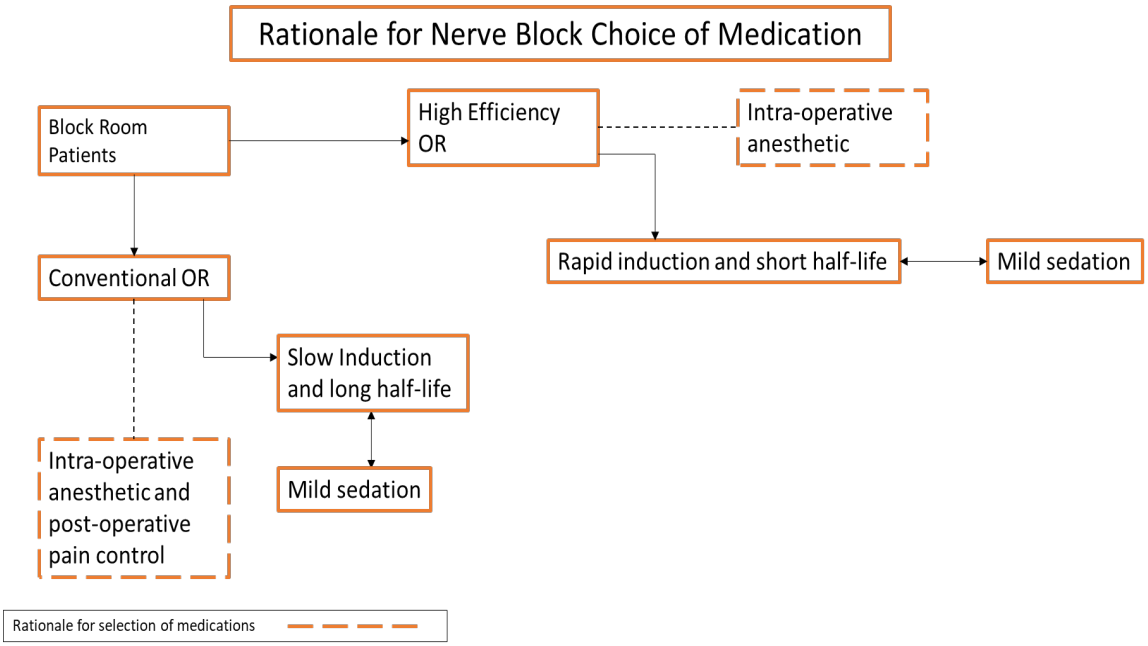

Figure 1.2. The rationale for choice of medication to administer a nerve block.

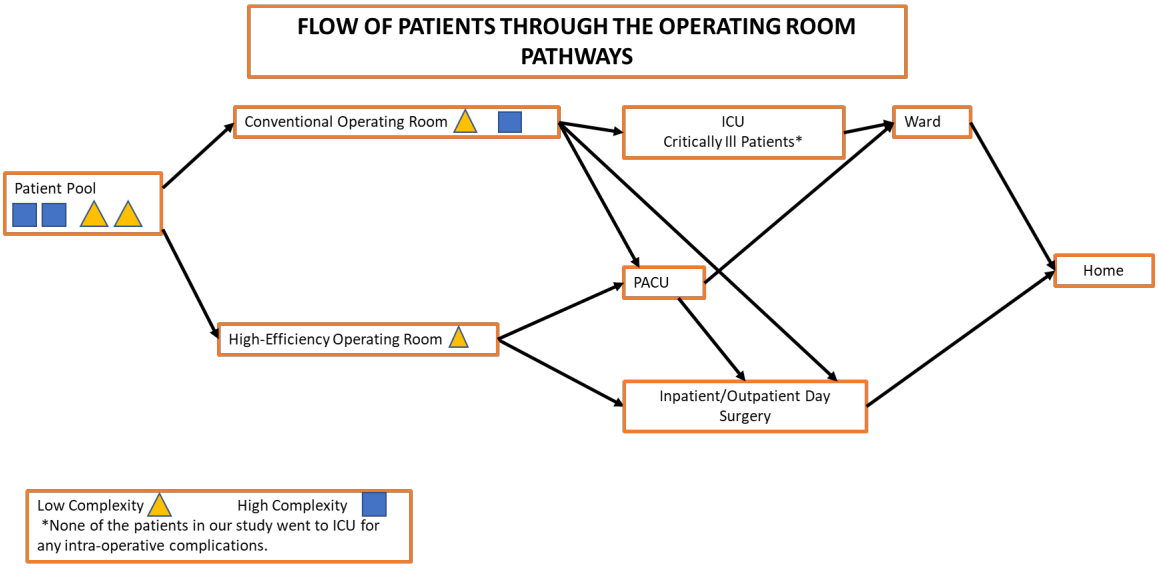

Figure 1.3. Flow of patients through the post-operative care.

harbour severe medical co-morbidities (e.g. heart failure, renal failure). Once the patient is stabilized, he/she can be moved back to an inpatient ward; if considered medically fit to be discharged, the patient is then released from the inpatient ward.

(b) Discharge to the post-anesthesia care unit (PACU): reserved for patients undergoing routine elective or emergency procedures, in order to recover from the effects of general anesthetic and to receive pain management. PACU also allows for an intensive monitoring in order to avoid respiratory or anesthetic complications. Once the patient becomes clinically stable and the pain is well controlled, he/she is then discharged to the post-operative surgery day care unit or to the appropriate surgical ward.

(c) Discharge to a post-operative day surgery unit: the typical end-point for two groups of patients – those who come from the PACU (as described above), or those comes directly from the OR. Patients not undergoing general anesthesia are usually discharged directly to post-operative day surgery unit. The reversal of anesthesia for these patients is usually rapid; if required, pain control is also optimized.

There is no timeline for a stay in PACU, but a general rule of thumb for patients is described as follows: general anesthetic with regional anesthesia – up to 60 minutes, general anesthetic without regional anesthesia – up to 120 minutes, general anesthetic without regional anesthesia but with local anesthetic infiltration in the OR – up to 120 minutes. The nursing staff uses Aldrete score for

discharging patients from PACU to Day Surgery, grading patients on the following five categories: activity, respiration, circulation, consciousness, and oxygen saturation. To be discharged from PACU, a score of ≥9 is required; usually, the patients are discharged from PACU 40 minutes after administration of the last IV dose of analgesic medication.

The following care services can be provided to patients in PACU:

(a) Pain control: morphine and its synthetic derivatives. The frequency of administration is q5min PRN. Once the initial pain after waking up is relieved, the nurses can administer medications prescribed to the patients for home use. Medications are administered only as an intravenous solution, not orally.

(b) Emergency services: in the event of a patient becoming unstable, emergency services are readily available, at a moment's notice The equipment at immediate disposal includes a crash cart, airway cart and airway baskets.

In the post-operative day surgery unit, the patients are given instructions on wound care, self-care, what to expect in the immediate post-operative period and when to arrange for a follow-up with the surgeon (usually scheduled within 2 weeks). Various specialties have other specific instructions (e.g. orthopaedic patients are also given instruction on their weight-bearing status, the use of waling aides). Once all proper instructions are given and comprehended by the patient, he/she is discharged to home care, to be followed-up in the appropriate

clinic. A prescription for analgesics is also provided; this may include a combination of acetaminophen/codeine, NSAIDs and opioids.

The length of stay in the post-operative day surgery area is approximately 60-90 minutes, with no strict cut-offs followed by the nursing team. Post-Anesthesia Discharge Scoring (PADS) system is used to assess whether a patient can be discharged; a score of ≥9 is required (Chung, Chan et al. 1995). PADS assesses patients in five categories: vital signs; activity and mental status; pain, nausea and vomiting; surgical bleeding; intake and output. Day surgery nurses also provide the care for the following complaints apart from general care normally provided to any postoperative patient:

(a) Pain control: post-operatively, the pain can be controlled by the anesthesia team (or, in case of orthopaedic surgery, the orthopaedic surgery team). Anesthesia team becomes involved if there is a breakthrough pain while on medications initiated by the anesthesia team. Orthopaedic team is involved in prescribing pain control medications for home use; currently, opioids (synthetic/non-synthetic), gabapentin and Tramacet are used. The immediate post-op period does not require Tylenol or NSAIDs for pain control.

(b) Anesthetic complications: nausea is one of the significant post-operative anesthetic complications; Gravol and Ondansetron are the most commonly used drugs for nausea control.

(c) Bleeding: patients are requested to keep their feet elevated to avoid bleeding. If a patient starts bleeding profusely, due to gravity-dependent

blood pooling, additional gauze is used to reinforce the dressing, with the two-week clinic visit allowing for a change in the dressing. As infection is very likely in the immediate post-operative period, early dressing change is avoided.

(d) Physiotherapy: if the patient was unable to receive physiotherapy instructions before the surgery, they are obtained at this time point, together with the weight-bearing instructions, before being discharged from the hospital.

1.4 OPTIMIZATION OF OPERATING ROOM SERVICES

Given the exponential increase in demand for OR services, coupled with restrictions in healthcare funding, the possibility of OR optimization was explored at London Health Sciences Centre – Victoria Hospital, by stratifying the surgical cases according to individual patient and case complexity. One of the problems with he existing, conventional OR setup is the equal allocation of staffing resources across all operating rooms; as such, the number of staff attending a complex heart surgery case is the same as that for a minor bunion surgery, arthroscopy, or carpal tunnel release. Therefore, a high-efficiency model was proposed, based upon process and staffing standardization to be used in less complex operations on relatively healthy patients. The proposed model, used as a pilot, is originally based on the ambulatory centres already in use in the United States.

1.4.1 Ambulatory Surgical Centre

In the USA, following the dominance of specialty hospitals, the concept of low-cost health care delivery centres was transformed into what is now known as an Ambulatory Surgical Centre (ASC). ASCs, formally brought under the Medicare/Medicaid umbrella by the US Congress in 1987, exponentially increased over a short period of time; unfortunately, the promulgation of the Affordable Care Act in 2010 led to a decline in the growth of these facilities.

ASC, as its name suggests, is a standalone surgical facility that can provide outpatient surgical services to patients. The reason for its popularity is its easy accessibility across the whole US. Although, in the majority of cases, these facilities do not function around the clock, they usually have a contract with a local area hospital that provides support to their ill patients, or those develop a complication requiring inpatient admission.

1.4.1.1 Population Characteristics

One of the critical aspects of the success of ASCs is the ability of the population to take advantage of them. Therefore, patient selection is key to the success. As patients' adverse events are dependent on the population characteristics, surgeons are in agreement that the suitable candidates for ASC use are healthy, with ASA score of ≤3, not dependent on opioids, and not having an obstructive sleep apnea (OSA).

Pediatric population is very uncommon in ASCs, since these patients cannot take care of themselves and are dependent on parental or caregiver

abilities (Miller, Nelson et al. 2018). In addition, children are unable to comprehend the physical signs and symptoms, or interpret their significance (an important consideration during the immediate post-op period in order to avoid any life-threatening complications).

1.4.1.2 Advantages of Ambulatory Surgical Centres

1.4.1.2.1 Expedited Access

Flexibility in scheduling surgical procedures by patients, which allows for expedited access, is discussed extensively in health economics literature. In the US, the majority of healthcare setups use the “As Needed” scheduling system, which allows the patients to pick a time and date suiting their needs; the relevant arrangements are then made to accommodate the request. If a particular date is not available, the patient has an option of choosing other dates.

In Canada, the “Assigned Block” scheduling system is followed. The system assigns a specific amount of operating room time to each surgeon. The surgeon can perform any surgery, in any format, within that time frame (e.g. a surgeon may choose to perform a hip joint replacement, followed by a knee arthroscopy). This necessitates a full equipment change between cases, reducing efficiency. One thing has to be kept in mind, however: unlike in Canada, surgeons in the US are often paid per patient, without any caps on how much they can operate; as a result, each surgeon within the same centre may have very different wait times. Canadian public-funded healthcare system allows surgeons freedom, but limits access in the current, existing setup. By altering the

surgical algorithm, one can increase efficiencies and improve access, but at the cost of requiring the surgeon to announce an efficient schedule.

1.4.1.2.2 Logistical Setup Advantage

In Canada, under the existing settings, a typical conventional OR setup within an academic teaching hospital consists of a two-member surgery team (surgeon and resident), one-member anesthesiology team (anesthetist) and 2.5-member nursing team (scrub nurse, circulating nurse and OR aide). The personnel involved remain the same for the duration of their shift, but the equipment changes for every operation. Under an ASC OR setup, all cases are booked for maximum efficiency; as such, the equipment remains constant, avoiding waste due to changeovers (Small, Gad et al. 2013). Furthermore, the equipment is reduced to the bare minimum of what is necessary to carry out the operations in question. This not only makes the setup more simple, but also more cost-effective.

1.4.1.2.3 Complications and Infection Rates

The sheer high volume of repetitive surgeries allows the surgical team in ASCs to master their skills for a select group of surgical procedures. This, in turn, translates into a lower complication rate when compared to the same operation being performed in an inpatient hospital setup (Owens, Barrett et al. 2014, Sayeed, Abaab et al. 2018, Thompson and Calandruccio 2018).

ASCs tend to be standalone units, detached from the main hospital. As such, there is minimal contact with patients having infectious diseases that could possibly introduce it to the ACS. In addition, there is no intensive care unit or inpatient unit that might harbour dangerous pathogens. All of this leads to a lower post-operative infection rate for all the patients treated.

Several researchers demonstrated superiority of ASC over the conventional hospital OR setup, particularly in terms of infections and complications. Lovett-Carter and Pugely both described a relationship between hospital stay and infection rates in post-operative patients (Pugely, Martin et al. 2013, Lovett-Carter, Sayeed et al. 2018). Thompson et al. (Thompson and Calandruccio 2018) reported a lower post-operative complication rate of 0.2-2.5% and a lower readmission rate for patients treated at an ASC. Sayeed et al. (Sayeed, Abaab et al. 2018) also found a general decrease in complication rates in patients treated in ASCs. Moreover, the rate of 14-day acute care visits for anterior cruciate ligament (ACL) repair and spine surgery was found to be 0.245% and 0.257%, respectively (Owens, Barrett et al. 2014). On the other hand, all surgical infections account for 20-31% of healthcare-associated infections, with 3% mortality rate, prolonged hospital stay of 7-10 days and admission costs anywhere between $20,000-$27,600. As such, 0.14% rate of post-op admission in ASC makes it an attractive option to conventional OR (Siow, Cuff et al. 2017).

1.4.1.2.4 Expedited Operating Time

There has been an extensive debate on the reorganization of operating room working strategies. Some of these include reassigning the responsibilities of staff inside the OR (Azzi, Shah et al. 2016), the creation of committees for scheduling of OR cases (van Veen-Berkx, Bitter et al. 2015) and enforcement of strict first-case start times (Kimbrough, McMasters et al. 2015). Regardless, ASCs have already demonstrated their ability to perform the same surgeries faster: the staff is highly specialized and efficient at performing their duties, as well as fewer equipment turnovers due to the similarities among cases greatly facilitates the turnover reduction.

1.4.1.2.5 Losses to Savings

In the US, ASCs can take away the lucrative, low-resource, high-profit cases causing financial losses to the general hospitals in an area (Casalino, Devers et al. 2003). In contrast, in Canada the same concept may be of benefit, since it would take away these small, resource-wasting cases carried out in fully-staffed ORs to a streamlined OR. Operating in High-Efficiency ORs can save up to 60%, when compared to conventional ORs.

1.4.1.2.6 Cost-Effectiveness

A comparison of ASC to standard hospital practice has demonstrated cost savings anywhere between 16.4-58% in the literature (Fabricant, Seeley et al. 2016, Goldfarb, Bansal et al. 2017). The reduction is secondary to decreased in-

patient care charges, including nursing charges, room charges, meals and drugs (Hadzic, Williams et al. 2005). Other medical support services (e.g. physiotherapy charges) are also reduced. The patients can refill some of the medication prescriptions under their personal health insurance drug coverage. Moreover, laboratory and diagnostic imaging bills are also lower (Oh, Perlas et al. 2016).

Anesthesia charges can be reduced when analgesia is given together with a nerve block instead of a general anesthetic, bypassing the need for PACU. Instead, the patients are taken care of in the day-surgery unit, since they are back to being fully conscious upon waking up from anesthetic sedation. Given the permanent specialist equipment in these rooms, it, in turn, translates into a smaller bill for surgical instrument processing (Oh, Perlas et al. 2016).

1.4.1.3 Disadvantages of ASC

1.4.1.3.1 Selective Patient Population

The ASC, by design, is built for patients who can withstand the rigours and stress of day surgery. Children and the elderly, those who are medically unwell, trauma patients and any other category requiring patients to be admitted to the hospital are automatically disqualified.

In the formative year of ASCs, there was a consensus about taking patients with an ASA≤3. Recent publications indicate instances where patients with a higher ASA level have also been operated on in an ASC, highlighting the importance of differences based on the perception of the ASA assessor.

Difference of opinion exists on considering patients fit for surgery based on ASA level (Siow, Cuff et al. 2017). As such, there is now a shift away from ASA towards the use of Charlson Comorbidity Index (CCI), which appears to be a better indicator of the surgical outcome. For the same reason, the Outpatient Arthroplasty Risk Assessment (OARA) score has also been used for orthopaedic surgery patients: OARA has a positive predictive value of 81.6% for same- or next-day discharge – higher than that of ASA and CCI (Sayeed, Abaab et al. 2018).

1.4.1.3.2 Absent Urgent/Emergency Care Services

The provision of emergency services during the management of patients in immediate post-operative period after discharge is a challenge for standalone ASCs. While they provide necessary medical help and are relatively cheaper to build in remote locations, the absence of a full-time emergency centre hinders access to essential medical treatment for the local population (Kahn 2006).

ASCs can overcome the hurdle by having a relationship with regional hospitals willing to accommodate ASC patients if the need arises. Yet another solution is that implemented by the Johns Hopkins Hospital, where the ASC is located next to the main hospital (Ishii, Pronovost et al. 2016).

1.4.1.3.3 Patient Anxiety

Patients treated at ASCs report higher anxiety levels, due to the assumption that there is no life-saving equipment present in the ASC (Gardner,

Nnadozie et al. 2005). However, this hurdle can be easily overcome, by locating the ASC in close proximity to a hospital.

1.4.1.3.4 Malignant Hyperthermia

Malignant hyperthermia is a severe, life-threatening complication of anesthesia. Patients require immediate attention and may need lifesaving drugs, equipment and maneuvers (Larach, Dirksen et al. 2012). Again, locating an ASC in a very close proximity to a hospital with an intensive care unit can provide the required clinical support.

1.4.2 Infrastructure and Construction of ASC

Traditionally, ASCs can fill a gap in provision of a vital health facility. Construction details of a conventional ASC in the US are described as follows:

1.4.2.1 Feasibility Analysis and Structure Cost

A proper economic evaluation is undertaken, considering the neighbourhood for the ASC construction, future neighbourhood patient needs, public transit access, highway access, parking and handicap access. Additionally, the procedures to be performed at an ASC are determined, as well as the identification of participating physicians and surgeons (Buehler, Mattison et al. 2008).

A typical ASC will have at least two operating rooms, spread over 5000ft^2 (determined by the US federal regulations). As the business starts to grow,

changes to the minimum and a potential for expansion should also be considered. In terms of equipment costs, the minimum needs will cost approximately $1.5 million dollars; this price tag includes medical equipment, furniture, etc. (Buehler, Mattison et al. 2008).

1.4.2.2 Legal and Regulatory Issues

A legal team should be designated to deal with any potential legal action against the hospital. Lawyers can also provide a better understanding of the legal framework (Buehler, Mattison et al. 2008).

1.4.2.3 Documentation, Licensure and Certification

An administrative team assigned to look after the proper facility licensing and certification necessary to keep the facility operational should be hired during the initial staff hiring drive. Documentation of all legal obligations in medical charts is another essential component that needs to be addressed (Buehler, Mattison et al. 2008).

1.4.2.4 Physical Design

An architectural team with the proper experience of ASC construction is required, in order to avoid under-designing, as well as the prevention of additional reconstruction and remodelling costs required to bring the facility up to the regulatory standards. As over-designing also increases the cost of the initial

construction costs for facilities that are not required in an ASC, the need for an experienced team cannot be over-emphasized (Buehler, Mattison et al. 2008).

1.4.2.5 Equipment

Initially, any over-equipping needs to be avoided, with any additional equipment procurement as an ongoing process. This plan should be included within the construction budget before laying any groundwork, thus preventing any revenue shortage in the middle of construction. Another important aspect to address is the provision of training of the employees on the proper use of the equipment; this needs to be addressed well before the facility opens (Buehler, Mattison et al. 2008).

1.4.2.6 Staffing

Director of nursing is a crucial component of ASC success. Funding for this position, securing the first six months of payments, should be arranged well in advance. Director of nursing is responsible for the proper staffing of ASC during the working hours. It has been demonstrated that the nursing and ancillary staff prefer working in an ASC, as it allows them to have regular working hours; as such, the proper training should be provided to these members of the team to increase ACS efficiency (Buehler, Mattison et al. 2008).

1.4.2.7 Contracting

Negotiations with the insurance companies require handling by a professional. In order to prevent revenue shortfalls and inadequate or overbilling, an accounting department, with an in-depth knowledge of medical billing, must be hired and adequately trained (Buehler, Mattison et al. 2008).

1.4.3 Pilot Studies: The High-Efficiency OR at LHSC-Victoria Hospital

In 2016, the Divisions of Orthopaedic and General Surgery department at Victoria Hospital (VH), a part of LHSC, had undertaken to run a pilot operating room, based on the concept of an ASC. A minimum of one and a maximum of three OR days per week were assigned to this new setup, based on the availability of the VH orthopaedic trauma or general surgeons. The purpose was to assess the economic benefits (if any) associated with a High-Efficiency OR.

For the orthopaedic surgery, forefoot, midfoot and hindfoot corrective surgery, foot and ankle fracture repair, and knee arthroscopy were selected; given their low surgical complexity, these were easily amenable to standardization.

1.4.3.1 Outcomes

In the high-efficiency OR, the pilot study noted a cost difference of 62%, coupled with 35% increase in efficiency when comparing them to the conventional OR. The turnover time for the patients in the high-efficiency OR was 8 minutes and 42 seconds, versus the LHSC conventional average of 23 minutes

and 30 seconds, and provincial average of 23 minutes. The average length-of-stay for high-efficiency OR patients was 4 hours, versus 6 hours for those in the conventional OR. The number of instruments on surgical trays was also significantly lower (30 instruments in high-efficiency versus 85 instruments in the conventional OR). As such, the data provided compelling evidence that further investigations of the high-efficiency OR versus the conventional OR should be undertaken in a more controlled manner.

1.5 THESIS RATIONALE

Canadian population has been steadily increasing over the years. Unfortunately, this has **not** been coupled with a construction of new hospitals or hiring more physicians/medical specialists to staff them. For example, the population of London, Ontario has now increased to almost 400,000 people, yet the city has only 3 hospitals (these were originally built to sufficiently service only, perhaps, half of that number). Population is also aging – there are more retirement-age people residing in London than young children. Aging population puts an increased demand on access to healthcare in all specialties, not reflected by new hires. As such, the wait times to see a specialist have been continuously increasing over the past decades.

Given the increased demands for surgeries, coupled with an increase in the wait times for all OR services (i.e. the lack of timely access for majority of elective surgery patients), this project was undertaken as a precursor to the

development and implementation of an ambulatory care centre at the LHSC, VH. The purpose was as follows:

(1) to ensure that the cost savings achieved the context of high-efficiency OR (if any) were not at the expense of the patient care, i.e. to ensure that the high-efficiency OR provided similar patient outcomes as the conventional OR;

(2) to confirm that significant cost savings were, indeed, achieved, before the commencement of the construction of the newly-proposed ASC;

(3) to establish the determinants of patient satisfaction, by comparing the patient-reported quality of life (QOL); and

(4) to compare the level of staff satisfaction in the high-efficiency OR versus that of the conventional OR.

As such, healthier patients requiring less pre-operative optimization and surgical procedures that could be safely carried out on an outpatient basis were chosen to participate. In order to ensure that no compromise in quality of care occurred, only such patients were streamlined through the high-efficiency pathway, while those with higher needs were still retained in the traditional, conventional pathway.

The study was assigned an acronym, ACTOR (**A**cademic **C**entre-**T**iered **O**perating **R**oom), based on the pilot study (**A**cademic **C**entre-**T**iered **I**nitiative Strategy in the **O**perati**n**g Room, ACTION-in-the-OR). Orthopaedic specialty was chosen to compare the conventional versus high-efficiency OR setup, due to the multi-componential nature of orthopaedic surgical procedures.

CHAPTER 2

MATERIALS AND METHODS

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2.1 GENERAL DESCRIPTION

The study was approved by the Health Sciences Research Ethics Board (HSREB) at the University of Western Ontario (Apprendix I). The study was of a two-group, prospective cohort observational design. A total of two hundred patients were enrolled, with 100 patients assigned to each experimental group (conventional OR versus high-efficiency OR).

The investigation was designed to evaluate patient satisfaction through patient-reported outcome surveys. In addition, questionnaires assessing staff satisfaction were utilized, given that the success of the new system is highly dependent on successful adoption by the employees. Cost and economic analyses were also conducted, in order to evaluate financial particulars of the potential benefits (if any) associated with the new, high-efficiency OR system.

2.1.1 Selection Criteria

All participants were adults capable of providing informed consent. Low-surgical resource orthopaedic procedures were selected for the study, as these could be easily streamlined and the equipment standardized, while repetition iself can increase efficiency. Additionally, a smaller, more efficient team was chosen; as such, it was easier to communicate the responsibilities to all members, avoiding confusion or interference. Mostly healthy patients were selected for the study, given that they would constitute the normal population distribution within

the proposed ASC, against which different population groups can be compared in the future. Patient screening questionnaire is shown in Appendix II.

2.1.1.1 Inclusion Criteria

All patients included in the study were of either sex (male or female), 18 years of age or older, and able to provide informed consent (Appendix III). They were undergoing low surgical resource, lower limb orthopaedic surgical intervention of short duration, with minimal equipment needs. The patient must not have had any significant co-morbidities that would prevent outpatient day surgery (i.e. ASA≤3).

2.1.1.2 Exclusion Criteria

Patients who refused to participate in the study, and/or were unable to read and write in English, even with the aid of an interpreter, were excluded from the study. The patients undergoing bilateral operative procedures, those with concurrent injury that was deemed to delay or alter rehabilitation, and patients judged by the investigators as having problems with maintaining follow-ups were also excluded.

2.1.2 Patient Contact Timelines

All patients were followed up by the operating surgeon and the research team, from the time of surgery for a minimum of 6 months. The follow-up appointments were scheduled at 2 weeks, 6 weeks, 3 months and 6 months after

the procedure. The research team consisted of the graduate student, research coordinator and the project supervisor.

2.2 CONVENTIONAL VERSUS HIGH-EFFICIENCY OR SETUP

2.2.1 Patient Recruitment

Patients were assigned to one of the two groups, based on the dates of availability for the two OR setups. All patients were healthy, undergoing lower limb surgery (forefoot, midfoot, hindfoot, ankle, tibia-fibula or knee). These included deformity correction, fusion, fracture fixation, instability, arthroscopy, irrigation and debridement, tendinopathy, hardware removal and revision surgery, as well as any other procedures involving the knee, ankle or foot and their sub-components.

The algorithm for patient assignment to the high-efficiency OR is summarized in Figure 2.1. Comparing it to the patient intake (see Figure 1.1), the only difference was the fact that the patients going into the high-efficiency OR stream did not require admission to the hospital following the initial consultation with an orthopaedic team. Apart from that, all the other steps were the same as those with the conventional OR (see Chapter 1 for detailed description).

Given that these patients were all elective, they reported directly to the pre-admit clinic on the day of their surgery. They underwent the proper surgical preparation in the pre-operative day surgery area, after which they were sent to the OR. Patient recruitment for the study was carried out in the day surgery.

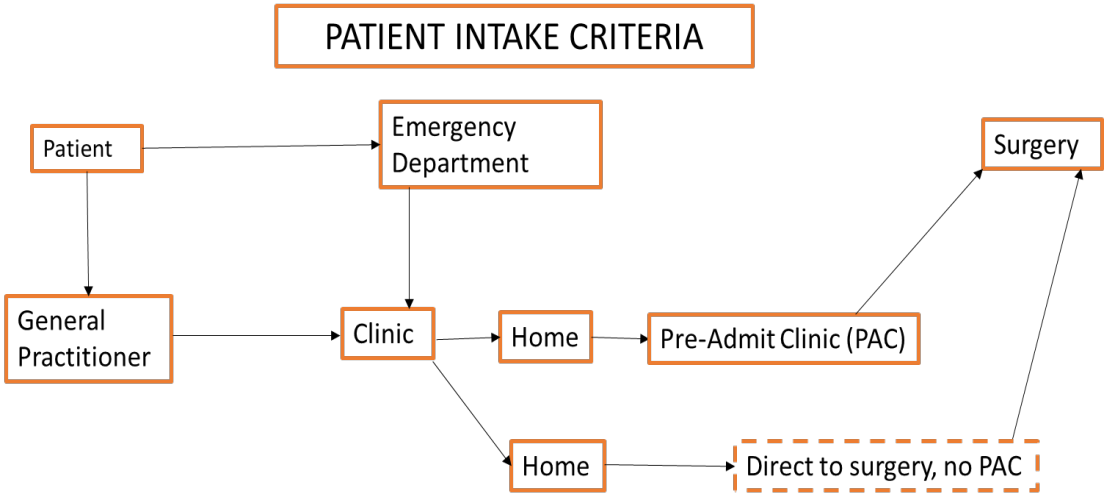

Figure 2.1. Patient intake criteria for patients going to the high-efficiency OR. There is no admission to the hospital after the emergency visit; the patients will not be admitted if seen in the clinic, as admission to hospital is an exclusion criterion for patients undergoing surgery in the high-efficiency OR group.

2.2.2 Choice of Anesthesia

In both, the high-efficiency and the conventional OR setups, all three anesthesia modalities (general, spinal, regional nerve block) were available to the patients. However, the choice was suggested/dictated by the anesthetic needs for the procedure the patient was to undergo.

Regional nerve block was the preferred (and most popular) choice for the high-efficiency OR group. Regional nerve block provided the localized sensory and motor anesthesia, combined with deep sedation, allowing the patient to be unconscious yet not paralyzed. The airway was protected, but did not require ventilation.

Regional spine anesthesia was the second choice, taking into consideration that the patients required post-operative mobilization (leg paralysis due to spinal anesthesia making post-operative mobilization difficult).

General anesthesia was chosen only when the nerve block or spinal anesthesia failed. Only five patients enrolled in the study had to be converted to a general anesthetic.

2.2.3 Post-Operative Care

All patients were sent to the post-operative day surgery area, directly from the OR (Figure 2.2). Anesthesia was rapidly reversed in the OR, since the patients obtained only a mild sedation as a part of the nerve block. The patients were given take-home instructions for wound care, weight-bearing, all necessary information for the immediate post-operative period and a prescription for

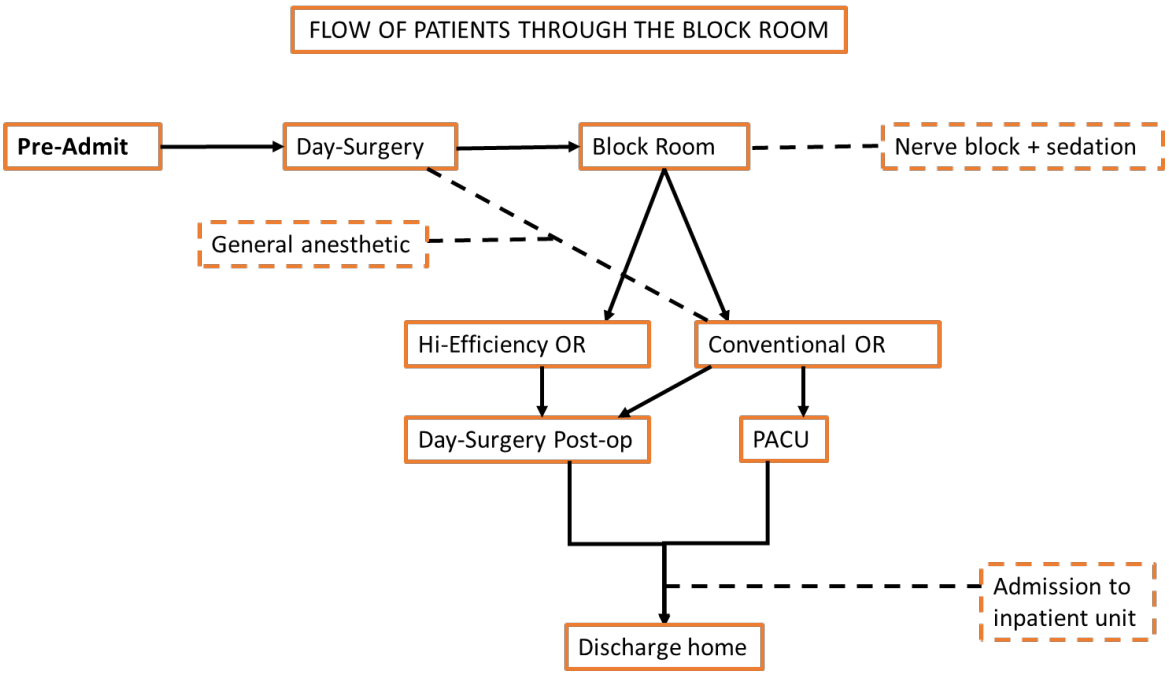

Figure 2.2. The flow of patients through the block room and post-operative care. The nerve block was the preferred method of anesthesia in the high-efficiency OR.

analgesics (combination of acetaminophen, NSAIDs and opioids). The patients were informed about their next visit at the 2-week post-op follow-up with the surgeon. Once deemed stable, the patients were discharged to home care.

Discharge to PACU was necessary only if the patient received general anesthesia; once clinically stable, the patient was brought to the post-operative day surgery unit.

2.2.4 OR Equipment and Staffing Requirements

The equipment in the high-efficiency OR was streamlined to include the standard bare minimum (Table 2.1). Unlike in the conventional OR, the surgical trays consisted of 30 tools (versus the minimum of 80 in the conventional OR, shown in Table 2.2).

Staffing of high-efficiency OR was geared towards increasing the team efficiency. Claims have been made that ASCs have higher efficiency, compared to general hospital, when performing the same surgery (Small, Gad et al. 2013), most likely due to the repetition of cases (Thompson and Calandruccio 2018). As such, only a select, small group of nurses was chosen to attend.

2.3 PATIENT EVALUATION

Each patient was presented with two questionnaires at the time of enrollment in the study: the screening form (Appendix II) and EuroQol EQ5D-5L survey (Appendix IV). The EuroQol EQ5D5L questionnaire was used to generate

Table 2.1. Contents of surgical instrument tray used in the high-efficiency OR. Unlike the tray in the conventional OR, the high-efficiency OR tray for minor orthopaedic procedures consisted of 25 surgical instruments.

DESCRIPTION	QUANTITY
FCP SPONGER STR SERR 9 ½	1
NH MAYO HEGAR 6 TC	1
NH CRILE WOOD FINE TC 6	1
FCP CRILE CVD 5 ½	2
FCP HALSTEAD MOSQ CVD 5	2
FCP BACKHAUS TOWEL 5 ½	1
RETR WIRE 1 DEL SINGLE PRONG	1
RONG KK SYNOVECTOMY ST C	1
CURETTE BRINS OVAL 7 # 00 HOLLOW HDL	1
ELEV FREER DBL-END SS BLUNT 7”	2
FCP ADSON 15CM 1 x 2 TEETH 8 1/4”	2
FCP POTTS-SMITH TISSUE 1 x 2 TEETH 8 1/4”	2
HOOK SHARP	1
SCISS METZ CVD 7.0 GOLD HNDL W/INSERT	1
SCISS STEVENS TENOTOMY CVD 5”	1
SCISS MAYO STR BEV 6 ¾	1
HANDLE KNIFE STANDARD #3	1
RETR SENN 3 PRONG	2
SUCTION ANTHONY 3MM	1
Total:	**25**

TOTAL NUMBER OF TOOLS = 25

Table 2.2 Contents of a standard tray for an orthopaedic procedure, used in the conventional OR. The standard tray consists of 80 surgical instruments.

BOTTOM OF THE TRAY

DESCRIPTION	QUANTITY
HAMMER ORTHO LIGHT 7 1LB. 2 OZ/8 OZ	1
RETR GELPI STANDARD	2
RONG LEKSELL 9 8 X 16MM 15° CVD	1
RONG ZAUFAL-JANSEN 7 5 X 15MM CVD DA	1
CUTTER BONE RUSKIN-LISTON STR	1
LEVEL BONES WATSON-JONES 11”	2
ELEV KEY 7 1/4 WIDTH	1
ELEV KEY 7 ½ WIDTH	1
ELEV KEY 8 ¾	1
FCP RUSSION TISSUE 8	1
Total	**12**

STRING

DESCRIPTION	QUANTITY
FCP HALSTEAD MOSQ STR 5	2
FCP HALSTEAD MOSQ CVD 5	2
FCP CRILE STR 5 ½	4
FCP ROCHESTER-PEAN HEMOSTAT CVD 6 ¼	4
FCP ROCH-OCHSNER HEM STR 6 ¼	4
FCP ALLIS TISSUE 5 X 6 TEETH 6” REG WEIGHT	2
NH CRILE WOOD FINE TC 6	2
NH MAYO HEGAR 7 ½ TC	2
FCP SPONGE STR SERR 9 ½	2
NH BERRY TM STERNAL 7 ¾ TC	1
FCP EDNA TOWEL 5 ½	3
FCP BACKHAUS TOWEL 5 ½	2
Total	**30**

PAPER POUCH #1

DESCRIPTION	QUANTITY
SCISS MAYO STR BEV 6 ¾	1
SCISS MAYO CVD BEV 6 ¾	1
SCISS METZ CVD 7.0 GOLD HNDL W /INSERT	1
SCISS TENOTOMY JAMISON METZ CVD 6”	1
HOOK SHARP	1
RETR SENN 3 PRONG	2
HOOK GILLIES SKIN 7 SM	2
Total	**9**

Table 2.2 (con't) Contents of a standard tray in the conventional OR.

PAPER POUCH #2

DESCRIPTION	QUANTITY
RETR LANGENBACK 8 ½" BLADE ½" X 1 5/8"	2
RETR LAHEY 8" ¼" X 1"	2
TISSUE HARRIS TOOTHED INSULATED	1
FCP JEFFERSON TISSUE TOOTHED 7"	2
FCP ADSON 15CM 1 X 2 TOOTHED	2
ELEV FREER DBL-END SS BLUNT 7"	2
IMPACTOR MICRO LATERAL 7	1
SUCTION ANTHONY 3MM	1
HANDLE KNIFE STANDARD #3	2
HANDLE KNIFE #7	1
HOOK DULL	1
TOTAL	17

SECTIONED TRAY LINER

DESCRIPTION	QUANTITY
RETR VOLKMAN RAKE 4 PRONG SHARP 8 SMALL	2
ELEV LANE SLIGHT CURVE NARROW (A)	1
ELEV LANE FULL CURVE NARRON (B)	1
ELEV LANE SLIGHT CURVE BROAD (C)	1
ELEV LANE FULL CURVE BROAD (D)	1
ELEV BRISTOW	1
BRUNS CURETTE ANG. 0	1
BRUNS CURETTE ANG. SIZE 2	1
BRUNS CURETTE ANG. SIZE 4	1
BRUNS CURETTE STR. SIZE 2	1
CURETTE BRUNS OVAL 9 # 0 HEX HANDLE	1
TOTAL	12

TOTAL NUMBER OF TOOLS = 80

three different scores; its self-reported questionnaire included a visual analog scale (VAS), which recorded the respondent's self-rated health status on a graduated (0–100) scale. It also included the EQ5D descriptive system, comprised of 5 dimensions of health: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The VAS provides a direct valuation of the respondent's current state of health, whereas the descriptive system can be used as a health profile or converted into an index score representing a von Neumann-Morgenstern utility value for current health (Rabin and de Charro, 2001). Therefore, the level of problem reported on each of the EQ5D dimensions determined a unique health state. Health states were then converted into a weighted health state index by applying scores from the EQ5D preference weights elicited from region-specific general population samples, with full health having a value of 1 and dead a value of 0. Quality Adjusted Life Years (QALY) score was also calculated; the score quantified the ability of a patient to live in full health at any point in time.

In our study participants, the EQ5D index value was calculated against the population weights based on responses received from the general North American population, correlating it to the local population.

2.3.1 Initial Screening at the Baseline Visit

The initial screening questionnaire consisted of patient demographic information (age, sex, weight and height). The patients were asked about work status, medical co-morbidities, length of time they had the operative diagnosis,

chronic pain and reason for getting surgery. Furthermore, pain index (10-point Likert scale), ankle function (100-point Likert scale) and activity level (100-point Likert scale) over the past seven days were also recorded. Additional information included the laterality (right versus left side) of surgery, location and type of surgery, as well as the type of anesthetic used and the operating surgeon.

2.3.2 Patient Follow-Up

The patient follow-up was conducted in the outpatient orthopaedic clinic. The follow-up appointments were carried out at 2 weeks, 6 weeks, 3 months and 6 months post-operatively. At the time of the follow-up appointment, the patients were asked to fill out the appropriate questionnaires.

2.3.2.1 Two-Week Follow-Up

At the time of two-week follow-up, the patients were asked to fill out the Patient Surgical Experience Satisfaction Survey (PSESS) (Appendix V) in addition to EQ5D-5L questionnaire. EQ5D captured patient information regarding pain, mobility, daily activities, anxiety/depression and self-care, as well as the patient's overall health (100 point Likert scale), while PSESS asked questions regarding overall patient experience during his/her visit for surgery, as well as their experiences with the anesthesia, surgery and nursing teams.

2.3.2.2 Six-Week Follow-Up

At the time of six-week follow-up, the patients were asked to fill out the American College of Surgeons National Surgical Quality Improvement Program questionnaire (ACS NSQIP) (Appendix VI) in addition to the EQ5D-5L. NSQIP is a standardized questionnaire on patient experience with the surgical team pre- and post-operatively; it consisted of three different sections evaluating pain, function and quality of surgical services.

One component of NSQIP questionnaire, the Item Response Theory (IRT), provided the basis for formulating patient-reported outcomes measurement information system (PROMIS) questions, a sub-component of the NSQIP questionnaire. IRT assists with the prevention of data misinterpretation, by comparing the patient's responses to a set of standardized responses, ensuring the recognition of specific patient characteristics, thereby decreasing the margin of error.

PROMIS consists of PROMIS Pain Interference and PROMIS Global questions, providing an assessment of the effects of pain on different aspects of an individual's life and his/her mental/physical health, respectively. PROMIS T-scores were calculated using online T-score calculator (Hays et al., 2009).

2.3.2.3 Three-Month And Six-Month Follow-Ups

At three-month follow-up appointments, the patients were asked to fill out the EQ5D-5L questionnaire. No other additional information was required.

2.4 STAFF SATISFACTION SURVEYS

Staff satisfaction surveys were carried out in order to evaluate the satisfaction of the hospital employees involved with the high-efficiency and conventional OR setups. The surveys were based on those of the Institute for Healthcare Improvement (IHI) (IHI 2018), and consisted of 6 questions about the satisfaction of an employee with his/her work environment (Appendix VII). Additionally, a short, personalized questionnaire tailored to different roles played by the various team members were also administered. Combined with the IHI satisfaction survey, the role-specific feedback for the study was thus provided.

2.4.1 IHI Nursing Survey

In addition to the six standard IHI survey questions, nursing staff were asked to respond to the following, using a visual analog scale (Appendix VII.1): anxiety level, time to prepare, satisfaction with information provided to the patient, need for additional information, satisfaction with communication between Day Surgery and OR staff.

2.4.2 IHI Anesthesia Survey

In addition to the six standard IHI survey questions, the anesthetists and block room nurses were asked to respond to the following, using a visual analog scale (Appendix VII.2): anxiety level, time to prepare the patient and administer anesthesia (general anesthesia or a regional block), satisfaction with information provided to the patient, assessment of the need for information required by the

patient, satisfaction with communication in the block room/OR staff during the procedure.

2.4.3 Orthopaedic Staff Survey

In addition to the six standard IHI survey questions, orthopaedic staff were asked to respond to the following, using a visual analog scale (Appendix VII.3): efficiency of OR setup, time to perform surgery, effectiveness of communication between OR staff.

2.5 STATISTICAL ANALYSIS

2.5.1 Database

Microsoft Excel 365 (Microsoft Corp., Redmond, WA) was used to build and maintain the database of participants in the study. Patient biographical information, including demographics, was collected. Patient anonymization was then carried out, by assigning each patient a unique study identification number; the number was then used to identify the patient for the duration of the study.

2.5.2 Statistical Tests

Statistical analysis was carried out using SPSS (v. 24, SPSS Inc., Chicago, IL) Microsoft Excel database was imported into SPSS. All parametric data was expressed as a mean ± standard deviation (SD) (all categorical data) or a mean ± standard error of the mean (SEM) (numerical non-categorical data). Student t-

test and one-way ANOVA analyses were used for continuous parametric data, while the Mann-Whitney U-test and Kruskal-Wallis ANOVA were used for non-parametric data. For categorical data, Chi-square (χ^2) test was used; confidence intervals (CI) were calculated for all proportions. A p-value of <0.05 was considered statistically significant.

Data from the screening form and PSESS were analyzed by χ^2 test, t-test and descriptive statistics. Common questions from the IHI staff satisfaction surveys were pooled, reported as a mean score for each question, and analyzed using t-test. Individual questions that were specific to surgeons, anesthetists and/or nurses were reported in each respective individual category.

Data obtained from the EuroQol EQ5D-5L was reported in three formats: EQ5D VAS, EQ5D Index Value and EQ5D QALY score. The EQ5D VAS score was reported as a trend across time, and compared by Kruskal-Wallis ANOVA at all five different time points. EQ5D Index Value score was calculated with the assistance of EuroQol-provided calculator, comparing it to a reference population (i.e. the general population of the US, as there was no reference population score for Canada). The outcome of Index Value score was a trend of the five patient scores obtained during each hospital visit (from the time of initial appointment to 6-month follow-up). EQ5D QALY score was calculated with the help of the EQ5D index value score, multiplied by time from the start of the study, yielding four scores (one for each of the follow-up visit); the score was reported as a trend.

NSQIP outcomes were divided into two streams: those related to the questions pertaining the PROMIS domain, and those pertaining to the Consumer Assessment of Healthcare Providers and Systems (CAHPS). PROMIS-related outcomes produced a T-score, calculated using the Health Measures website-provided automated calculator, taking into the account the three scores (i.e. PROMIS Pain Interference, PROMIS Global Mental Health and PROMIS Global Physical Health sections). PROMIS T-scores were compared by a t-test between those obtained for conventional versus high-efficiency OR patients. Answers pertaining to CAHPS questions were reported across five categories. A t-test was used to compare the answers from the CAHPS questionnaire between conventional OR versus high-efficiency OR patients.

2.5.3 Statistical Power Calculation

Power calculation was carried out using the data from the ACTION-in-the OR pilot data (see Section 1.4.3 in Chapter 1), using the EQ5D-5L questionnaire. A 10-point difference in the EQ5D-5L score between the means of the two groups was considered as clinically significant, while 20-point difference was set as one standard deviation (SD). The minimum sample size, using two-sided significance, α error of 0.05 and a power of 80%, was found to be 63 patients per group. As such, a sample size of 100 patients per group was established as the minimum number of patients to recruit, to account for any losses to follow-up.

2.6 COST DATA

The collection of the cost data was carried out by the administration at the London Health Sciences Centre, Victoria Hospital. The OR expenses included the cost of equipment, medications and salaries for allied healthcare staff, including nurses. Surgeon's salaries were not included in the cost calculation, as they are paid directly by the provincial government, not by the hospital administration.

2.6.1 Operating Room Costs

OR costs were reported in two major categories: fixed and variable. Variable costs were further subdivided into the costs of labour, equipment, general supplies and patient-specific supplies.

Direct labour costs (variable costs) included the salaries of nurses, technicians and other allied healthcare workers, taking into the account the entire cost of the labour force, i.e. including the sick and vacation time, benefits, lunch breaks, etc. The calculation was carried out by adding all tracked patient minutes within the system (the denominator of the equation), and the total amount spent on related cost for nursing or technical labour (the numerator of the equation).

Direct supplies costs (variable costs) included the cost of all supplies used to carry out the procedures. For the OR supplies, a sample of expenses was obtained through the 'orange bag process', i.e. all packaging of the supplies/equipment used was put into an orange bag for later segregation and barcode scanning for the cost. All other areas (i.e. those not in the OR) used the

weighing system: the cost of supplies was based on the weight per patient minutes (assuming that more supplies were used on the patients with longer length of stay).

2.6.2 Cost of Anesthesia

The cost of anesthetics was also tallied. For the conventional OR, the calculation included all medications necessary for the general anesthesia; that for the high-efficiency OR included all medications necessary to carry out the nerve blocks, but not the cost of general anesthesia (general anesthetics were only kept on standby).

CHAPTER 3

RESULTS

CHAPTER 3. RESULTS

3.1 PATIENT DEMOGRAPHICS

The summary of participant demographics is shown in Table 3.1. The average age of patients undergoing surgery in the conventional OR group was 48.6±1.5 years (95% CI, 44.5-51.7), while that for high-efficiency OR was 54.2±1.5 years (95% CI, 51.2-57.2); the patients in the conventional OR group were significantly younger by an average of 5.6 years than those of the high-efficiency OR group (t-test, p=0.010). The number of patients in the high-efficiency OR with age below 50 years was significantly lower (36 patients versus 50 in the conventional OR); the number of patients above the age of 50 was higher in the high-efficiency OR group (69 versus 50 in the conventional OR, χ^2 test, p=0.007). Although a higher number of males were represented in both groups, the differences were not statistically significant (χ^2 test, p=0.151, n.s.).

BMI of patients in the conventional OR group was 29.8±0.6, while that for the patients in high-efficiency OR group was 27.2±0.6 (p=0.003) (Table 3.1); patients in the conventional OR group were significantly heavier than those in the high-efficiency OR group (88kg versus 77kg, t-test, p<0.001). Twenty-one patients in the conventional OR group were smokers, while there were 23 smokers in the high-efficiency OR group (p=0.37, n.s.). Sixty-six patients in the conventional OR group (65.3%) versus 67 (67%) patients in high-efficiency OR group reported being in chronic pain (p=0.627, n.s.).

Table 3.1 Demographic characteristics of patients enrolled in the study.

*p<0.05. *CI*, confidence interval.

VARIABLE	Conventional OR		High-Efficiency OR		p-value
	Mean or N	95% CI	Mean or N	95% CI	
Age (years)	48.6±1.5	45.5-51.7	54.2±1.5*	51.2-57.2	0.010
<55 (N)	50		32		
≥55 (N)	50		69		
Sex (N)					
Male	41		31		
Female	58		70		
Other	1		0		
Smoking Status (N)					
Smoker	21		23		
Non-Smoker	51		54		
Ex Smoker	26		17		
Physical Attributes					
Height (cm)	171.6±1.1		167.8±1.0		0.010
Weight (kg)	88.3±2.3		77.7±1.8*		<0.001
BMI	29.2±0.6	28.5-31.1	27.2±0.6*	26.0-28.4	0.003
Work Status (N)					
Employed FT	47		44		
Employed PT	9		6		
Student	5		2		
Home Maker	4		3		0.780
Retired	17		21		
Retired due to disability	11		10		
Other	5		8		
Chronic Pain (N)					
Yes	66		67		
No	31		27		
Time with Condition (months)	45±8		88±13*		0.004
Reason for Surgery (N)					
Pain	56		70		
Discomfort	1		6		
Appearance	0		0		0.020
Function	21		13		
Other	19		5		
Pre-Surgery Levels					
Pain (/10)	6.3±0.3		6.1±0.3		0.450
Function (/100)	65.4±3.1		75.2±2.5*		0.002
Activity (/100)	49.1±3.5		66.5±3.2*		<0.001

3.1.1 Reasons for Surgery

The reasons for surgery, as given by the patients, were pain (56 patients in the conventional OR versus 70 in the high-efficiency OR), loss of function (21 patients in the conventional OR versus 13 in high-efficiency OR group), discomfort (1 patient in the conventional OR versus 6 in the high-efficiency OR) (χ^2 test, p=0.002) (Table 3.1). In the conventional OR group, 56% of patients opted for surgery due to pain, compared to 69.3% in the high-efficiency OR group (t-test, p<0.01).

The average length of time with the disease for the patients in the conventional OR group was 44.5±7.9 months, while that for the patients in the high-efficiency OR group was 87.6±12.7 months (p<0.01) (Table 3.1).

3.1.1.1 Pre-Surgical Level of Disability

The mean numeric pain level score of the patients in the conventional OR group was reported as 6.3±2.6, while that in the high-efficiency group was 6.1±2.5 (t-test, p=0.45, n.s.) (Figure 3.1). The mean numeric function level score of patients was 65.4±30.2 in the conventional OR group and 75.2±24.0 in the high-efficiency OR group (Mann Whitney U-test, p=0.020). The mean numeric activity level reported was 49.1±34.1 in the conventional OR and 66.5±30.7 in the high-efficiency OR groups (Mann Whitney U-test, p<0.001) (Figure 3.1).

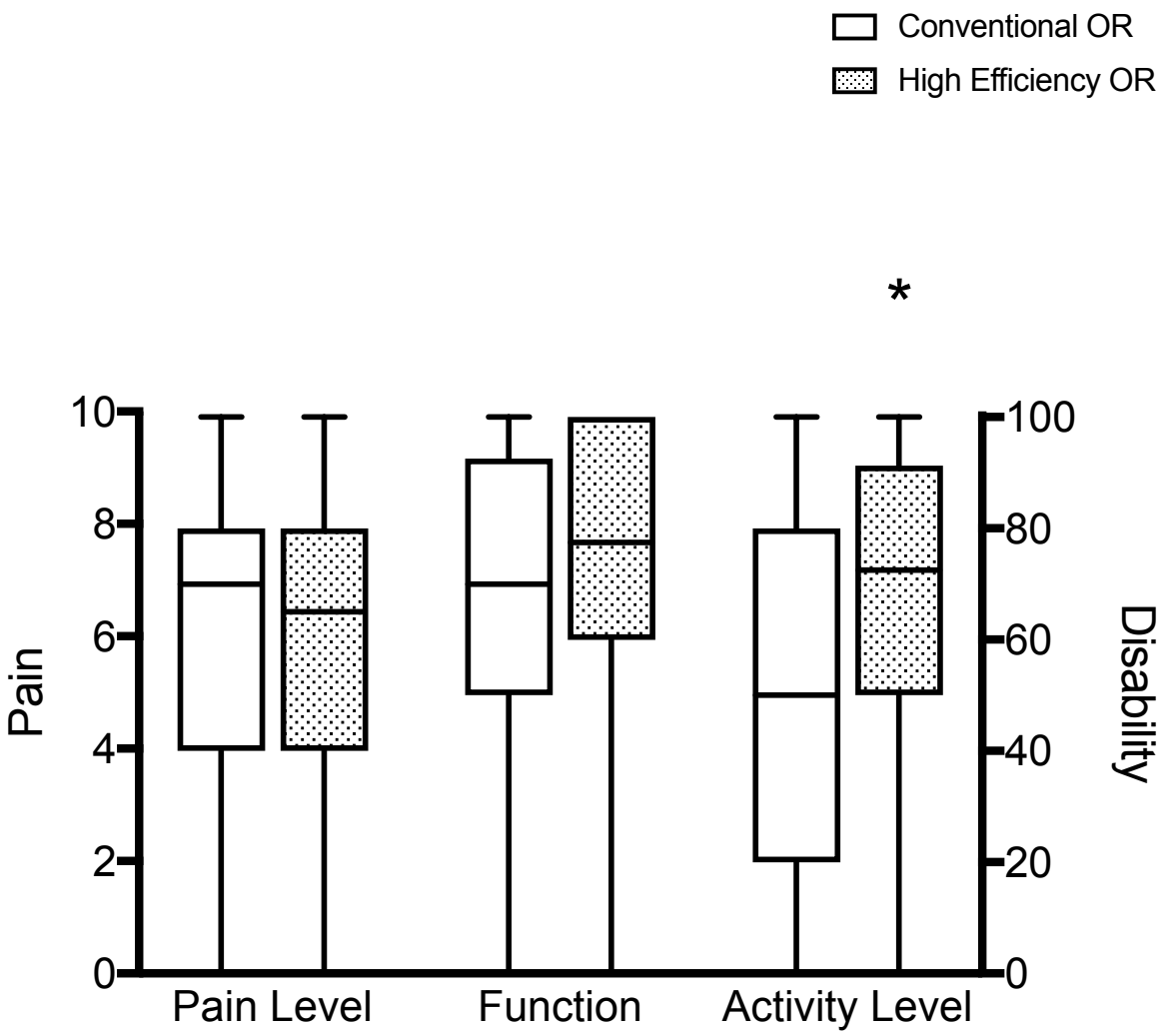

Figure 3.1 Pre-surgical level of disability (pain, function, activity) reported by patients enrolled in the study. Levels were measured on Pain and/or Likert scale, (pain on a scale out of 10, function/activity on a Likert scale out of 100). Boxes correspond to interquartile range, with median at the horizontal bar; whiskers correspond to maximum and minimum. *$p<0.05$

3.2 PATIENT SURGICAL EXPERIENCE SATISFACTION SURVEYS

3.2.1 Satisfaction with Wait Times

The level of satisfaction of all study patients with their wait times are shown in Figure 3.2. The mean numeric satisfaction score for the length of time from the physician referral to the initial appointment with an operating surgeon was 7.1±2.9 by the conventional OR patients and 7.4±2.6 by the high-efficiency OR group of patients (p=0.441, n.s.). The mean numeric score for the wait times from the initial appointment to the time of surgery was reported as 8.4±2.1 by the conventional OR patients and 8.8±1.5 by the high-efficiency OR patients (p=0.08, n.s.).

3.2.2 Satisfaction with Anesthesia Team

Patient satisfaction with the anesthesia team is summarized in Figure 3.3A. Satisfaction with the information provided to the patients by the anesthesia team was given a mean numeric score of 9.0±1.1 by the patients in the conventional OR and 9.0±1.5 in the high-efficiency OR group (t-test, p=0.753, n.s.). Patients in the conventional OR group rated the care they received from the anesthesia team at 9.1±1.2 and those in high-efficiency OR group at 9.0±1.5 (t-test, p=0.916, n.s.). The type of anesthetic used to carry out the surgical procedure was given mean numeric scores of 8.8±1.5 and 8.9±1.8 in conventional and high-efficiency ORs, respectively (t-test, p=0.600, n.s.). The patients in the high-efficiency OR were more likely to recommend the type of anesthetic they received during their

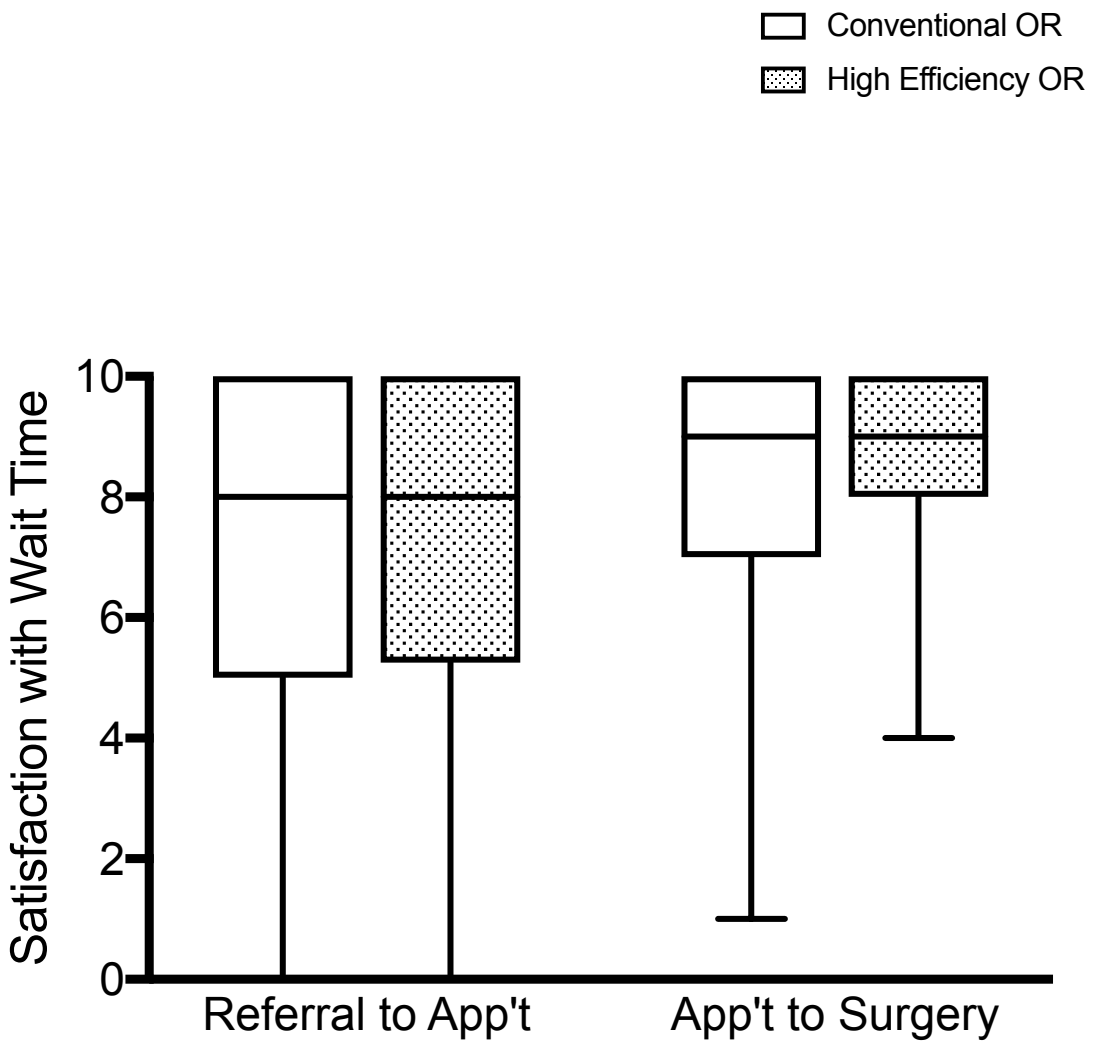

Figure 3.2 Patient satisfaction with wait times (from referral to appointment with surgeon, from appointment to surgery). Satisfaction was measured on Likert scale of 1-10. Boxes correspond to interquartile range, with mean at the horizontal bar; whiskers correspond to maximum and minimum.

App't, appointment.

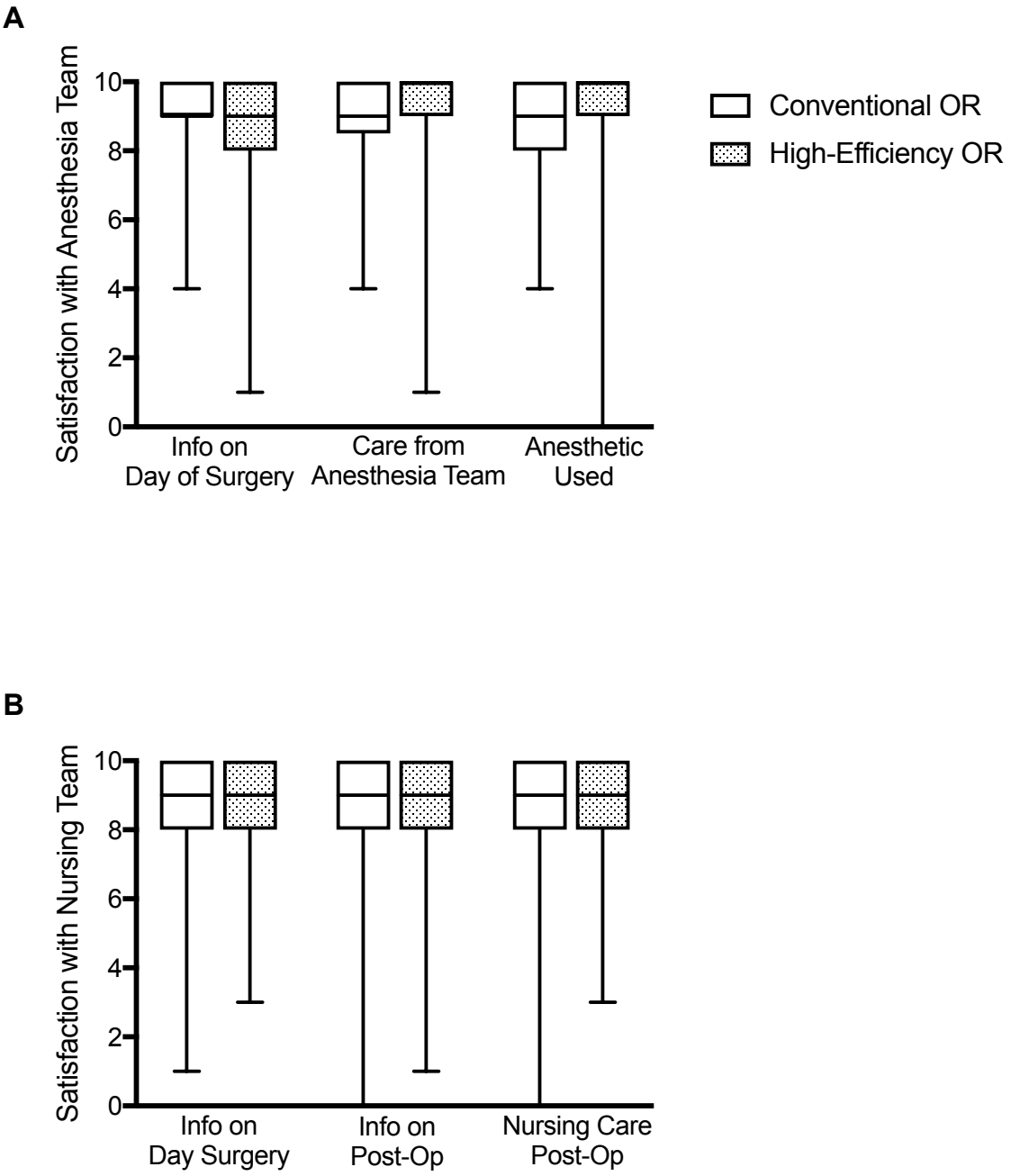

Figure 3.3 Patient satisfaction with anesthesia and nursing teams. Satisfaction was rated on Likert scale of 1-10. Boxes correspond to interquartile range, with median score at the horizontal bar; whiskers correspond to maximum and minimum.

surgery to family and friends (mean numeric score of 9.2±1.7 versus 8.7±1.8 in conventional OR, t-test, p=0.046).

3.2.3 Satisfaction with Nursing Team

Patient satisfaction with the post-operative nursing care is summarized in Figure 3.3B. The mean numeric satisfaction scores for the information provided to patients by the nurses on the day surgery were 8.8±1.7 in the conventional OR and 8.9±1.3 in the high-efficiency OR groups (t-test, p=0.486, n.s.). The mean numeric satisfaction scores for information on the post-operative care provided to the patients were 8.5±2.0 and 8.7±1.7 in the conventional and high-efficiency OR groups, respectively (t-test, p=0.589, n.s.). The mean numeric satisfaction scores for the post-operative care provided to the patients by the nurses were 8.8±1.7 in the conventional OR and 8.9±1.4 in the high-efficiency OR groups (t-test, p=0.422, n.s.).

3.2.4 Satisfaction with Surgical Team

Reported levels of patient satisfaction with the surgical team are shown in Figure 3.4A. Mean numeric score of patient satisfaction with the information provided to them by the operating surgeon was 8.0±2.0 in the conventional OR patient group and 8.6±1.6 in the high-efficiency OR patient group (t-test, p=0.327, n.s.). The patients reported satisfaction with the information provided to them about the preparation for the day of the surgery with numeric means of 8.8±1.7

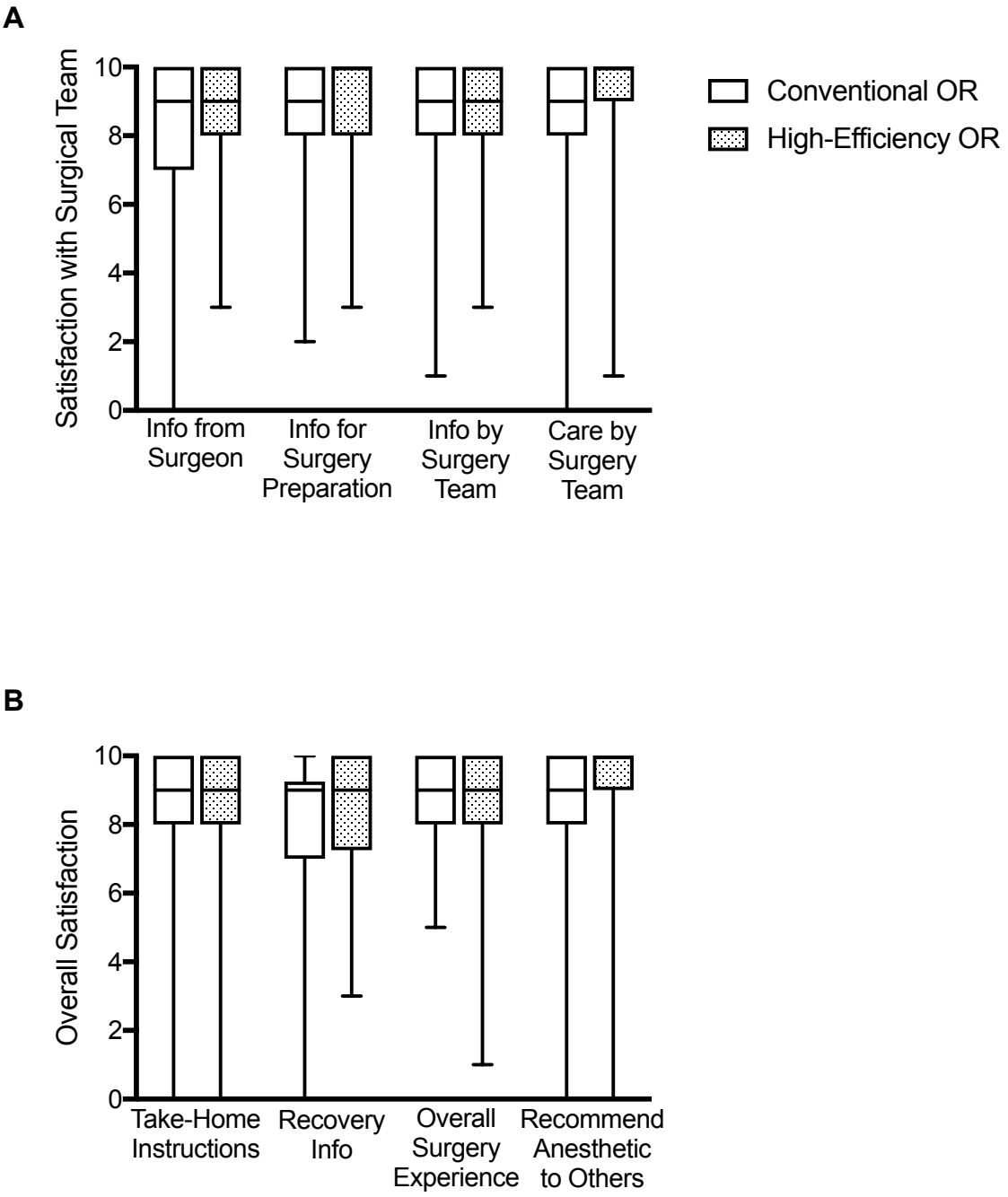

Figure 3.4 Patient satisfaction with surgical team and their overall surgical experience. Satisfaction was rated on Likert scale of 1-10. Boxes correspond to interquartile range, with median score at the horizontal bar; whiskers correspond to maximum and minimum.

and 9.1±1.3 in the conventional and high-efficiency OR groups, respectively (t-test, p=0.113, n.s).

Patients rated their satisfaction with the information provided by the surgical team on the day of the surgery with mean numeric scores of 8.9±2.4 and 9.2±1.9 in the conventional and high-efficiency OR groups, respectively (t-test, p=0.140, ns). Care provided by the surgical team was rated with mean numeric score of 9±1.6 by the conventional OR group and 9±1.5 by the high-efficiency OR group (t-test, p=0.291, n.s.).

3.2.5 Overall Satisfaction with Surgery Experience

Figure 3.4B shows the overall satisfaction with the surgery experience received by all patients. Satisfaction with take-home instructions was scored at a numerical mean of 8.5±1.8 by the conventional OR group and 8.6±1.7 by the high-efficiency OR patients (t-test, p=0.730, n.s.). Satisfaction with the recovery information was rated at a numerical mean of 8.0±2.1 by the patients in the conventional OR and 8.3±1.7 by high-efficiency OR patients (t-test, p=0.271, n.s.). Satisfaction with the overall surgery experience was numerically scored at 8.7±1.3 and 9.0±1.3 by the conventional OR and high-efficiency OR patients, respectively (t-test, p=0.105, n.s.). The likelihood of recommending the chosen OR setup to family and friends were rated at numerical means of 9.2±1.1 and 9.4±1.0 by the patients in conventional and high-efficiency OR setup groups, respectively (t-test, p=0.239, n.s.).

3.2.6 Post-Operative Recovery

Table 3.2 provides the detailed summary of post-operative recovery in all patients. In the conventional OR group, 67% of patients reported being informed about the anesthetic pre-operatively, while 87% received this information in the high-efficiency OR group (p=0.01). The time to discharge was significantly lower in the high-efficiency OR patients (χ^2 test, p<0.01). Thirty-seven patients experienced side effects from anesthesia in the conventional OR group, while 19 patients experienced these in the high-efficiency OR group (p<0.01). Verbal and written take-home instructions were provided to 75% of patients in the conventional OR, versus 90% in the high-efficiency OR group (p=0.03).

3.3 EVALUATION OF PATIENT QUALITY OF LIFE

3.3.2 Evaluation System – EQ5D Visual Analogue Score (VAS)

The self-reported patient baseline VAS scores were 75±2 in the conventional OR and 74±2 in the high-efficiency OR groups (p=0.992, n.s.). The self-reported VAS scores increased to 77±2, 78±2, 81±2 and 83±8 in the conventional OR, and to 72±2, 77±2, 78±3 and 74±12 in the high-efficiency OR patients at 2 weeks, 6 weeks, 3 months and 6 months follow-ups (Kruskal Wallis ANOVA, p=0.664, n.s.) (Figure 3.5A).

Table 3.2 Post-operative recovery parameters of patients enrolled in the study.

	Conventional OR N (%)	High-Efficiency OR N (%)	p-value
Informed about anesthetic pre-operatively	64 (67%)	82 (84%)	0.01
Time to Discharge	<1 hour: 2 (2%) 1-2 hour: 33 (34%) 2-3 hour: 29 (30%) 3-6 hour: 20 (20%) >6 hours: 6 (6%) Other: 2 (2%) Do Not Recall: 4 (4%)	<1 hour: 19 (19%) 1-2 hour: 45 (45%) 2-3 hour: 18 (18%) 3-6 hour: 10 (10%) >6 hours: 4 (4%) Other: 3 (3%) Do Not Recall: 3 (3%)	<0.01
Side Effects from Anesthesia	No: 61 (62%) Yes: 37 (38%)	No: 81 (81%) Yes: 19 (19%)	<0.01
Type of take-home instructions	Verbal: 11 (11%) Written: 9 (9%) Verbal and Written: 71 (75%) Do not recall: 4 (4%)	Verbal: 3 (3%) Written: 6 (6%) Verbal and Written: 71 (90%) Do not recall: 1 (1%)	0.03

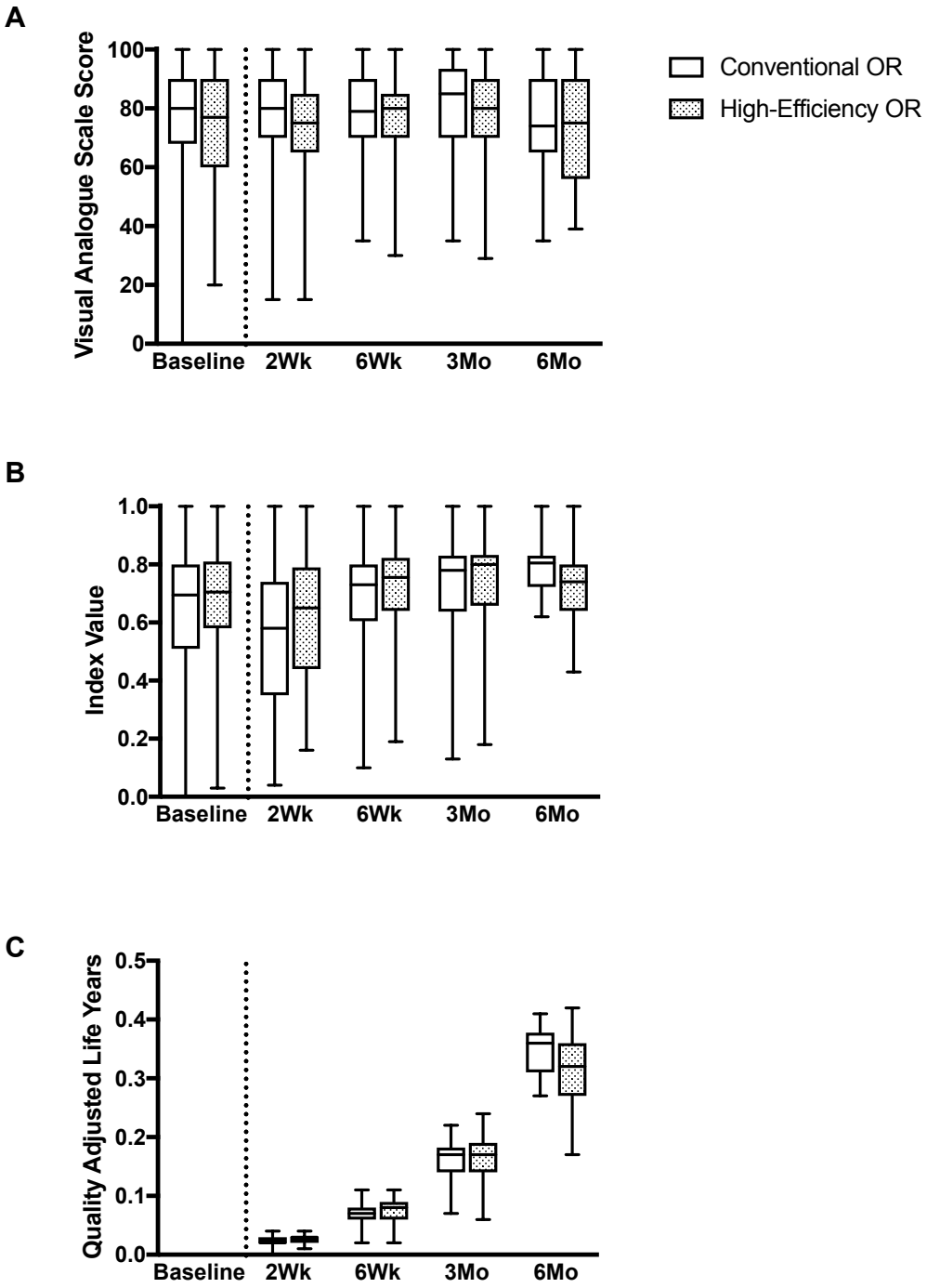

Figure 3.5 Patient-reported changes in the description and evaluation of their health state levels. (A) visual analogue score, **(B)** index value and **(C)** quality adjusted life years at follow-ups indicated.

3.3.2 Descriptive System – EQ5D Index Value

Computed baseline EQ5D index values for conventional and high-efficiency OR patient groups were 0.63±0.02 and 0.66±0.02, respectively (p=0.826, n.s.). For both groups of patients, the index values slightly decreased from their baselines at 2 weeks follow-up, to 0.56±0.02 for conventional and 0.61±0.02 for high-efficiency OR groups. The index values then progressively increased at 6 weeks, 3 months and 6 months follow-ups, to 0.68±0.02, 0.72±0.02 and 0.79±0.03 for the conventional OR and to 0.72±0.02, 0.75±0.02 and 0.72±0.04 for the high-efficiency OR patients (Kruskal Wallis ANOVA, p=0.234, n.s.) (Figure 3.5B).

3.3.3 Quality Adjusted Life Years (QALY)

The calculated post-operative QALY values for the conventional OR patients were found to progressively increase to 0.023±0.001, 0.072±0.002, 0.159±0.004 and 0.347±0.012 at 2 weeks, 6 weeks, 3 months and 6 months follow-ups, respectively (ANOVA, p<0.001) (Figure 3.5C). Post-operative QALY values for the high-efficiency OR patients also progressively increased, to 0.024±0.001, 0.076±0.002, 0.169±0.004 and 0.303±0.018 at their 2 weeks, 6 weeks, 3 months and 6 months follow-ups, respectively (Kruskal Wallis ANOVA, p<0.001). There was no statistical difference in QALY between patients in the conventional OR and those in the high-efficiency OR (p=0.246, n.s.).

3.4 NATIONAL SURGICAL QUALITY IMPROVEMENT PROGRAM EVALUATION SURVEYS

3.4.1 PROMIS Scores

The calculated PROMIS Pain Interference T-score of patients in the conventional OR group was 63.1±0.7, while that for the high-efficiency OR group was 64.7±0.8 (t-test, p=0.131, n.s.). PROMIS Global Mental Health and Global Physical Health T-scores of patients in the conventional OR were 49.1±1.0 and 42.2±0.8, respectively, while those of high-efficiency OR patients were 49.5±1.1 and 42.8±0.8, respectively (t-test, p=0.791 for Global Mental Health and p=0.572 for Global Physical Health, n.s.) (Figure 3.6).

3.4.2 CAHPS Surveys

3.4.2.1 Patient Characteristics

The breakdown of enrolled patient populations by the maximum achieved education level is shown in Figure 3.7A. In both groups, the majority of patients had at least 2-year college/university education (37% in the conventional, 31% in high-efficiency OR group), with those who graduated high school (or equivalent) being the second most numerous category (24% and 26% in the conventional and high-efficiency OR, respectively), followed by those who had more than 4-year college/university degree (14% and 17% in the conventional and high-efficiency OR, respectively). The education levels of patients in the conventional OR group were found to be equivalent to those in the high-efficiency OR group across all categories (χ^2 test, p=0.460, n.s.).

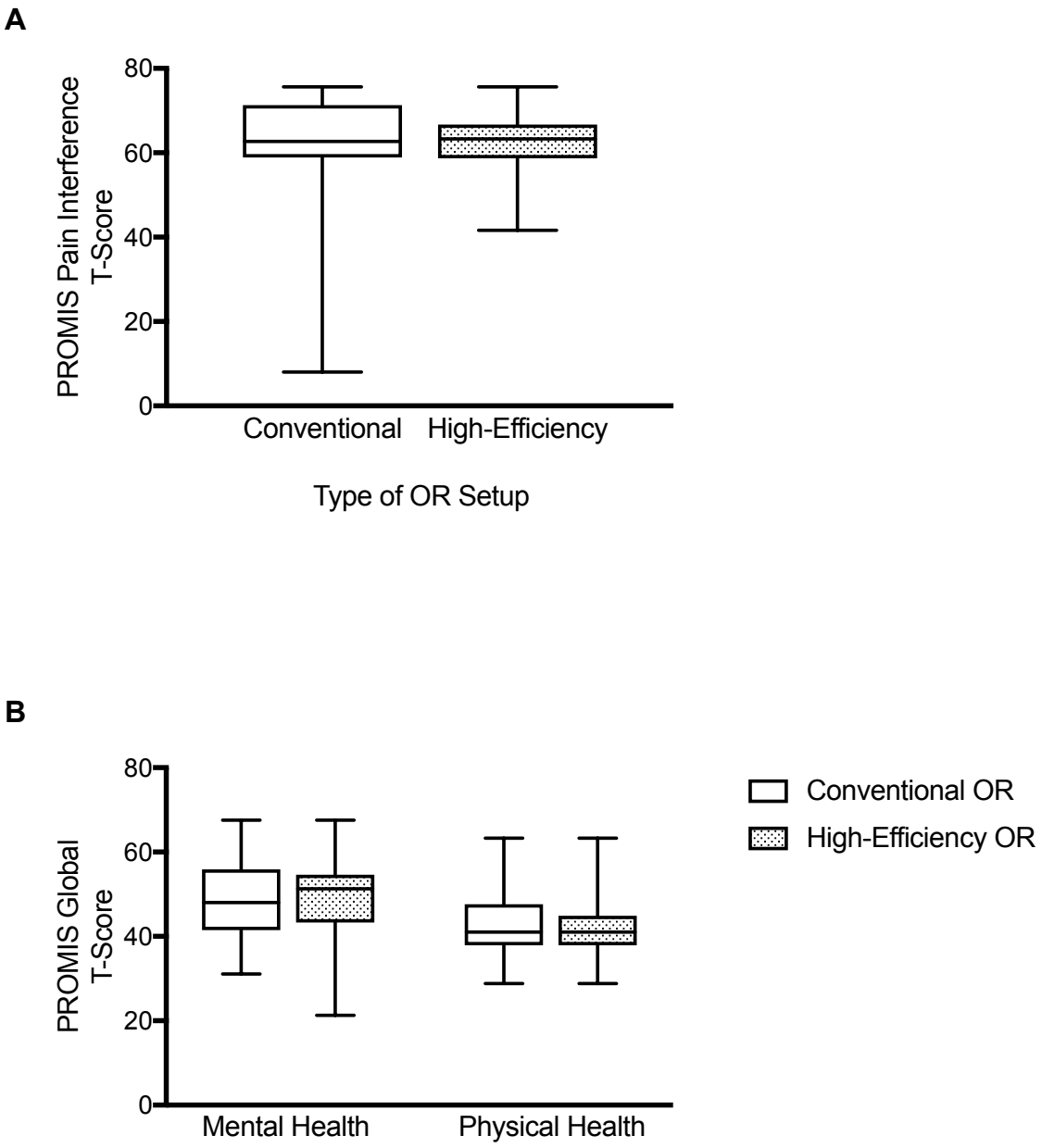

Figure 3.6 ACS NSQIP outcome evaluation of participating patients. (**A**) PROMIS Pain Interference, and (**B**) PROMIS Global (mental and physical health) T-scores, obtained at 6 weeks post-surgery follow-up. Boxes correspond to interquartile range, with mean at the horizontal bar; whiskers correspond to maximum and minimum.

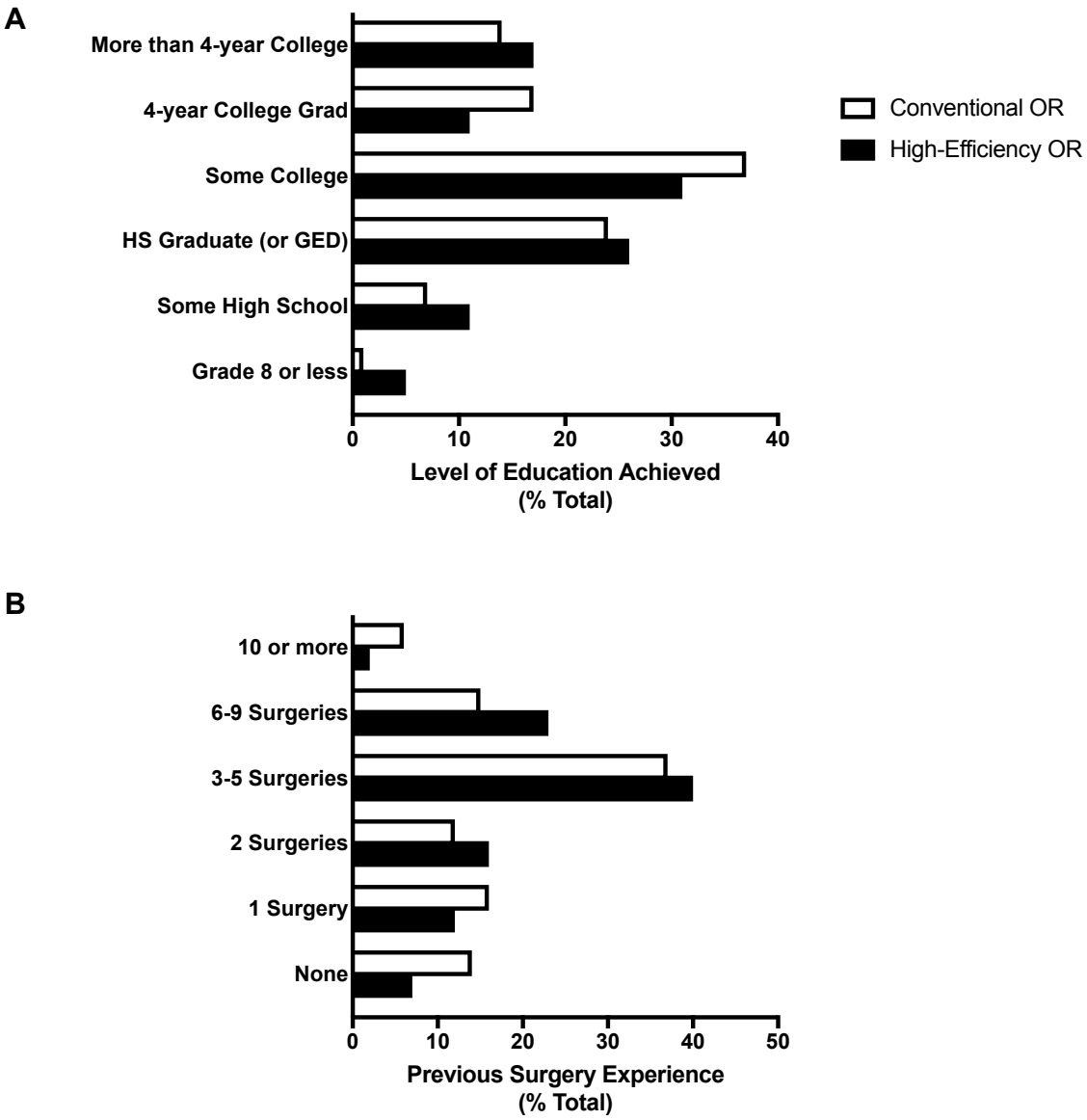

Figure 3.7 Characteristics of patients evaluating conventional and high-efficiency OR surgical setups. (**A**) maximum education level obtained by the patients, (**B**) previous surgery experience.

The breakdown of patients by their previous experience with surgery is shown in Figure 3.7B. Fourteen percent of patients in the conventional OR group and 7% of patients in the high-efficiency OR group reported having no previous surgery experience. Majority of patients had 3-5 previous surgeries (37% and 40% for the conventional and high-efficiency OR groups, respectively); 6% in the conventional and 2% in the high-efficiency OR patients reported having 10 or more surgeries previously. Patients in the conventional OR group were found to have an equivalent level of previous surgery experience to those in the high-efficiency OR group (χ^2 test, p=0.310, n.s.).

3.4.2.2 Patient Perspectives on Total Surgical Experience

Patient satisfaction with the reception staff is shown in Table 3.3. Eighty-four percent of patients in the conventional OR and 89% in high-efficiency OR group reported the front desk staff being as helpful as expected, while 2% of conventional and none of the high-efficiency OR patients did not find the staff helpful at all (χ^2 test, p=0.301, n.s.). Eighty-seven percent of patients in the conventional and 91% in high-efficiency OR groups reported being treated with courtesy and respect, while 1% in the conventional and 2% in high-efficiency OR groups were not satisfied with the service provided by the reception staff (χ^2 test, p=0.452, n.s.).

Pre-operative patient experience is shown in Table 3.4. A large majority (i.e. more than 75%) of patients described their experience as ‘definitely satisfied’ across all categories, with a low percentage (i.e. less than 5%) as ‘not satisfied’.

Table 3.3 Patient satisfaction with reception staff

Question	OR Type	Yes, definitely	Yes, somewhat	No	p-value
Helpful as expected	Conventional	84%	14%	2%	0.301
	High-efficiency	89%	11%	0%	
Treated with courtesy and respect	Conventional	87%	12%	1%	0.452
	High-efficiency	91%	7%	2%	

Table 3.4 Patient satisfaction with their pre-operative experience.

Question	OR Type	Yes, definitely	Yes, somewhat	No	p-value
Pre-surgery information package	Conventional	75%	22%	3%	0.160
	High-efficiency	84%	16%	0%	
Pre-surgery information instructions	Conventional	84%	13%	3%	0.140
	High-efficiency	92%	8%	0%	
Surgeon's listening skills	Conventional	88%	11%	1%	0.660
	High-efficiency	92%	7%	1%	
Adequate time	Conventional	77%	20%	3%	0.540
	High-efficiency	82%	17%	1%	
Encouraged to ask questions	Conventional	74%	21%	5%	0.270
	High-efficiency	81%	12%	7%	
Respect for patient's perspective	Conventional	89%	10%	1%	0.400
	High-efficiency	94%	6%	0%	
Image helped in explanation	Conventional	85%	11%	4%	0.920
	High-efficiency	86%	11%	3%	
Stress relief	Conventional	75%	22%	3%	0.950
	High-efficiency	77%	20%	3%	

A breakdown of post-operative patient experience evaluation is shown in Table 3.5. A majority of patients rated their experience as 'completely satisfied' across all categories in both groups, with a mild trend towards higher level of satisfaction experienced by the patients in the high-efficiency OR group.

Patients in both the conventional and high-efficiency OR groups were equally satisfied with their operating surgeon, with median score of 10 (t-test, p=0.84, n.s.) (Figure 3.8). Patients scored the provision of surgical eduation and awareness by the whole team fairly equally, although the ratings were slightly higher by the high-efficiency OR group in three out of six categories (Table 3.6).

3.5 INSTITUTE FOR HEALTHCARE IMPROVEMENT STAFF SURVEYS

3.5.1 Staff Satisfaction with Work Environment

Results of staff satisfaction surveys are summarized in Table 3.7. Out of the surveyed 25 nursing staff, 8 surgeons and 25 anesthesia staff respondents, nurses rated their satisfaction with the team at 8.5±1.2 (versus 9.3±1.0 by surgeons and 8.5±1.4 by anesthesia staff, p=0.280, n.s.), intra-team courtesy at 8.5±1.4 (versus 9.3±1.0 by surgeons and 8.9 by anesthesia staff, p=0.300, n.s.), communication and cooperation at 8.3±1.2 (versus 9.3±1.0 by surgeons and 8.4±1.3 by anesthesia staff, p=0.130, n.s.), team morale at 6.8±2.1 (versus 9.3±1.0 by surgeons and 8.3±1.3 by anesthesia staff, p<0.001), personnel morale at 8.3±1.7 (versus 8.9±1.7 by surgeons and 8.6±1.3 by anesthesia staff, p=0.570, n.s) and setup preference for family and friends at 9.2±0.9 (versus

Table 3.5 Patient satisfaction with their post-operative experience.

Question	OR Type	Yes, definitely	Yes, somewhat	No	p-value
Outcome of surgery	Conventional	48%	34%	18%	0.300
	High-efficiency	55%	35%	10%	
Expectations during recovery period	Conventional	54%	31%	15%	0.230
	High-efficiency	61%	32%	7%	
Info on emergency symptoms	Conventional	72%	15%	13%	0.250
	High-efficiency	71%	22%	7%	
Instructions on recovery period	Conventional	69%	22%	9%	0.520
	High-efficiency	75%	20%	5%	
Pain relief before discharge	Conventional	77%	11%	12%	0.120
	High-efficiency	83%	13%	4%	
Post-op attention	Conventional	77%	20%	3%	0.240
	High-efficiency	88%	9%	3%	
Post-op time spent	Conventional	65%	25%	10%	0.560
	High-efficiency	74%	20%	6%	

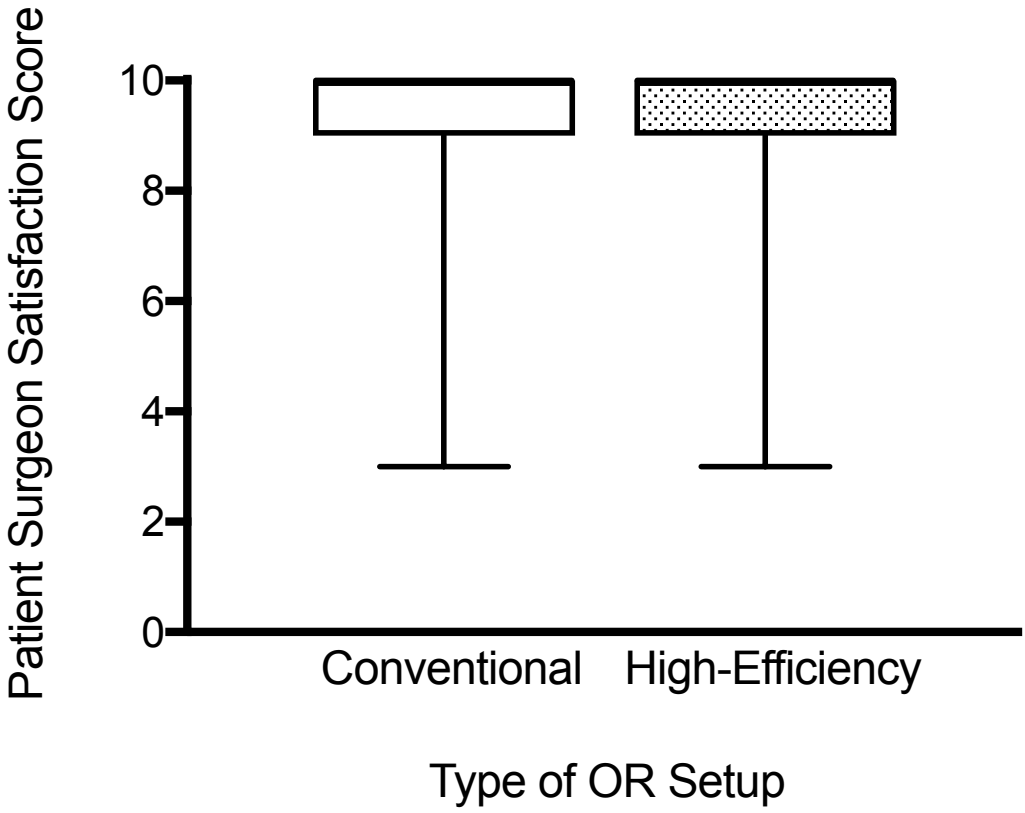

Figure 3.8 **Patient satisfaction with operating surgeon, as rated by each patient at 6 weeks follow-up.** Boxes correspond to interquartile range, with median at the horizontal bar (score 10); whiskers correspond to maximum and minimum.

Table 3.6 Patient satisfaction with surgical education/awareness.

Question	OR Type	Yes	No	p-value
Treatment options given	Conventional	53%	47%	0.550
	High-efficiency	48%	52%	
Patient preference for treatment	Conventional	74%	26%	0.360
	High-efficiency	80%	20%	
Education with images	Conventional	49%	51%	0.620
	High-efficiency	45%	55%	
Pre-surgery visit	Conventional	68%	32%	0.950
	High-efficiency	68%	32%	
Office visits to surgeon	Conventional	65%	35%	0.080
	High-efficiency	77%	23%	
Help with forms	Conventional	18%	80%	0.150
	High-efficiency	10%	90%	

Table 3.7 Staff scoring of satisfaction with their work environment.

	Nursing Staff (N=35)	Surgery Staff (N=8)	Anesthesia Staff (N=25)	p-value
Team Rating	8.5±1.1	9.3±1.0	8.5±1.4	0.28
Intra-Team Courtesy	8.5±1.4	9.3±1.0	8.9±1.2	0.300
Communication and Cooperation	8.3±1.2	9.3±1.0	8.4±1.3	0.130
Team Morale	6.8±2.1	9.3±1.0	8.3±1.2	<0.001
Personnel Morale	8.3±1.7	8.9±1.7	8.6±1.3	0.57
Setup Preference for Family	9.2±0.9	9.2±1.0	8.8±1.1	0.29
Average Score	**8.3**	**9.2**	**8.6**	

9.3±1.0 by surgeons and 8.9±1.1 by anesthesia staff, p=0.290, n.s.). Surgeons gave a mean score of 9.3±1.0 across all categories. The overall satisfaction with the work environment scores of the surveyed staff were given mean scores of 8.3, 9.2 and 8.6 by the nurses, surgeons and anesthesia staff, respectively (Table 3.7).

3.5.2 Staff Satisfaction in Conventional versus High-Efficiency OR Setup

Twenty-two staff in the conventional and 40 staff in the high-efficiency OR setup participated in the survey. The mean scores of satisfaction with the work environment across the surveyed categories by the conventional OR setup staff were 8.3±1.2, 8.6±1.3, 8.2±1.3, 7.7±1.8, 8.4±1.4 and 9.1±0.9 for team rating, intra-team courtesy, communication and cooperation, team morale, personnel morale and setup preference for family and friends, respectively, while those for the high-efficiency OR staff were 8.7±1.3 (p=0.200, n.s.), 8.8±1.3 (p=0.649, n.s.), 8.6±1.2 (p=0.189, n.s), 7.6±2.1 (p=0.741, n.s.), 8.4±1.7 (p=0.274, n.s.) and 9.1±1.1 (p=0.980, n.s.) (Table 3.8).

3.5.2.1 Anesthesia Staff

Average scores of anesthesia staff combined (nurses and anesthetists) in the conventional OR setup group were 4.3±2.3, 6.3±2.1 and 8.2±1.1 for the level of stress during patient preparation, adequacy of preparation time and quality of communication, respectively (Table 3.9); those by the high-efficiency OR setup group were 4.5±2.6 (p=0.820, n.s.), 5.7±1.4 (p=0.340, n.s.) and 7.6±1.8 (p=0.310,

Table 3.8 Comparison of the overall levels of staff satisfaction in the two types of OR setup.

	Conventional OR (N=22)	High-Efficiency OR (N=40)	p-value
Team Rating	8.3±1.2	8.7±1.3	0.21
Intra-Team Courtesy	8.6±1.3	8.8±1.3	0.650
Communication and Cooperation	8.2±1.3	8.6±1.2	0.190
Team Morale	7.7±1.8	7.6±2.1	0.740
Personnel Morale	8.4±1.4	8.4±1.7	0.850
Setup Preference for Family	9.1±0.9	9.1±1.1	0.98

Table 3.9 Comparison of anesthesia staff, surgeons and nursing staff satisfaction with working in the two types of OR setup.

		Conventional OR	High-Efficiency OR	p-value
Anesthesia Staff	Level of stress during preparation	4.3±1.3	4.5±1.2	0.820
	Adequacy of preparatory time	6.3±1.3	5.7±1.3	0.340
	Quality of communication	8.2±1.2	7.6±1.3	0.310
Surgical Staff	Level of stress during preparation	9.3±1.0	9.5±0.6	0.671
	Adequacy of preparatory time	7.5±2.4	9.8±0.5	0.114
	Quality of communication	9.0±0.9	9.8±0.5	0.168
Nursing Staff	Level of stress during preparation	5.0±2.1	4.7±2.8	0.787
	Adequacy of preparatory time	4.9±2.5	6.2±2.7	0.300
	Quality of communication	7.6±0.8	6.9±2.8	0.566
	Anesthesia Information	3.0±2.3	2.3±2.7	0.888
	Discharge Planning	1.8±1.6	2.0±2.6	0.593

n.s.). When the anesthesia nursing staff and anesthetists were assessed separately, the scores were as follows: 3.7±1.7 versus 3.7±1.5 for the level of stress during patient preparation (p=0.27, n.s.); 6.2±1.3 versus 5.7±1.2 for the adequacy of preparation time (p=0.44, n.s.); and 8.3±1.1 versus 7.6±3.2 for the quality of communication (p=0.22, n.s.), respectively.

3.5.2.2 Surgical Staff

Average scores of surgical staff in the conventional OR setup group were 9.3±1.0, 7.5±2.4 and 9.0±0.8 for the level of stress during patient preparation, adequacy of preparation time and quality of communication, respectively (Table 3.9); those by the high-efficiency OR setup group were 9.5±0.6 (p=0.670, n.s.), 9.8±0.5 (p=0.114, n.s.) and 9.8±0.5 (p=0.168, n.s.), respectively.

3.5.2.3 Nursing Staff

Average scores of nursing staff in the conventional OR setup group were 5.0±2.1, 4.9±2.5, 7.6±0.8, 3.0±2.3 and 1.8±1.6 for the level of stress during patient preparation, adequacy of preparation time, quality of communication, anesthesia information and discharge planning information, respectively (Table 3.9); those by the high-efficiency OR setup group were 4.7±2.8 (p=0.787, n.s.), 6.2±2.7 (p=0.300, n.s.), 6.9±2.8 (p=0.566, n.s.), 2.3±2.7 (p=0.888, n.s.) and 2.0±2.6 (p=0.593, n.s.), respectively.

3.6 FINANCIAL COST-BENEFIT ANALYSIS

3.6.1 Cost Distribution Per Patient

The summary of expenses associated with patient surgical care is shown in Table 3.10. All prices are in Canadian dollars, and are rounded to the nearest dollar. The current cost per patient in the conventional OR was calculated, based on the cost of both the labour and the cost of materials used.

Charges for OR use were $249 for labour and $220 for materials; charges for the post-anesthetic care unit were $129 for labour and $7 for materials; costs of day surgery pre-operative and post-operative care were $139 for labour and $16 for materials; clinical laboratory charges were $4 for labour and $1 for materials; medical imaging charges were $15 for labour and $1 for materials; charges for physiotherapy were $7 for labour; pastoral care charges were $1 for labour. As such, the cost was calculated at $544 for labour and $244 for materials used, for a total of $689 per patient.

The cost per patient in the high-efficiency OR was calculated as follows: charges for the OR use were $75 for labour and $97 for materials; charges for day surgery pre-operative/post-operative care were $116 for labour and $13 for materials; medical imaging charges were $8 for labour; physiotherapy charges were $10 for labour. There were no charges associated with post-anesthetic care unit, clinical laboratory fees or pastoral care. Thus, the total cost was calculated at $209 for labour and $110 for materials used, for a total of $319 per patient.

Table 3.10 Breakdown of surgery care costs per patient in the conventional and high-efficiency OR setups. Values in red indicate the weighted savings/losses from the total cost of surgical care.

Category	Conventional OR			High-Efficiency OR			Diff from Conv. OR	% Total Savings
	Labour	Materials	Total	Labour	Materials	Total		
OR Costs	$249	$220	$469	$75	$97	$172	↓63%	59%
PACU	$129	$7	$136	$0	$0	$0	↓100%	17%
Day Surgery	$139	$16	$155	$116	$13	$129	↓17%	20%
Clinical Lab	$4	$1	$5	$0	$0	$0	↓100%	1%
Medical Imaging	$15	$1	$16	$8	$0	$8	↓50%	3%
Physio-therapy	$7	$0	$7	$10	$0	$10	↑43%	-2%
Pastoral Care	$1	$0	$1	$0	$0	$0	↓100%	0%
NET TOTAL	**$544**	**$245**	**$789**	**$209**	**$110**	**$319**	**↓60%**	

3.6.2 Cost Differences Between Conventional and High-Efficiency OR Setups

The differences between the conventional and high-efficiency OR setups were as follows: high-efficiency OR setup had savings of 63% compared to conventional OR; post-anesthetic care unit costs were completely eliminated in the high-efficiency OR setup, making for 100% savings in this category; day surgery pre-operative/post-operative care costs were 17% lower in the high-efficiency OR setup; by eliminating clinical laboratory charges, 100% savings were obtained in this category; medical imaging charges were 50% lower in the high-efficiency OR setup; physiotherapy charges increased by 43% in the high-efficiency OR patients; pastoral care charges were completely eliminated. As such, the total cost of high-efficiency OR care was 60% lower than that of the conventional OR.

There is an extra charge in the OR setup that should be considered: the possible additional cost of anesthetic. The cost of drugs for the induction of general anesthesia in the conventional OR was estimated at $23 per patient; this charge was included in the calculation of total OR cost. The price of medication for the nerve block (i.e. primary choice of anesthesia in the high-efficiency OR) was $17. Patients in the conventional OR did not undergo nerve block; therefore, if they were to use this option, the cost of anesthesia (hence the cost of the OR charges) in the conventional OR would be further changed by $17 (increase of 2% in OR charges, total increase of less than 1% per patient).

CHAPTER 4

DISCUSSION

CHAPTER 4. DISCUSSION

Canadian population has been steadily increasing over the years, a condition that has not been paralleled with a construction of new hospitals or hiring of more physicians/medical specialists to staff them. In addition, the existing population is also aging, putting an increased demand on access to healthcare across all medical specialties; as such, the wait times to see a specialist have been continuously increasing over the past decades.

Given the increased demands for surgeries, coupled with an increase in the wait times for all OR services (i.e. the lack of timely access for majority of elective surgery patients), this project was undertaken in order to provide a timely access and optimization of OR services while achieving significant cost savings, maintaining or improving patient outcomes and staff satisfaction with their working environment. The study was focused on orthopaedic specialty, due to the multi-componential nature of orthopaedic surgical procedures.

4.1 OVERVIEW OF RESULTS

4.1.1 Patient Demographics

4.1.1.1 Patient Age

To compare the outcomes of the conventional versus high-efficiency OR setups, it was important to match the two populations entering each OR stream. For example, older patients frequently suffer from osteoarthritis, experiencing

higher frequency/level of pain. As such, it is expected that these patients would have a worse surgical outcome: a poor pre-operative functional status due to pain usually translates to a poor post-operative functional status (Ostendorf, Buskens et al. 2004). Previous studies have reported age >75 years correlating with 2.6 times higher odds of complications (Gromov, Kjaersgaard-Andersen et al. 2017), or that increase in age and BMI can have a direct relationship with post-operative hypoxemic events (Biddle, Elam et al. 2016). In our study, however, age did not appear to have any significant impact on outpatient surgery outcomes (Figure 3.5), and as such, it should not be an exclusion criterion for outpatient surgery. Moreover, unlike in the study by Zheng et al. (2012), our data did not indicate any delay in the procedure length due to patients' age (Zheng, Panton et al. 2012).

A consensus on ASC patient intake criteria in the US had reported that patients who are younger, have lower BMI and are healthier were better candidates for ASCs (Aynardi, Post et al. 2014). In our study, the high-efficiency group of patients were slightly older, but had a lower BMI and a higher overall functional level. As such, it is plausible to assume that our results are due to a combination of demographic factors, not just the age of the patient. Although our patient population was younger than the one evaluated by Aynardi et al. (2014), other factors (e.g. BMI, patient functionality level) should also be considered in patient selection for ASCs.

Another important implication is that many ASCs in the US are transitioning towards a creation of patient acceptance criteria. These usually do

not have age limit attached to them. Our findings validate this, and as such, allow us to accept patients based on their health status. This is particularly important for Canadians, as the concept of ASCs gains wider popularity across Canada. The need to provide speedy healthcare services to all patients, regardless of their age, is imperative; therefore, patients should be excluded only on the basis of higher probability of post-op complications (Biddle, Elam et al. 2016, Kingery, Cuff et al. 2018).

4.1.1.2 Patient Wait Times

In our study, the patients in the high-efficiency OR group experienced almost double the duration of living with their orthopaedic complaint versus those in the conventional OR group. Longer wait times have been frequently quoted as a contributing factor to patient outcomes, although there has been much debate as to whether or not these translate into poor outcomes. Some authors are not strong proponents of this line of thought (Snider and MacDonald 2004, Hoogeboom, van den Ende et al. 2009), while others, particularly those who have published details with Oxford Hip Score, Western Ontario and McMaster University Osteoarthritis Index and Quality of Life assessment scores, indicate that there might be a correlation between longer wait times and poor patient outcomes (Ostendorf, Buskens et al. 2004, Ackerman, Bennell et al. 2011, Desmeules, Dionne et al. 2012). In our study, the patient outcomes did not differ between the conventional and high-efficiency OR groups. One of the reasons for this may be the fact that the high-efficiency patients were more functional and

active, despite being older and harbouring their illness for longer (Table 3.1) (Ostendorf, Buskens et al. 2004). It is essential to note that triaging ill patients is of great importance: those who have a higher disease burden need to be treated preferentially, instead of just letting wait times decide quicker access to healthcare (Sutherland, Crump et al. 2016).

4.1.2 Patient Surgical Experience Satisfaction

4.1.2.1 Patient Satisfaction with Wait Times

Our results indicate that there was no difference in patient satisfaction with their wait times, both the time from referral to appointment and appointment to surgery, between the conventional and high-efficiency OR patient groups (Figure 3.2) in the waiting periods assessed. Despite the similarity of outcomes and lack of statistical differences between the two patient groups, the satisfaction confidence intervals were smaller, particularly those in the ‘from appointment to surgery’ time, when comparing wait time to first appointment and wait time to surgery. This may be explained by the previous observations indicating that one of the significant contributors to patients’ satisfaction is a conversation with their surgeon (Schmocker, Cherney Stafford et al. 2015). The confidence interval was much tighter in the high-efficiency OR patient group, indicating that there was a trend towards higher satisfaction in majority of patients going through the high-efficiency stream. As such, the new setup actually provided the desired outcome it was created for.

4.1.2.2 Patient Satisfaction with Anesthesia Team

In our study, patient satisfaction with anesthesia team did not demonstrate any statistically significant differences between the conventional and high-efficiency OR patients (Figure 3.3A). Anesthetists form an integral part of the surgical team; as such, the pre-operative education and post-operative pain control by them might be one of the crucial components of ensuring good surgical outcomes, and, to some extent, they have an interdependence on each other (Crawford, Li et al. 2015, Gonzalez, Fisk et al. 2017). Since both setups had high satisfaction levels and no difference in outcomes between the two OR setups was found, it would indicate that both OR setups were equally successful (Figure 3.3).

The information provided to patients by the anesthesia team pre-operatively appeared to be sufficient for creating high patient satisfaction. An important point to consider is that while there was a difference in how the logistics of the operating rooms work, there was no difference in the pre-operative awareness of this experienced by the patients. The only difference was the use of nerve block with sedation by the high-efficiency OR patients versus a nerve block/general anesthetic in the conventional OR patients. Patient education, therefore, appears to be an important factor that can improve satisfaction with post-op pain control by alleviating patient anxiety (Gardner, Nnadozie et al. 2005, Roh, Gong et al. 2014), and contribute to overall success and continuation of the new, high-efficiency OR setup (Arshi, Leong et al. 2017). This was also evident from the high satisfaction ratings given for the care

provided by the anesthesia team and with the anesthetic used for their respective surgeries (Figure 3.3A).

4.1.2.3 Patient Satisfaction with Nursing Team

Patient satisfaction with nursing team was found to be equal across all categories by both the conventional and high-efficiency OR patients (Figure 3.3B). Nurses usually provide the 'first line of defense' for patient care; as such, patient interaction with nurses is crucial, translating into better outcomes (Crawford, Li et al. 2015, van Eck, Toor et al. 2018). Just like the role that provision of information by anesthetists plays, the information provided by the nurses reinforces the patient expectations, and gives them some basic information to improve satisfaction. The lack of any differences in satisfaction between the two OR setups can be ascribed to the fact that the nurses providing care were the same in both OR groups, and were able to provide relevant information for that particular surgical group. The routines practiced by the nursing staff tend to help with maintenance of pre-operative and post-operative satisfaction with patient care. Some surgical centres in North America routinely conduct pre-operative educational classes for patients on patient management of his/her post-operative expectations (van Eck, Toor et al. 2018). Although in our study no such classes were conducted, the routine sharing of information of the staff with the patient most likely helped to maintain the satisfaction levels between the two patient groups.

4.1.2.4 Patient Satisfaction with Surgical Team

Patient satisfaction with their surgical team was found to be similar across all categories between the conventional and high-efficiency OR patient groups (Figure 3.4A). The lack of any statistical difference indicates that both OR setups provided the same level of care to all patients. Patients indicated that they were happy with the information provided to them by the surgeon, information for surgery preparation and information provided by the surgical team. The common practice at LHSC is to meet with every patient before his/her surgery; as such, the lack of difference in outcomes is merely a reflection of the similarities in patient care of the two OR setups. As mentioned before, patient surgeon interaction significantly improves patient satisfaction (Schmocker, Cherney Stafford et al. 2015); this was confirmed by our study results.

4.1.2.4 Post-Operative Recovery

Significant differences in all post-operative recovery parameters were found between patients in the conventional and high-efficiency OR groups (Table 3.2). Patients in the high-efficiency OR group indicated that they were better informed informed about their options for anesthesia, one of the keys to the management of patient expectations. The patients in the high-efficiency OR group experienced fewer side effects of anesthesia; this can be explained by the use of block-room and minimal utilization of general anesthetics. Moreover, the high-efficiency OR patients spent significantly less time at the hospital. Given that these patients demonstrated the same level of post-operative recovery

satisfaction as those in the conventional OR group was found to be contrary to the previous opinions with regards to patients being anxious about not staying in the hospital after their surgery (Gardner, Nnadozie et al. 2005). Finally, high-efficiency OR patients were also more promptly given a verbal and written version of take-home instructions, which probably significantly aided in managing their satisfaction (Table 3.2).

4.1.3 Patient Outcomes

Self-reported patient outcomes were evaluated using series of EQ5D questionnaires; EQ5D is a standardized, highly respected tool used to evaluate patients' perceived health (Devlin and Brooks 2017); EQ5D-5L questionnaire provided the means of expressing the results in terms of VAS, Index Value and QALY score.

No significant differences were found in patient VAS scores between the conventional and high-efficiency OR patients (Figure 3.5A). VAS score evaluates the patient's personal assessment of his/her overall health (van Reenen and Janssen 2015). In this study, no difference in outcomes between the two groups was found over the course of six months, increasing the validity of the obtained results (Feng, Parkin et al. 2014). VAS is also important, because it takes into the account the detailed variability in patient outcome scores, unlike a simple Likert scale (used as a part of various other questionnaires in the project) (Brokelman, Haverkamp et al. 2012).

There was no statistically significant difference in Index Value scores between patients in the conventional versus high-efficiency OR groups (Figure 3.5B). The decrease in 2-week Index Value score from the baseline, followed by a progressive, incremental increase up until the 6-month follow-up was expected, given that the patients had just undergone a surgical procedure. The importance of Index Value is its relatability to the general North American population and the wider applicability to the global population (Devlin and Brooks 2017). An increase in Index Value implied resumption of patients' health towards their pre-operative health state; the lack of difference in outcome between the two patient groups was in accordance with all the other outcome surveys for assessing patient satisfaction. Both patient groups were improving with the passage of time, as their surgical wounds were healing. The similarities in trends imply that there was no difference in patient-reported outcomes between the two groups.

No statistically significant difference in QALY scores were found between the patients in the conventional versus high-efficiency OR groups. QALY is an important indicator of patient outcomes, taking into consideration not only the state of health of the patient given by the Index Value, but also the length of time that the patient spends in that particular state. A significant, progressive improvement in QALY scores was found between the baseline and up to 6-month follow-up (Figure 3.5C). This is because, at baseline, QALY score is calculated by multiplication with time (which, at baseline, was zero). The QALY score can also evaluate the impact of patient health on healthcare economics; this was not the case in the present study – which was purely interested in the comparison of

patient-reported outcomes; as such, the economic effect/benefit was not calculated.

Overall, the EQ5D patient outcome scores assisted with evaluation of the difference in the health of patients in both the conventional and high-efficiency OR groups, and provided a deeper understanding of how the setups differ and what the lack of differences implied for the new, high-efficiency OR surgical setup (Figure 3.5).

4.1.4 National Surgical Quality Improvement Program

NSQIP questionnaire was specifically developed to evaluate surgical care in hospitals. Its purpose is to provide surgical specialty-specific feedback. It is important to point out that in the current study, NSQIP evaluation consisted of a modification of the the original NSQIP questionnaire to include PROMIS Pain Interference, PROMIS Global Health Score and CAHPS, in order to provide an objective assessment of the impact of the study results.

4.1.4.1 PROMIS Pain Interference

There was no statistical difference between in the PROMIS Pain Interference T-score between the patients in the conventional versus high-efficiency OR groups (Figure 3.6A). In the current study, T-score value in the 60s was 10 points higher than that for the average of 50 points for the North American population, calculated by Health Measures. Pain Interference score of 54-65 indicates a moderate pain category. All patients in our study were six

weeks post-op: a higher T-score was to be expected. The important consideration is the equivalence of T-scores in both patient cohorts, indicating no existing difference between the two patient populations. The results suggest that both the conventional and high-efficiency OR groups were performing equally well in their day-to-day life (Figure 3.6-A). Another vital point of interest is the tight interquartile range for both patient groups, indicating that the similarity in pain outcomes was shared by majority of the participants in both groups.

Responses to the PROMIS Pain Interference questions reflected on self-reported consequences of pain on relevant aspects of each patient's life. They could predict the interference that pain had on social, cognitive, emotional and physical aspects of patient's life. They could provide a small insight into patient's sleep pattern and the life enjoyment in general. The responses presented a 7-day average of the patient's symptoms at the six-week follow-up. Six-week follow-up was chosen, because it was viewed as an important milestone allowing more freedom in weight bearing by the majority of patients. As such, it would explain the high value of pain, given that patients were still not completely healed, yet at the same time they were becoming more physically active (causing more pain). On the other hand, an increased ability to mobilize can be viewed as useful for physiotherapy, because it could increase the rate of recovery (Sayeed, Abaab et al. 2018). Overall, an improved post-operative health state could promote better recovery in patients (Ackerman, Bennell et al. 2011).

4.1.4.2 PROMIS Global

There are two components to the PROMIS Global score: (1) score that evaluates the mental health of the patient, and (2) score that evaluates global physical health of the patient. When using the two scores in conjunction, they provide a better comprehensive evaluation of patient health as opposed to using either of these individually. Thus, overall PROMIS Global scores provide an assessment of each patient's physical, mental and social health. Normally, PROMIS Global scores range between 20-80. Generally, the T-score has a mean of 50 with a standard deviation of 10. Clinically, the rule for PROMISE Global T-scale implies that a higher score is better than a lower one; hence a higher score in both the mental and physical health would indicate a better result.

According to Health Measures, a Global Mental Health score above 40 is considered 'Good', above 48 is 'Very Good' and a value above 56 is considered 'Excellent'. Patients in both the conventional and high-efficiency OR groups appeared to be in a very good mental health state, given that their average T-scores were above the 60s (Figure 3.6A). This result could be associated with the previously published evidence that related pain with poor mental health state; as such, it would appear that the patients in our study must have experienced a relatively lower level of pain, which allowed them to stay in a 'Very Good' mental health state (Ostendorf, Buskens et al. 2004).

According to Health Measures, a Global Physical Health T-score above 42 qualified for a status of 'Good' physical health, a score above 50 qualified for 'Very Good' physical health and a score above 58 qualified as 'Excellent.' In our

study, patients in in both the conventional and high-efficiency OR groups scored at or above 50, indicating a ‘Good’ health state. At their six-week follow-up after the surgery, patients performed equally well with similar physical health (Figure 3.6B).

Thus, an important conclusion could be drawn from our results: although the patients could not be as physically fit as compared to general population at six-week follow-up (reflected by the PROMIS Global Physical health score), they were doing well mentally (reflected by the PROMIS Global Mental health score). This outcome indicates that, as per our initial expectation, the high-efficiency OR setup can provide an equally good outcome as that of the conventional setup.

4.1.4.3 CAHPS

CAHPS questions delivered a comprehensive feedback on services provided by the surgical team. Since the questions in CAHPS could be classified into different categories, results were reported according to the structure of the question asked, rather than based on a pre-determined classification that would not be able to provide full details.

First, CAHPS allowed for comparison and determination of the level of patient education (Figure 3.7A). Patient education can significantly influence patient outcomes (Ostendorf, Buskens et al. 2004). Given that the patients in both the conventional and high-efficiency OR groups had equivalent levels of education, the results would indicate that there, indeed were no differences in reported patient outcomes. Likewise, a similarity in patient surgical experience

also meant that patients in both groups had a good familiarity with their post-operative expectations (Figure 3.7B). Obtained data demonstrated that patients in both the conventional and high-efficiency OR groups were equally satisfied with front-desk staff at the clinic (Table 3.3).

In terms of pre-operative and post-operative patient satisfaction, there were no significant differences between the conventional and high-efficiency OR patients (Tables 3.4 and 3.5). There was a trend towards a higher satisfaction level by the high-efficiency OR patients in majority of the questions, in both the pre-operative and post-operative categories. Finally, patients in both the conventional and high-efficiency OR groups displayed an equal level of (high) satisfaction with their operating surgeons (Figure 3.8).

4.1.5 Staff Satisfaction

Satisfied staff has been shown to be a key to a success of any company; in the context of healthcare setup, the same concept applies, with nurses and doctors viewed as employees (Pash, Kadry et al. 2014). As such, IHI staff satisfaction surveys could provide the insight into success of implementation of any new surgical setup. Previous studies indicate that the ASCs across North America (ASCs seen as the equivalent of high-efficiency OR) are preferred by the healthcare staff, as they provide a suitable environment for work in, with zero overtime or call schedule requirements (Buehler, Mattison et al. 2008).

In the current study on the OR setup, the nurses, anesthetists and surgeons were more than 80% satisfied with their overall working environment

(Table 3.7). The study identified one problem: the morale of the nursing staff was significantly lower the than the morale of the other two healthcare professions. This was an important finding that can greatly assist with the improvement of operative setup, and as such, perhaps provide an additional increase in patient satisfaction.

The comparison of the staff satisfaction employed in the conventional versus high-efficiency OR setups did not reveal any significant differences. Across the domains of the six questions asked, both conventional and high-efficiency OR staff displayed equal overall levels of satisfaction (Table 3.8). It can be surmised that, in the high-efficiency OR setup, the standardization of patients, the type of surgeries performed and the equipment utilized in these helps the anesthetists, nurses and surgeons equally (Avansino, Goldin et al. 2013). Another factor could be the acceptance of the OR efficiency optimization by all healthcare staff, similar to some of the cross-functional teams utilized in various healthcare setups across North America (van Veen-Berkx, Bitter et al. 2015).

In terms of role-specific questions, asked in order to further the understanding the procedural or institutional problems, no statistically significant differences were found between the conventional and high-efficiency OR setups (Table 3.9). As such, one cannot make the claim that one setup is better than the other.

Anesthetists found either OR setup equally stressful, with reported level of satisfaction in the range of 40% for both the conventional and high-efficiency ORs (Table 3.9). Although they were highly satisfied with their working

environment (reporting a level of 80%), they also reported having a slightly lower level of satisfaction in the adequacy of preparatory time and quality of communication in the high-efficiency OR stream. Unfortunately, given the purpose of the high-efficiency OR setup, it is unlikely that the adequacy of preparatory time could be significantly improved upon at this time.

The surgical team tended to claim a higher level of satisfaction with the adequacy of preparatory time in the high-efficiency OR setup, as opposed to the conventional OR (Table 3.9). Surgical team had a high acceptance level of the high-efficiency OR, despite having a smaller surgical instrument tray to work with and no scrub nurse present – two items that make a big difference to the OR budget (Avansino, Goldin et al. 2013).

Nursing staff reported very low levels of satisfaction, regardless of the OR setup (Table 3.9). This appeared to be a common theme that needs to be addressed by the management staff in order to make both the conventional and high-efficiency OR setups more productive. Although no statistically significant differences were found, nursing staff tended to be poorly satisfied with the provision of anesthesia information and discharge planning in both the conventional and high-efficiency ORs. Given that these two components are directly related to patient outcomes, it is of prime importance to address these if any long-term outcomes of surgical patients are to be improved.

4.1.6 Financial Cost-Benefit

Evaluation of the finances necessary to run the conventional versus high-efficiency OR setups demonstrated a significant cost difference between these two groups (Table 3.10). In the high-efficiency OR setup, significant savings were achieved in all aspects of the required patient care. One of the pivotal items to achieve significant savings was the requirement for fewer pieces of equipment and the absence of a scrub nurse (Guzman and Gitelis 2015). Not having a scrub nurse negated the requirement of nurse breaks and the salary impact they normally have on OR time/nurse changeover; as such, it allowed the surgical team to stay small and more efficient (Azzi, Shah et al. 2016). It is an established fact that a proper definition of roles for nurses allows them to focus on their job, protecting them from getting distracted into doing miscellaneous work and wasting OR time; this is perhaps one of the most important reasons that allowed and increase the caseload in the high-efficiency OR in the same amount of time (Cendan and Good 2006).

Bypassing the PACU by the high-efficiency OR patients provided its own financial advantages: savings of 17% in total cost per patient. Several studies have shown that bypassing the PACU can save up to 64 minutes per patient (Twersky, Sapozhnikova et al. 2008), or $400, and an additional $1000 if the patients are not admitted to the hospital (Hadzic, Williams et al. 2005). Given that patient-reported outcomes in both the conventional and high-efficiency OR groups were equivalent (i.e. no difference between the two setups), these cost

savings would free up the resources that could then be applied to other patients (e.g. those requiring intensive care).

Anesthesia costs, which are also related to PACU cost, cannot be discounted. Although the direct cost of the anesthetic may have appeared as trivial (only $6), significant cost savings were achieved since the patients receiving nerve block did not need PACU care. Moreover, patients reported having better pain control with the nerve block, compared to local infiltration of anesthetic after the completion of surgery (Hadzic, Williams et al. 2005).

The costs associated with laboratory charges, imaging, pastoral care and physiotherapy should also be taken into account. It has been demonstrated that outpatient procedures are less expensive than inpatient procedures (Crawford, Li et al. 2015). Although physiotherapy cost was found to be slightly higher for the patients in the high-efficiency OR setup (an increase in the total cost of less than 2%), the intensive use of physiotherapy comes with its own advantages: it increases the rate of recovery for the patients (Sayeed, Abaab et al. 2018), and it reduces the workload for the orthopaedic staff, which can then be utilized in other places (Aiken, Atkinson et al. 2007, MacKay, Davis et al. 2009, MacKay, Davis et al. 2012).

None of the cost-saving measures found in the high-efficiency OR setup would be possible, however, if the intake selection criteria for the high-efficiency OR cohort were not clearly identified as those of low-risk, low-morbidity patients. Patients with higher morbidity rates (i.e. higher ASA levels) would most likely

have contributed to a higher hospital readmission rate, thus increasing the overall cost per patient (Biddle, Elam et al. 2016).

All of the cost-saving measures found in the high-efficiency OR setup could make a significant impact on the cost of surgical services within the Canadian Healthcare System. All cost savings could be utilized by hiring more staff, helping patients in areas where there is limited funding, or reducing the existing wait times (Bender, Nicolescu et al. 2015). The analysis of surgical outcomes allows the healthcare setups to introspect and compel themselves to increase their productivity and innovation, thus to increase their efficiency (Archer and Macario 2006).

4.2 STUDY LIMITATIONS AND FUTURE DIRECTIONS

Limitations of this study include some degree of loss at 6-month follow-up, affecting patient-reported outcomes, despite all efforts to assess all participants. Different strategies were employed to counter this problem: creation of a team for clinic follow-up, as well as advance notice of patient appointments. This lack of assessment would tend to bias the results toward observing no difference between the conventional and high-efficiency OR patient outcomes, and, therefore, there may be some degree of difference present.

Another limitation was the extraction of the precise information contained within the NSQIP CAHPS questionnaire. The questionnaire data extraction requires utilization of a proprietary software that produces a collective score for

all CAHPS questions. Due to study funding limits, the proprietary software could not be obtained; as such, an in-house alternate method for data extraction was used.

In the future, patient recruitment could expand to all hospitals in London, Ontario (Victoria Hospital, University Hospital, St. Joseph's Healthcare Centre) and include other types of orthopaedic subspecialties (trauma/foot/ankle, hip and knee arthroplasty). In addition, other surgical specialties that frequently encounter less complex cases could be included (e.g. General Surgery – cholecystectomy and appendectomy). Significant improvements to patient follow-up should be made, to ensure that longer-term (e.g. 6-month) outcomes can be properly evaluated.

Based on the results of the pilot studies, the building of an outpatient surgical unit (Surgi-Centre) was approved by the Southwestern Ontario Local Health Information Network. As such, once it commences its operations, all day surgery cases would be transferred to the Surgi-Centre, freeing up resources for more complex OR cases.

4.3 CONCLUSION

Overall, no significant differences were found between the conventional and high-efficiency operating room setups, particularly in patient-reported outcomes and patient quality of life. However, there was a markedly lower cost associated with the high-efficiency OR setup. The data indicate that significant

cost savings could be achieved by streamlining surgical services, while providing the same (or equivalent) patient care quality between the conventional and high-efficiency OR groups. As such, outcomes management within the existing healthcare setup is probably the way forward for provision of the best possible medical care, while at the same time managing the hospital budget (Psutka 1992). All of the cost-saving measures found in the high-efficiency OR setup could make a significant impact on the cost of surgical services within the Canadian Healthcare System; the significant savings achieved by streamlining surgical services could be applied towards hiring more staff, helping patients in areas where there is limited funding, and reducing the existing wait times.

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APPENDICES

APPENDIX I. HUMAN RESEARCH ETHICS BOARD APPROVAL LETTER

Western Research

Date: 26 February 2018

To: Dr. Abdel-Rahman Lawendy

Project ID: 110936

Study Title: Academic Centre tiered Operating Room Strategy (ACTION -in-the-OR)

Application Type: HSREB Initial Application

Review Type: Full Board

Meeting Date: January 9, 2018

Date Approval Issued: 26/Feb/2018

REB Approval Expiry Date: 26/Feb/2019

Dear Dr. Abdel-Rahman Lawendy

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above mentioned study as described in the WREM application form, as of the HSREB Initial Approval Date noted above. This research study is to be conducted by the investigator noted above. All other required institutional approvals must also be obtained prior to the conduct of the study.

Documents Approved:

Document Name	Document Type	Document Date
ACTION in the OR protocl_20Feb2018_final	Protocol	20/Feb/2018
Consent_06Feb2018_final	Written Consent/Assent	06/Feb/2018
EQ5D_Baseline_05December2017	Paper Survey	05/Dec/2017
EQ5D_Followup_05December2017	Paper Survey	05/Dec/2017
NSQIP Patient Reported Surgical Satisfaction questionnaire_05Dec2017	Paper Survey	05/Dec/2017
Patient Surgical Experience Satisfaction Survey_05Dec2015	Paper Survey	05/Dec/2017
TierOR data forms_05Dec2017	Other Data Collection Instruments	05/Dec/2017

No deviations from, or changes to, the protocol or WREM application should be initiated without prior written approval of an appropriate amendment from Western HSREB , except when necessary to eliminate immediate hazard(s) to study participants or when the change(s) involves only administrative or logistical aspects of the trial.

REB members involved in the research project do not participate in the review, discussion or decision.

The Western University HSREB operates in compliance with, and is constituted in accordance with, the requirements of the TriCouncil Policy Statement: Ethical Conduct for Research Involving Humans (TCPS 2); the International Conference on Harmonisation Good Clinical Practice Consolidated Guideline (ICH GCP); Part C, Division 5 of the Food and Drug Regulations; Part 4 of the Natural Health Products Regulations; Part 3 of the Medical Devices Regulations and the provisions of the Ontario Personal Health Information Protection Act (PHIPA 2004) and its applicable regulations. The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.

Please do not hesitate to contact us if you have any questions.

Sincerely,

Karen Gopaul, Ethics Officer on behalf of Dr. Marcelo Kremenchutzky, HSREB Vice-Chair

Note: This correspondence includes an electronic signature (validation and approval via an online system that is compliant with all regulations).

APPENDIX II. PATIENT SCREENING QUESTIONNAIRE

ACTION in the OR

Screening Form		
Study ID (if eligible) _____	Initials: _____	Date of Visit _____ dd / mm / yy

INCLUSION CRITERIA	Yes	No
Male or Female aged 18 years or greater (≥ 18yrs).	☐	☐
Undergoing Low Surgical Resource foot or ankle orthopedic surgical intervention of short duration with minimal equipment needs	☐	☐
No significant comorbidities preventing outpatient day surgery.	☐	☐
Procedures allowing for standardization of equipment and staff		
Provision of Informed Consent.	☐	☐

EXCLUSION CRITERIA	Yes	No
Refusal to participate	☐	☐
Undergoing bilateral operative procedures	☐	☐
Concurrent injury deemed to delay or alter rehabilitation.	☐	☐
Likely problems, in the judgment of investigators, with maintaining follow-up (i.e. patients with no fixed address, patients not competent to give consent, prisoners etc.).	☐	☐
Unable to read/write English even with the aid of an interpreter	☐	☐

***You must answer **Yes** to each inclusion criteria and answer **No** to each exclusion criteria for the patient to be eligible.

Date Informed Consent obtained: _____ (dd/mm/yyyy)

Copy of Consent given to patient: ☐ Yes ☐ No

Date Referral Received: _____ (dd/mm/yyy)

Date of Consult Appointment: _____ (dd/mm/yyyy)

Version: 22 Nov 2017

ACTION in the OR

Baseline Characteristics		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy

Patient Information:

Age at Consent: _____ Sex: ☐ Male ☐ Female

Height_____ (cm or inches) Weight_____ (kg or lbs.) BMI = _____

Pre-Surgery Work Status: (check all that apply)

☐ Employed full time ☐ Employed part time ☐ Student ☐ Homemaker

☐ Retired (not due to ill health) ☐ Disabled and/or Retired (due to ill health)

☐ Other _____

Usual Pre Surgery Use of Ambulatory Aids ☐ No ☐ Yes

☐ Cane, ☐ 1 ☐ 2

☐ Walker

☐ Other, please describe_____

Smoking Status

☐ Non smoker ☐ Current smoking or chewing tobacco use ☐ Ex-smoker

Comorbidities

☐ None

☐ Respiratory ☐ Cardiovascular disorder ☐ Diabetes ☐ Depression/Anxiety

☐ Musculoskeletal disorder (e.g. arthritis, osteoporosis) ☐ Obesity and/or body mass index >30

☐ Gastrointestinal disorder ☐ Genitourinary disorder ☐ Hematological disorder

☐ Hypertension ☐ Other health condition _____

Version: 22 Nov 2017

ACTION in the OR

Baseline Characteristics		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy

Length of Time with Foot or Ankle Condition: _____(Select one :years, months, days)

Chronic Pain: ☐ Yes ☐ No

Primary Reason now seeking surgery:

☐ Pain ☐ Discomfort ☐ Appearance ☐ Function ☐ Other: _____

Pre Surgery level of pain

Please indicate on the scale the typical level of pain/discomfort you have been experiencing over the last week as related to your foot or ankle condition.

0 1 2 3 4 5 6 7 8 9 10

No Pain Worst Pain Imaginable

Pre surgery foot or ankle function

Please indicate on the scale the usual level of functioning of your foot or ankle.

0 10 20 30 40 50 60 70 80 90 100

Worst function Full function

Pre Surgery level of activity

Please indicate on this scale your usual current level of activity.

0 10 20 30 40 50 60 70 80 90 100

Low activity High activity

Version: 22 Nov 2017

ACTION in the OR

Operative Treatment Data		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy

OR Set up assigned to: ☐ Tiered OR ☐ Status Quo OR

Side: ☐ Right or ☐ Left

Date of Surgery: _____ (dd/mm/yyyy)

Surgical Site:

☐ Forefoot ☐ Midfoot ☐ Hindfoot ☐ Ankle ☐ Tib Fib ☐ Knee

Type of Primary Procedure:

☐ Deformity correction ☐ Fracture fixation ☐ Fusion ☐ Arthroscopy

☐ Irrigation and Debridement ☐ Instability ☐ Tendinopathy

☐ Removal of Hardware ☐ Revision surgery

☐ Other_____

Anesthesia:

Type: ☐ Regional Block ☐ Nerve Block ☐ General

Time Patient in Room: _____

Start Time: _____ Stop Time: _____

Surgery

Surgery Start: _____ Surgery Stop: _____

Duration: _____ (skin to skin)

Procedure end (patient out of room): _____

Pre-op Antibiotics: _____

Primary Surgeon: _____

Version: 22 Nov 2017

ACTION in the OR

Operative Treatment Data Cont'd		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy

Type of Set Used (Check all that apply):

☐ **Forefoot set** ☐ **Hindfoot set** ☐ **Small Fragment** ☐ **Small Fragment Locking**

☐ **Hindfoot Fusion Nail** ☐ **Other:** _____

Constructs (Check all that apply):

☐ **Screws** ☐ **Plates** ☐ **Nail** ☐ **Other:** _____

Intraoperative Complications: ☐ None

☐ Surgical: _____

☐ Anaesthesia: _____

Post-Operative Treatment

Additional Procedures Performed During Operative Intervention ☐ No ☐ Yes

If yes, please describe: _____

Post-operative Antibiotics: ☐ No ☐ Yes If Yes, Type: _____

Immediate Post-Operative Complications (recovery period prior to discharge):

☐ None

☐ Systemic: ☐ Cardiac ☐ Pulmonary ☐ Other: _____

☐ Neurologic: _____

☐ Vascular: _____

☐ Implant failure ☐ Failure to obtain/maintain reduction

☐ Other (specify): _____

ACTION in the OR

Treatment Data Cont'd		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy

Patient Discharge Pain Medication(s) Check all that apply

☐ NSAID (Ibuprofen, Naproxen, Advil, Aleve, Motrin etc.)

☐ Non-narcotic (e.g. Acetaminophen, Tylenol)

☐ Mild narcotic (e.g. Codeine, Tramadol)

☐ Narcotic (e.g. Percocet, Hydromorphone, Oxycodone, Morphine)

Drug: _____ Dose: _____ Freq: _____ # prescribed: _____

Drug: _____ Dose: _____ Freq: _____ # prescribed: _____

Drug: _____ Dose: _____ Freq: _____ # prescribed: _____

Drug: _____ Dose: _____ Freq: _____ # prescribed: _____

Drug: _____ Dose: _____ Freq: _____ # prescribed: _____

Discharge Instructions for Pain Control:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Version: 22 Nov 2017

ACTION in the OR

Follow up Visit Assessment		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks** ☐ **6 Weeks** ☐ **3 Months** ☐ **6 Months**		

Complications at surgical site: ☐ No ☐ Yes , *If Yes, complete Complication Form*

Use of Analgesics: ☐ No ☐ Yes, if yes: Check all that apply

☐ NSAID ☐ Non-narcotic (e.g. Acetaminophen)

☐ Mild narcotic (e.g. codeine, tramadol) ☐ Narcotic (e.g. Percocet, hydromorphone, oxycodone, morphine)

Drug: _____ Dose:_____ # taken: _____

Frequency: ☐ several x/day ☐ 1x/day ☐ 1x/week ☐ 3-4x/week ☐ several x/month ☐ once in a while as needed

Drug: _____ Dose:_____ # taken: _____

Frequency: ☐ several x/day ☐ 1x/day ☐ 1x/week ☐ 3-4x/week ☐ several x/month ☐ once in a while as needed

Drug: _____ Dose:_____ # taken: _____

Frequency: ☐ several x/day ☐ 1x/day ☐ 1x/week ☐ 3-4x/week ☐ several x/month ☐ once in a while as needed

Narcotic Prescription Renewal:

☐ No ☐ Yes, if Yes: ☐ Family Doctor ☐ Surgeon ☐ Other:_____

Drug: _____ Dose:_____ Freq: _____ # prescribed_____

Drug: _____ Dose:_____ Freq: _____ # prescribed_____

Weight Bearing Status

☐ Non/ toe touch ☐ Heel Weight bearing

☐ Protected ☐ Weight bearing as tolerated

Version: 22 Nov 2017

ACTION in the OR

Follow up Visit Assessment Cont'd		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks** ☐ **6 Weeks** ☐ **3 Months** ☐ **6 Months**		

Level of pain

Please indicate on the scale the typical level of pain/discomfort you have been experiencing over the last week as related to your foot or ankle.

0 1 2 3 4 5 6 7 8 9 10

No Pain — Worst Pain Imaginable

Foot or ankle function

Please indicate on the scale the current level of functioning of your foot or ankle you have been experiencing over the last week.

0 10 20 30 40 50 60 70 80 90 100

Worst function — Full function

Level of activity

Please indicate on this scale your current level of activity.

0 10 20 30 40 50 60 70 80 90 100

Low activity — High activity

Version: 22 Nov 2017

ACTION in the OR

Complications/Adverse Events		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks** ☐ **6 Weeks** ☐ **3 Months** ☐ **6 Months**		

Check all that apply.

Soft tissue/wound healing

☐ Skin slough ☐ Hematoma ☐ Wound necrosis ☐ Cellulitis

☐ Wound dehiscence ☐ Drainage ☐ Protrusion of bone through skin

☐ Other: _____

Infection

☐ Superficial Infection (requiring only oral antibiotics): Antibiotic:_____ # of days:__

☐ Deep Infection (requiring IV Antibiotics, surgical intervention or hospital admission):

- ☐ IV Antibiotics: Type of Antibiotic: _____ # of days:_____
- ☐ Irrigation and debridement required, if yes, date of repeat surgery:_____
- ☐ Hospital admission required, if yes, number of days admitted to hospital:_____

Cultures obtained? ☐ No ☐ Yes, if Yes: Negative ☐ Positive ☐ :_____

Bone formation

☐ Delayed union (no healing at 3 months) ☐ Malunion ☐ Calcification between tibia/fibula

☐ Non Union (no healing at 6 months) ☐ Re-fracture

Implant failure/Painful Implant: ☐ Loosening ☐ Breakage ☐ Local irritation

Neurovascular

☐ Nerve deficit/palsy: Describe: _____

Other : _____

ACTION in the OR

Complications/Adverse Events Cont'd		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks** ☐ **6 Weeks** ☐ **3 Months** ☐ **6 Months**		

Treatment if any: _____

_____

_____

☐ Antibiotics given: ☐ No ☐ Yes If Yes, Type/Amount _____ - IV vs. PO

Surgical Intervention: ☐ No ☐ Yes *Please complete Surgical Intervention*

_____

Outcome: ☐ Recovered: _____(dd/mmm/yy)

☐ Still undergoing treatment

☐ Recovered with sequelae:_____ (dd/mmm/yy)

Comments: _____

_____

Version: 22 Nov 2017

ACTION in the OR

Surgical Intervention – Complications Post Initial Surgical Treatment		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks** ☐ **6 Weeks** ☐ **3 Months** ☐ **6 Months**		

Operative Procedure date:_____ (dd/mmm/yy)

Primary Surgeon: _____

Indication for Surgical Intervention: _____

_____

Surgery Performed:

_____

_____

_____

Duration of operation (skin to skin: _____(hh:mm)

Admitted to Hospital: ☐ No ☐ Yes If Yes, length of stay_____

Complications: ☐ Surgical

☐ Anaesthesia

☐ Immediate post-operative

☐ Other: _____

Details of complications: _____

Version: 22 Nov 2017

ACTION in the OR

Study Exit Form		
Study ID: _____	Initials: _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks** ☐ **6 Weeks** ☐ **3 Months** ☐ **6 Months**		

Reason for Study Exit

☐ Subject completed 6 Months of Study Follow up

☐ Subject Withdrew Consent/no longer wanted to continue specify date: _____

and provide details below

☐ Unable to locate/lost to follow up

☐ Death (complete AE FORM 6.1, 6.2)

☐ Other reason:_____

Please provide details:

_____

_____

_____

Version: 22 Nov 2017

APPENDIX III. LETTER OF INFORMATION AND CONSENT FORM

LETTER OF INFORMATION:

STUDY TITLE: Academic Centre Tiered Operating Room Strategy (ACTION in-the-OR)

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PRINCIPAL INVESTIGATORS:
Dr. David Sanders, London Health Sciences Centre, Victoria Hospital
Dr. Abdel Lawendy, London Health Sciences Centre, Victoria Hospital

PHONE NUMBER:

INVITATION TO PARTICIPATE: You are being invited to participate in this study because you have a deformity of your foot (e.g. bunion, lesser toe deformities such as a hammer toe etc.) or ankle fracture that you have decided to have fixed with surgery. Your surgeon is also an investigator of this research study. Please ask questions if there is anything that you do not understand.

This Letter of Information provides detailed information about the research study which a member of the research team will discuss with you. This discussion should go over all aspects of this research: its purposes, the procedures that will be performed, any risks of the procedures and possible benefits. Once you understand the study and all your questions have been answered, if you still wish to participate, you, along with a member of the research team, will be asked to sign the informed consent. You will receive a copy of it to keep as a record.

PURPOSE OF THIS STUDY: You have decided to undergo surgery to correct the deformity in your foot or for your broken ankle.

The demand for surgery to correct deformities such as the one you have, often results in long wait times not only to see a specialist (surgeon) but also for the surgery itself. Hospital budgets are not keeping pace with demands and hospitals are often told to “make it work” with the funding available.

Operating room (OR) costs consume a significant portion of hospital budgets. Standard or “Status Quo” OR design and set up is inefficient and outdated. These ORs are equipped with the same, fixed set of assigned resources, regardless of case complexity or actual resource requirements. Allocation of resources in standard ORs is the same whether one is having heart surgery or bunion removal.

London Health Sciences Centre, Victoria Hospital has been piloting a new OR design in an effort to streamline the surgical process. In this new pilot OR set up, resources (staff and equipment) are carefully matched to procedure complexity as a novel means of healthcare delivery. This prospective, comparative cohort pilot study will compare two operating room (OR) setup designs. The Tiered OR setup (study intervention) will be an efficiently staffed

and equipped OR, geared to the complexity of the surgical procedure. The level of care provided would be equivalent to that of an out-patient day surgery setup. The standard Status Quo OR setup (control intervention) will be a standard fully equipped, fully staffed OR.

We pilot tested a tiered strategy for surgical procedures wherein resources were carefully matched to procedure complexity. Preliminary results suggested dramatic improvements in efficiency (up to 35%) and reductions in cost (up to 62%) were the result with no negative effects on patient care. While results from a pilot test of a high efficiency Tiered OR was positive, demonstrating case cost reductions and increased efficiency in OR turnover, longer follow-up, larger sample size, an economic evaluation, and additional high quality evidence is needed to bolster this work.

This is a prospective, comparative cohort pilot study comparing the efficiency and patient satisfaction outcomes of two different OR set up designs for orthopedic patients undergoing low complexity foot and ankle surgery at London Health Sciences Centre (LHSC), Victoria Hospital in London, On. This study will also assess staff satisfaction with the OR designs and compare the economic and time impact of the different OR set ups.

The Tiered OR group (study intervention) will have their surgery conducted in an efficiently staffed and equipped OR, geared to the complexity of the surgical procedure. The level of care provided would be equivalent to that of an out-patient day surgery setup.

The standard Status Quo OR group (control intervention) will have their surgery conducted in a standard fully equipped, fully staffed OR.

By reducing unnecessary OR time and equipment resources for minor procedures, the surplus OR time and costs saved could be made available for the more time consuming surgical procedures and for more patients overall. Specialization and standardization has the potential to improve access to and quality of care.

The **primary outcome** will be patient completed health-related quality of life questionnaires and satisfaction with the surgical experience. **Secondary outcomes will examine** rates of surgical site infections; readmissions; emergency room visits, and wait times, cost data as well as surgical team satisfaction. . A cost-effective analysis will also be conducted.

PROCEDURES OF THIS STUDY*:*
Up to two hundred orthopedic surgery patients undergoing foot or ankle surgery procedures at London Health Sciences Centre, Victoria Hospital (VH) will be allocated to either the Tiered OR set up (study intervention) or to the “status quo” or standard OR setup (control group).

You have been selected as a possible candidate for the study, since your surgical procedure is of relatively short duration and you meet the criteria for day surgery as far as your health goes.

If you agree to participate and sign the consent form, you will be assigned to either the Tiered OR set up (pilot study group) or the standard "Status Quo" set up (control group) based on OR availability and your personal preference as to your timing/date of surgery.

The surgical procedures utilized are part of routine standard of care for foot and ankle orthopaedic injuries. The difference between the 2 ORs, is in the logistic changes made to the operating room setup and streamlining of the staff and equipment needed for your type of surgery in the Tiered OR group. That is, only the equipment and staff needed for your type of surgery is present in the Tiered OR.

Regardless of which group you have been assigned to, your surgical procedure will remain the standard of care for your type of deformity as determined by your surgeon to provide the best outcome.

Both groups will receive a nerve block/regional anesthesia and local infiltration anesthesia. General anesthesia can be performed in the Status Quo OR group if required but will not be used in Tiered OR group. Nerve blocks/regional anesthesia, local infiltration anesthesia and general anesthesia are considered standard of care for your type of procedure.

Regional anesthesia/nerve block - regional block/nerve block involves injection of medication to temporarily numb a specific area of the body. As part of regional anesthesia, you usually receive medications to mildly sedate you. If regional anesthesia does not provide sufficient pain relief, you may receive general anesthesia or intravenous pain-relieving drugs to supplement regional anesthesia.

The risks of regional anesthesia include, but are not limited to low blood pressure, itching or allergic reaction to drugs, obstruction or cessation of breathing, severe headache, paralysis, nerve injury, bleeding, blood clots, infection or meningitis, falls after surgery, drug reactions (including rash, shock, and cardiac/respiratory arrest), stroke or brain injury, heart failure or heart attack, and death. These risks would have been explained during the surgical/anesthesia consent process for routine clinical care.

General anesthesia makes you unconscious and insensitive to pain through the use of medications which you may breathe or have injected. A breathing tube is usually placed into your windpipe once you are unconscious and later removed before you are fully awake. Occasionally the breathing tube will remain in place a little longer until you are strong enough to breathe independently.

Some patients fear awakening during their surgery but this complication is very rare. Other risks associated with general anesthesia include but are not limited to damage to lips or teeth, sore throat, headache, eye injury or blindness, low blood pressure, infection, drug reactions (including rash, shock, and cardiac/respiratory arrest), blood clots, aspiration, lung infection, obstruction or cessation of breathing, loss of sensation or limb function, paralysis, stroke or brain injury, heart failure or heart attack, and death. These risks would have been explained during the surgical/anesthesia consent process for routine clinical care.

However, for procedures of short duration, nerve blocks or regional anesthesia is often chosen as the side effects from anesthesia are greatly reduced (e.g. nausea or vomiting, sore throat, length of time needed to recover from anesthesia etc.).

It is however, important that you understand the risks of both types of anesthesia and which of these risks are more or less likely or serious in a person with a medical history like yours. Whether or not you have already spoken with an anesthesiologist about the options for anesthesia during the surgery, the study team can arrange a discussion with an anesthesiologist to enable you to make an informed decision about participation in this study and to answer any specific questions you may have.

Your post-operative pain management will be performed using only drugs approved for standard care and is expected to vary somewhat from patient to patient. This study will not influence any aspect of your clinical care beyond the OR set up.

Study Related Assessments

There will be 5 study related visits. These visits coincide with routine standard of care at baseline, 2 and 6 weeks, 3 and 6 months, regardless if you participate in the study or not. We will ask you questions about any problems you may have had and what activities you are able to perform. The study visits will take approximately 5-10 minutes of your time. .

There are 3 questionnaires to complete at one or more of the study visits

1. The EQ 5D is widely used to describe the extent to which someone is having a problem in each of 5 categories of health (mobility, self-care, usual activities, pain, and anxiety/depression). This questionnaire will be completed at all visits.

2. The Patient Surgical Experience Satisfaction Survey (PSESS) asks your opinion about whether your surgical expectations were met at each stage (e.g. surgeon visit, OR, recovery). This questionnaire will be completed at 2-week follow up.

3. The American College of Surgeons Patient National Quality Improvement Program (NSQIP) assesses your pain and health as well as your opinion on your quality of life and surgical experience after surgery. This questionnaire will be completed at the 6 week follow up visit.

POSSIBLE RISKS AND DISCOMFORTS:
If you find the questionnaires you receive during the course of the study upsetting or distressing, you do not have to answer those questions.

POSSIBLE BENEFITS: We cannot guarantee that you will receive any direct benefit from your participation in this study. Benefits may exist for future patients in terms of understanding the impact of OR design on patient access to treatment in a safe and efficient, cost saving manner. Also, this study hopes to identify where perhaps more information is needed to give to the patient to provide a less worrying surgery and recovery experience.

RESEARCH-RELATED INJURY: You do not waive any of your legal rights by signing the consent form. If you become ill or injured as a direct result of participating in this study, necessary medical treatment will be available at no additional cost to you. However, your signature on the consent form only indicates that you have read the information regarding your participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the investigator, the study doctor, or involved institutions from their legal and professional responsibilities.

CONFIDENTIALITY: Every effort will be made to maintain the confidentiality of your study records. The information we gain due to your participation in this study will be available to doctors and researchers who are members of the study team. In addition, representatives of Western Ontario Health Sciences Research Ethics Board or members of Lawson Quality Assurance may contact you or require access to your study-related records to monitor the conduct of the research.

Your study records will be identified only by a unique identification number and will not contain your name in part or in full. These records are kept in locked storage. Data collected for the study will be entered into an electronic spreadsheet which is kept on a secure, password protected computer server that is only accessible by study staff. The electronic data will not contain any identifying information (de identified) and will only be identified by a unique study number. If the results of the study are published, your name will not be used and no information that discloses your identity will be released or published. Information collected for the study will be kept for a period of 15 years.

WITHDRAWAL FROM STUDY: Participation in this study is voluntary. You may refuse to participate, refuse to answer any questions or withdraw from the study at any time with no effect on your future care. Beginning on the date that you revoke your approval in writing, no new personal health information will be used for research. However, the study doctor/investigator may continue to use the health information that was provided before you withdrew your approval.

COMPENSATION: There will be no costs to you for being in the study, nor will you be paid for participating in the study.

INDIVIDUAL(S) TO CONTACT:

If you have any questions about your rights as a research participant or the conduct of this study, you may contact the Patient Experience Office at LHSC at (519) 685-8500 ext. 52036 or access the online form at: https://apps.lhsc.on.ca/?q=forms/patient-experience-contact-form.

If you have any medical questions please contact your orthopedic surgeon. For study related questions, please contact the Research Coordinator at (519) 685-8500 Ext. 55362.

This letter is yours to keep.

CONSENT FORM

STUDY TITLE: Academic Centre Tiered Operating Room Strategy (ACTION in-the-OR)

.

PRINCIPAL INVESTIGATORS:
Dr. David Sanders, London Health Sciences Centre, Victoria Hospital
Dr. Abdel Lawendy, London Health Sciences Centre, Victoria Hospital

PHONE NUMBER:

I have read the Letter of Information, have had the nature of the study explained to me, and I agree to participate. All questions have been answered to my satisfaction.

I will receive a copy of the Letter of Information and Consent Form.

_____
Name of Participant (please print)

_____ _____
Signature Date Signed

PARTICIPANT'S **TRANSLATOR (if applicable**)

_____ _____
Name of Translator (please print)

_____
Signature Date Signed

_____
Name of Person Obtaining Consent (please print)

_____ _____
Signature Date Signed

APPENDIX IV. EQ5D-5L QUESTIONNAIRE

IV.1 Baseline Questionnaire

ACTION in-the–OR Pilot Study

EQ5D-5L		
Study ID_____	Initials _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **Baseline**		

We are interested in knowing your overall state of health PRIOR to your injury or surgery. By placing a tick in one box in each group below, please indicate which statements best describe your own health state today:

Mobility
☐I have no problems in walking about
☐I have slight problems in walking about
☐I have moderate problems in walking about
☐I have severe problems in walking about
☐I am unable to walk about

Self-Care
☐I have no problems washing or dressing myself
☐I have slight problems washing or dressing myself
☐I have moderate problems washing or dressing myself
☐I have severe problems washing or dressing myself
☐I am unable to wash or dress myself

Usual Activities (e.g. work, study, housework, family or leisure activities)
☐I have no problems doing my usual activities
☐I have slight problems doing my usual activities
☐I have moderate problems doing my usual activities
☐I have severe problems doing my usual activities
☐I am unable to do my usual activities

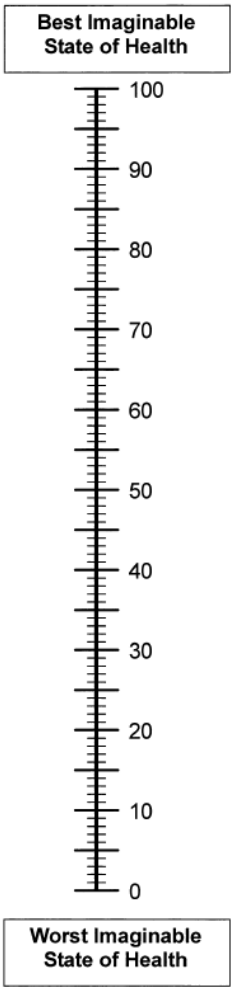
Pain/Discomfort
☐I have no pain or discomfort
☐I have slight pain or discomfort
☐I have moderate pain or discomfort
☐I have severe pain or discomfort
☐I have extreme pain or discomfort

Anxiety/Depression
☐I am not anxious or depressed
☐I am slightly anxious or depressed
☐I am moderately anxious or depressed
☐I am severely anxious or depressed
☐I am extremely anxious or depressed

ACTION in-the–OR Pilot Study

We would like to know how good or bad your health is **TODAY**.
100 means the best health you can imagine.0 means the worst health you can imagine.

Please mark an X on the scale to indicate how good or bad your health is TODAY.



IV.2 Follow-Up Questionnaire

ACTION in-the–OR Pilot Study

EQ5D-5L		
Study ID_____	Initials _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ 2 weeks ☐ 6 Weeks ☐ 3 Months ☐ 6 Months		

We are interested in knowing your overall current state of health. By placing a tick in one box in each group below, please indicate which statements best describe your own health state today:

Mobility
☐I have no problems in walking about
☐I have slight problems in walking about
☐I have moderate problems in walking about
☐I have severe problems in walking about
☐I am unable to walk about

Self-Care
☐I have no problems washing or dressing myself
☐I have slight problems washing or dressing myself
☐I have moderate problems washing or dressing myself
☐I have severe problems washing or dressing myself
☐I am unable to wash or dress myself

Usual Activities (e.g. work, study, housework, family or leisure activities)
☐I have no problems doing my usual activities
☐I have slight problems doing my usual activities
☐I have moderate problems doing my usual activities
☐I have severe problems doing my usual activities
☐I am unable to do my usual activities

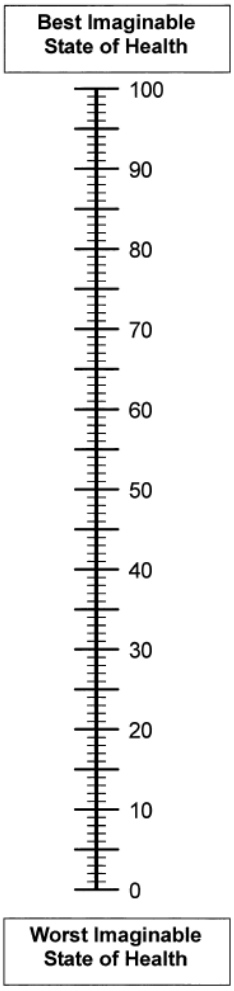
Pain/Discomfort
☐I have no pain or discomfort
☐I have slight pain or discomfort
☐I have moderate pain or discomfort
☐I have severe pain or discomfort
☐I have extreme pain or discomfort

Anxiety/Depression
☐I am not anxious or depressed
☐I am slightly anxious or depressed
☐I am moderately anxious or depressed
☐I am severely anxious or depressed
☐I am extremely anxious or depressed

ACTION in-the–OR Pilot Study

We would like to know how good or bad your health is **TODAY**.
100 means the best health you can imagine.0 means the worst health you can imagine.

Please mark an X on the scale to indicate how good or bad your health is TODAY.



APPENDIX V. PATIENT SURGICAL EXPERIENCE SATISFACTION SURVEY

ACTION in-the–OR Pilot Study

Patient Surgical Experience Satisfaction Survey		
Study ID_____	Initials _____	Date of Visit _____ dd / mm / yy
VISIT: ☐ **2 weeks**		

We would like to better understand your quality of life after your surgery and what was your overall satisfaction level with your surgical experience and whether the experience met your expectations.

Please rate your satisfaction level with your surgical experience on the scale below. One (1) is the being the worst satisfaction level imaginable and 10 being the best possible satisfaction level imaginable.

Wait Time for Procedure/Surgical Appointment

1. How would you rate your level of satisfaction with the length of time from when your family doctor made the referral to the surgeon and your appointment date to see the surgeon?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

2. How would you rate your level of satisfaction with the length of time from when you saw the surgeon to your date of surgery?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

Information Received for Procedure Prior to Surgery

Surgeon

3. How would you rate your level of satisfaction with the information you received from the surgeon regarding the procedure and your recovery?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

4. Did you seek further information about your procedure ☐ No ☐Yes, if Yes from:
   - ☐ Internet
   - ☐ Friends or family with medical training
   - ☐ Friends or family with personal experience
   - ☐ Other (specify): _____

ACTION in-the–OR Pilot Study

Surgeon's Office

5. How would you rate your level of satisfaction with the information you received from the surgeon's office regarding your appointment for surgery, where to go, what to expect and suggested equipment you may need (e.g. crutches)?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

Pre-operative Preparation

6. How would you rate your level of satisfaction with the information you received from your nurse in answering any questions you had regarding the procedure, your recovery etc.?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

7. Overall, did the information you receive from your nurse help to make the procedure less worrying to you?

0 1 2 3 4 5 6 7 8 9 10
Made it worse/more worrying — Made a great difference/Less worrying

Anesthesia – Day of surgery

8. How would you rate your level of satisfaction with the information you received from anesthesia on the day of surgery?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

9. Were you aware prior to your surgery, the type of anesthetic you were going to receive?
   - ☐ Yes
   - ☐ No
   - ☐ Do not recall

10. Overall, how would you rate your level of satisfaction with the care you received from anesthesia on your day of surgery?

0 1 2 3 4 5 6 7 8 9 10
Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

ACTION in-the–OR Pilot Study

Orthopedic Surgery –Day of Surgery

11. How would you rate the information you received from your orthopedic surgeon on the day of surgery?

0 1 2 3 4 5 6 7 8 9 10

Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

12. Overall, how would you rate your level of satisfaction with the care you received from orthopedic surgery on your day of surgery?

0 1 2 3 4 5 6 7 8 9 10

Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

Recovery Post Surgery

13. How long were you in hospital after your surgery before being sent home?
    - ☐ <1 hour
    - ☐ 1-2 hours
    - ☐ 2-3 hours
    - ☐ 3-6 hours
    - ☐ > 6 hours
    - ☐ Other (specify): _____ hours/ days.
    - ☐ Do not know/recall

Satisfaction with Anesthesia Care

14. Did you experience any side effects from anesthesia? ☐ No ☐Yes, if yes, please select all that apply:
    - ☐ Drowsiness
    - ☐ Thirst
    - ☐ Sore throat
    - ☐ Nausea or vomiting
    - ☐ Feeling cold
    - ☐ Confusion or disorientation
    - ☐ Pain at the site of anesthesia injection
    - ☐ Do not recall

ACTION in-the–OR Pilot Study

15. Have you had previous experience with anesthesia? ☐ No ☐Yes, if yes, type of anesthetic you received?
    - ☐ Local or regional
    - ☐ General
    - ☐ Nerve block
    - ☐ Do not recall

    Compared to your previous anesthetic experience, how would you rate your overall level of satisfaction with the type of anesthetic you received for this surgery?

    0 1 2 3 4 5 6 7 8 9 10
    Very unsatisfied/Worse than previous — Highly satisfied/Exceeded expectations

16. Based on your overall anesthesia experience, would you recommend the type of anesthetic (local block and regional anesthetic) you received to your friends and family?

    0 1 2 3 4 5 6 7 8 9 10
    Not recommend at all — Absolutely recommend

Nursing- post op

17. How would you rate your level of satisfaction with the information you received from the nursing staff after your surgery?

    0 1 2 3 4 5 6 7 8 9 10
    Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

18. How would you rate your level of satisfaction with the care you received from nursing after your surgery?

    0 1 2 3 4 5 6 7 8 9 10
    Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

Take home Instructions and Equipment

19. Did you receive ambulation (weight bearing and walking) instructions?
    - ☐ Yes
    - ☐ No
    - ☐ Do not recall

20. Which walking aid was recommended for you to use for your recovery?
    - ☐ Crutches
    - ☐ Walker
    - ☐ Wheelchair
    - ☐ Other (specify): _____
    - ☐ Do not recall

21. Did you bring the equipment with you to hospital?
    - ☐ Yes
    - ☐ No, but have at home
    - ☐ No, did not know I needed to purchase or rent equipment

22. How would you rate your level of satisfaction with the take home instructions/information provided to you after your surgery, prior to discharge regarding what to expect/do during your recovery?

0 1 2 3 4 5 6 7 8 9 10

Very unsatisfied/Below expectations — Highly satisfied/Exceeded expectations

23. What type of instructions did you receive?
    - ☐ Verbal only
    - ☐ Written only
    - ☐ Verbal and written
    - ☐ Do not recall

24. Overall, did the information you received about your recovery before you left the hospital help to make your recovery process less worrying to you?

0 1 2 3 4 5 6 7 8 9 10

Made it worse/more worrying — Made a great difference/Less worrying

25. How confident did you feel that you are well enough to travel home on discharge from the day surgery unit?

0 1 2 3 4 5 6 7 8 9 10

Not at all confident — Very confident

26. Would you have preferred to stay in hospital longer or overnight following your procedure?
    - ☐ Yes, longer
    - ☐ Yes, overnight
    - ☐ No

ACTION in-the–OR Pilot Study

Overall Surgical Experience

27. How would you rate your overall surgical experience?

0 1 2 3 4 5 6 7 8 9 10
Worst experience — Best experience imaginable

28. Based on your experience, would you recommend the day surgery unit you used to your friends and family?

0 1 2 3 4 5 6 7 8 9 10
Not recommend at all — Absolutely recommend

Assistance from others

29. As a result of your day surgery procedure, did someone take time off work or gave up their usual activities to drive you home from the hospital?

☐ Yes, if Yes, who was this person:
- ☐ spouse
- ☐ family
- ☐ friend
- ☐ other (specify): _____

☐ No, if No, how did you get home from the hospital? Specify: _____

30. As a result of your day surgery procedure, did someone take time off work or gave up their usual activities care for you immediately after your surgery?

☐ No ☐ Yes, if Yes, who was your caregiver:
- ☐ spouse
- ☐ family
- ☐ friend
- ☐ other (specify): _____

31. Did you pay someone to help you after your surgery? ☐ No ☐Yes, if yes, for (select all that apply):
- ☐ Childcare
- ☐ Housework (e.g. laundry, cooking, cleaning etc.)
- ☐ Driving to/from appointments
- ☐ Grocery shopping
- ☐ Yard work

☐ Other (Specify): _____

Please provide comments (good and bad) on any aspect of your experience with day surgery that are important to you.

Thank you for your assistance in helping us improve the day surgery patient experience

APPENDIX VI. NATIONAL SURGICAL QUALITY IMPROVEMENT PROGRAM QUESTIONNAIRE

Dear Patient,

Your surgeon and your hospital are doing a Quality Improvement Project to better understand your quality of life after your surgery and what your experience with surgery has been. Your answers will help other patients like you.

This survey should take no more than 10 minutes to complete. Please try to answer all of the questions the best you can.

There is no risk involved in participating, and you may choose not to participate. Your answers will only be shared with your surgeon and your care team so that they can best evaluate your care. Otherwise, your answers will remain strictly confidential. Your decision to participate is entirely your choice, and you may stop at any time.

If you have any questions about this survey, please contact your surgeon's office.

Before you start, please write down today's date:

_____

Thank you for making surgery safer and better for everyone!

Please respond to each question or statement by marking one box per row.

In the past 7 days….	**Not at all**	**A little bit**	**Somewhat**	**Quite a bit**	**Very much**
How much did pain interfere with your day to day activities?	☐	☐	☐	☐	☐
How much did pain interfere with work around the home?	☐	☐	☐	☐	☐
How much did pain interfere with your ability to participate in social activities?	☐	☐	☐	☐	☐
How much did pain interfere with your household chores?	☐	☐	☐	☐	☐

Please respond to each item by marking one box per row.

	Excellent	Very Good	Good	Fair	Poor
In general, would you say your health is:	☐	☐	☐	☐	☐
In general, would you say your quality of life is:	☐	☐	☐	☐	☐
In general, how would you rate your physical health?	☐	☐	☐	☐	☐
In general, how would you rate your mental health, including your mood and your ability to think?	☐	☐	☐	☐	☐
In general, how would you rate your satisfaction with your social activities and relationships?	☐	☐	☐	☐	☐
In general, please rate how well you carry out your usual social activities and roles. (This includes activities at home, at work and in your community, and responsibilities as a parent, child, spouse, employee, friend, etc.)	☐	☐	☐	☐	☐

	Completely	Mostly	Moderately	A little	Not at all
To what extent are you able to carry out your everyday physical activities such as walking, climbing stairs, carrying groceries, or moving a chair?	☐	☐	☐	☐	☐

In the past 7 days….

	Never	Rarely	Sometimes	Often	Always
How often have you been bothered by emotional problems such as feeling anxious, depressed or irritable?	☐	☐	☐	☐	☐

	None	Mild	Moderate	Severe	Very severe
How would you rate your fatigue on average?	☐	☐	☐	☐	☐

How would you rate your pain on average?	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
	0	1	2	3	4	5	6	7	8	9	10
	No pain										**Worst imaginable pain**

Before Your Surgery

1. A health provider could be a doctor, nurse, or anyone else you would see for health care. Before your surgery, did anyone in this surgeon's office give you all the information you needed about your surgery?

   ☐ Yes, definitely

   ☐ Yes, somewhat

   ☐ No

2. Before your surgery, did anyone in this surgeon's office give you easy to understand instructions about getting ready for your surgery?

   ☐ Yes, definitely

   ☐ Yes, somewhat

   ☐ No

3. During your office visits before your surgery, did this surgeon tell you there was more than one way to treat your condition?

   ☐ Yes

   ☐ No

4. During your office visits before your surgery, did this surgeon ask which way to treat your condition you thought was best for you?

   ☐ Yes

   ☐ No

5. During your office visits before your surgery, did this surgeon talk with you about the reasons you might want to have the surgery?

   ☐ Not at all

   ☐ A little

   ☐ Some

   ☐ A lot

6. During your office visits before your surgery, did this surgeon talk with you about the reasons you might **not** want to have the surgery?

   ☐ Not at all

   ☐ A little

   ☐ Some

   ☐ A lot

7. During your office visits before your surgery, did this surgeon listen carefully to you?

   ☐ Yes, definitely

   ☐ Yes, somewhat

   ☐ No

8. During your office visits before your surgery, did this surgeon spend enough time with you?

   ☐ Yes, definitely

   ☐ Yes, somewhat

   ☐ No

9. During your office visits before your surgery, did this surgeon encourage you to ask questions?

   ☐ Yes, definitely

   ☐ Yes, somewhat

   ☐ No

10. During your office visits before your surgery, did this surgeon show respect for what you had to say?

    ☐ Yes, definitely

    ☐ Yes, somewhat

    ☐ No

11. During your office visits before your surgery, did anyone in this surgeon's office use pictures, drawings, models, or videos to help explain things to you?

    ☐ Yes

    ☐ No → **If No, go to #13**

12. Did these pictures, drawings, models, or videos help you better understand your condition and its treatment?

    ☐ Yes, definitely

    ☐ Yes, somewhat

    ☐ No

Your Surgery

13. **After you arrived** at the hospital or surgical facility, did this surgeon visit you before your surgery?

    ☐ Yes

    ☐ No → **If No, go to #15**

14. Did this visit make you feel more calm and relaxed?

    ☐ Yes, definitely

    ☐ Yes, somewhat

    ☐ No

15. **Before you left** the hospital or surgical facility, did this surgeon discuss the outcome of your surgery with you?

- ☐ Yes
- ☐ No
- ☐ Don't know

After Your Surgery

16. Did anyone in this surgeon's office explain what to expect during your recovery period?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

17. Did anyone in this surgeon's office warn you about any signs or symptoms that would need immediate medical attention during your recovery period?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

18. Did anyone in this surgeon's office give you easy to understand instructions about what to do during your recovery period?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

19. Did this surgeon make sure you were physically comfortable or had enough pain relief **after you left the hospital or surgical facility** where you had your surgery?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

20. After your surgery, did you talk with this surgeon by phone or visit the surgeon at his or her office?

- ☐ Yes
- ☐ No → **If No, go to #25**

21. After your surgery, did this surgeon listen carefully to you?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

22. After your surgery, did this surgeon spend enough time with you?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

23. After your surgery, did this surgeon encourage you to ask questions?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

24. After your surgery, did this surgeon show respect for what you had to say?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

Your Overall Care From This Surgeon

25. Using any number from 0 to 10, where 0 is the worst surgeon possible and 10 is the best surgeon possible, what number would you use to rate all your care from this surgeon?

- ☐ 0 Worst surgeon possible
- ☐ 1
- ☐ 2
- ☐ 3
- ☐ 4
- ☐ 5
- ☐ 6
- ☐ 7
- ☐ 8
- ☐ 9
- ☐ 10 Best surgeon possible

Clerks and Receptionists at This Surgeon's Office

26. During these visits, were clerks and receptionists at this surgeon's office as helpful as you thought they should be?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

27. During these visits, did clerks and receptionists at this surgeon's office treat you with courtesy and respect?

- ☐ Yes, definitely
- ☐ Yes, somewhat
- ☐ No

About You

28. Not counting this surgery, about how many other surgeries have you had?

- ☐ None
- ☐ 1 surgery
- ☐ 2 surgeries
- ☐ 3 to 5 surgeries
- ☐ 6 to 9 surgeries
- ☐ 10 or more

29. What is the highest grade or level of school that you have completed?

- ☐ 8th grade or less
- ☐ Some high school, but did not graduate
- ☐ High school graduate or GED
- ☐ Some college or 2-year college
- ☐ 4-year college graduate
- ☐ More than 4-year college graduate

30. Did someone help you complete this survey?

- ☐ Yes
- ☐ No → **Thank You. Please return the completed survey to your surgeon's office.**

31. How did that person help you? Mark all that apply.

- ☐ Read the questions to me
- ☐ Wrote down the answers I gave
- ☐ Answered the questions for me
- ☐ Translated the questions into my language
- ☐ Helped in some other way

Please print: _____

_____

Thank You.

Please return the completed survey to your surgeon's office.

APPENDIX VII. IHI STAFF SATISFACTION SURVEYS

VII.1 Nursing Staff Satisfaction Survey

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

You are being asked to complete this survey as part of a pilot study to streamline the OR set up geared to surgical case requirements (Tiered Pilot OR) compared to the standard full OR design (Status Quo OR) and for use of block/regional anesthesia for foot or ankle surgery . This survey is anonymous. Your participation is greatly appreciated. Please fill out part 1 and the part belonging to your specific role in this setup.

*********When complete, please send Intercampus to: Christina, Orthopedic Surgery, E1-414************

Date of completion: _____

What is your position/location (Please check one as related to the last position worked and for which you are responding to the questionnaire at this time)

- ☐ Nurse (Day Surgery Pre Op, Block Room, OR Scrub, OR circulating, Day Surg Post op)

  (specify): _____

- ☐ Aide (Day Surgery Pre Op, OR, Day Surg Post op)

  (specify): _____

How long have you been working in this position? _____ (years, weeks, days)

Please respond to the following questions using a scale of 1 to 10 (with 1 being the lowest rating and 10 the highest rating).

Part 1: Overall STAFF SATISFACTION with Work Environment

1. Overall, how would you rate your team as a place to work on a scale of 1 – 10?

1	2	3	4	5	6	7	8	9	10
Bad									Good

2. Overall, how would you rate the level of courtesy and respect with which you are treated by people at all levels, including medical and non-medical staff?

1	2	3	4	5	6	7	8	9	10
Bad									Good

3. Overall, how would you rate how well people you work with cooperate, communicate and help each other?

1	2	3	4	5	6	7	8	9	10
Bad									Good

4. Overall, how would you rate other people's attitudes about working here, in other words, their morale?

1	2	3	4	5	6	7	8	9	10
Bad									Good

5. Overall, how would you rate your own attitude about working here, in other words, your morale?

1	2	3	4	5	6	7	8	9	10
Bad									Good

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

6. Overall, would you recommend your team as a place for your loved ones to come for care?

1	2	3	4	5	6	7	8	9	10
Not Recommended									Recommend

Part 2: Day Surgery Pre and Post-operative Patient Care Nursing Staff

Please respond to the following questions using a scale of 1 to 10 (with 1 being the lowest rating and 10 the highest rating).

What is your level of stress in preparing these patients for surgery?

1	2	3	4	5	6	7	8	9	10	Not applicable
Low									High	

Do you feel that you have adequate time to prepare patient's undergoing block/regional anesthesia while answering questions about the regional blocks, documenting medical history, medications, start IVs etc?

1	2	3	4	5	6	7	8	9	10	Not applicable
No									Yes	

Do you feel that more information needs to be provided to the patient ahead of time about the type of anesthesia (block/regional) they will be receiving in this OR set up?

1	2	3	4	5	6	7	8	9	10	Not applicable
Yes									No	

Do you feel that more information needs to be provided to the patient ahead of time regarding discharge planning (e.g. weight bearing status, walking aids, house set up, equipment required, assistance with care etc)

1	2	3	4	5	6	7	8	9	10	Not applicable
Yes									No	

How would you rate the communication in Day Surgery between staff members for this type of anesthesia?

1	2	3	4	5	6	7	8	9	10	Not applicable
Bad									Good	

Version: 21 November 2017

VII.2 Anesthesia Staff Satisfaction Survey

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

You are being asked to complete this survey as part of a pilot study to streamline the OR set up geared to surgical case requirements (Tiered Pilot OR) compared to the standard full OR design (Status Quo OR) and for use of block/regional anesthesia for foot or ankle surgery . This survey is anonymous. Your participation is greatly appreciated. Please fill out part 1 and the part belonging to your specific role in this setup.

*********When complete, please send Intercampus to: Christina, Orthopedic Surgery, E1-414************

Date of completion: _____

What is your position/location (Please check one as related to the last position worked and for which you are responding to the questionnaire at this time)

- ☐ Nurse (Block Room)
- ☐ Anesthesiologist Block Room (Consultant, Resident, Fellow)

  Specify: _____
- ☐ Anesthesiologist OR (Consultant, Resident, Fellow)

  Specify: _____

How long have you been working in this position? _____ (years, weeks, days)

Please respond to the following questions using a scale of 1 to 10 (with 1 being the lowest rating and 10 the highest rating).

Part 1: Overall STAFF SATISFACTION with Work Environment

1. Overall, how would you rate your team as a place to work on a scale of 1 – 10?

1	2	3	4	5	6	7	8	9	10
Bad									Good

2. Overall, how would you rate the level of courtesy and respect with which you are treated by people at all levels, including medical and non-medical staff?

1	2	3	4	5	6	7	8	9	10
Bad									Good

3. Overall, how would you rate how well people you work with cooperate, communicate and help each other?

1	2	3	4	5	6	7	8	9	10
Bad									Good

4. Overall, how would you rate other people's attitudes about working here, in other words, their morale?

1	2	3	4	5	6	7	8	9	10
Bad									Good

5. Overall, how would you rate your own attitude about working here, in other words, your morale?

1	2	3	4	5	6	7	8	9	10
Bad									Good

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

6. Overall, would you recommend your team as a place for your loved ones to come for care?

1 2 3 4 5 6 7 8 9 10
Not Recommend Recommend

Part 2: Block Room Nursing Staff

Please respond to the following questions using a scale of 1 to 10 (with 1 being the lowest rating and 10 the highest rating).

What is your level of stress in preparing these patients for surgery?

1 2 3 4 5 6 7 8 9 10 Not applicable
Low High

Do you feel that you have adequate time to prepare patient's undergoing block/regional anesthesia while answering questions about the regional blocks, documenting medical history, medications, start IVs etc?

1 2 3 4 5 6 7 8 9 10 Not applicable
Low High

Do you feel that more information needs to be provided to the patient ahead of time about the type of anesthesia (block/regional) they will be receiving in this OR set up?

1 2 3 4 5 6 7 8 9 10 Not applicable
Low High

How would you rate the communication in Block Room between staff members for this type of anesthesia?

1 2 3 4 5 6 7 8 9 10 Not applicable
Low High

Part 3: Block/Regional Anesthesia Staff

Please respond to the following questions using a scale of 1 to 10 (with 1 being the lowest rating and 10 the highest rating).

Please check which OR set up you were working in: ☐ Tiered Pilot OR ☐ Standard OR ☐ Block Room

What is your level of stress in preparing these patients for surgery?

1 2 3 4 5 6 7 8 9 10 Not applicable
Low High

Do you feel that you have adequate time to perform the block/regional anesthesia?

1 2 3 4 5 6 7 8 9 10 Not applicable
Low High

Version: 21 November 2017

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

How would you rate the efficiency of this OR setup?

1	2	3	4	5	6	7	8	9	10	Not applicable
Low									High	

How would you rate the communication in the OR between staff members in this OR set up?

1	2	3	4	5	6	7	8	9	10	Not applicable
Low									High	

VII.3 Orthopaedic Staff Survey

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

You are being asked to complete this survey as part of a pilot study to streamline the OR set up geared to surgical case requirements (Tiered Pilot OR) compared to the standard full OR design (Status Quo OR) and for use of block/regional anesthesia for foot or ankle surgery . This survey is anonymous. Your participation is greatly appreciated. Please fill out part 1 and the part belonging to your specific role in this setup.

*********When complete, please send Intercampus to: Christina, Orthopedic Surgery, E1-414************

Date of completion: _____

What is your position/location (Please check one as related to the last position worked and for which you are responding to the questionnaire at this time)

- ☐ Surgeon (Consultant, Resident, Fellow)

  Specify: _____

How long have you been working in this position? _____ (years, weeks, days)

Please respond to the following questions using a scale of 1 to 10 (with 1 being the lowest rating and 10 the highest rating).

Part 1: Overall STAFF SATISFACTION with Work Environment

1. Overall, how would you rate your team as a place to work on a scale of 1 – 10?

   1 2 3 4 5 6 7 8 9 10
   Bad Good

2. Overall, how would you rate the level of courtesy and respect with which you are treated by people at all levels, including medical and non-medical staff?

   1 2 3 4 5 6 7 8 9 10
   Bad Good

3. Overall, how would you rate how well people you work with cooperate, communicate and help each other?

   1 2 3 4 5 6 7 8 9 10
   Bad Good

4. Overall, how would you rate other people's attitudes about working here, in other words, their morale?

   1 2 3 4 5 6 7 8 9 10
   Bad Good

5. Overall, how would you rate your own attitude about working here, in other words, your morale?

   1 2 3 4 5 6 7 8 9 10
   Bad Good

6. Overall, would you recommend your team as a place for your loved ones to come for care?

   1 2 3 4 5 6 7 8 9 10
   Not Recommend Recommend

ACTION in-the–OR Pilot Study

Institute for Healthcare Improvement (IHI) Provider and Staff Satisfaction Survey

Part 2: Orthopedic Surgery Staff

Please check which OR set up you were working in Tiered Pilot OR Standard OR Block Room

Do you feel that you have adequate time to perform the surgical procedure?

1 2 3 4 5 6 7 8 9 10 Not applicable
Not adequate Adequate

How would you rate the efficiency of this OR setup?

1 2 3 4 5 6 7 8 9 10 Not applicable
Bad Good

How would you rate the communication in the OR between staff members in this OR set up?

1 2 3 4 5 6 7 8 9 10 Not applicable
Bad Good

Version: 21 November 2017

VITA

Name:	Moaz Bin Yunus Chohan
Post-secondary Education and Degrees:	Dow University of Health Sciences Karachi, Pakistan 2004 – 2010 MBBS University of Western Ontario London, Ontario, Canada 2017 – present MSc (Surgery)
Honours and Awards:	Best Research Award, Dow Medical College 2009 Province of Ontario Graduate Scholarship 2017 – 2018
Related Work Experience:	Research Assistant University of Calgary 2013 – 2014 Research Associate University of Calgary 2015 – 2017 Research Assistant University of Western Ontario 2017 – present

Publications:

Chohan MBY, Siddiqui MZ, Haider S, Siddiqui MA. Post burn scar carcinoma. Pak J Surg. 2009 Oct; 24(4): 298-300.

Singh P, Ens T, Hayden KA, Sinclair S, LeBlanc P, **Chohan M**, King-Shier KM. Retention of ethnic participants in longitudinal studies. J Immigr Minor Health. 2018 Aug; 20(4):1011-1024.

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