

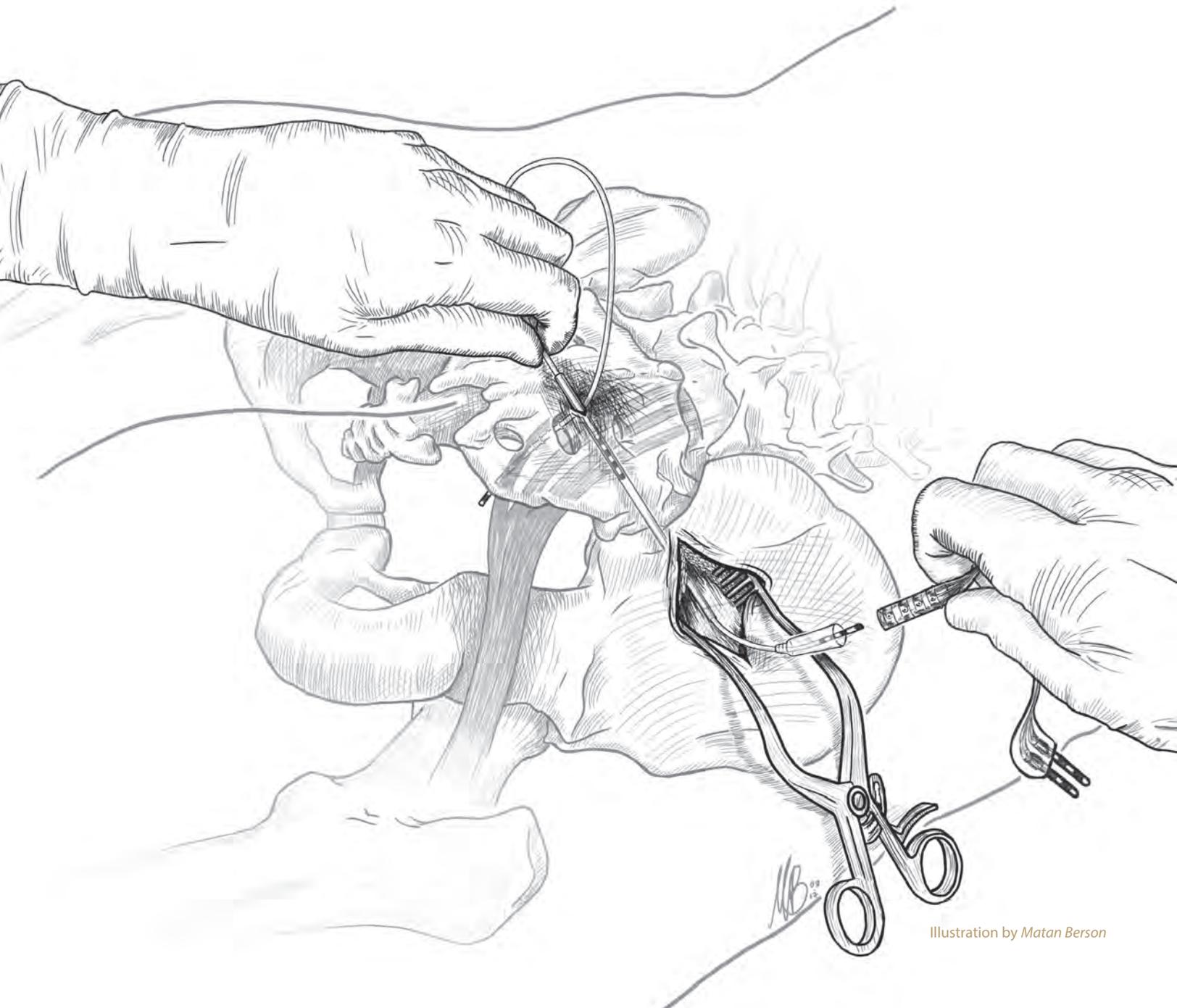
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Preface from the Editors

Dear Reader,

We are pleased to present you with the second issue of the 94th volume of the *UTMJ*. While a large spectrum of human disease has been discussed in previous editions of the *UTMJ*, our current theme of Surgery has remained largely out of the spotlight. With over 359 million surgical procedures performed annually around the world,¹ surgery has become an integral component of healthcare delivery. According to estimates, at least 30% of the global burden of disease can be alleviated by surgery or by involving a surgeon in disease management.² Research driven advancements in the field continue to challenge the status-quo and transform the delivery of surgical care around the world.

We are thrilled to feature original research, reviews, commentaries, and interviews that encompass a variety of topics pertinent to Surgery. In his review, Aadil Ali provides a thorough discussion of the world renowned Normothermic Ex

Vivo Lung Perfusion Toronto Protocol. We are also proud to feature interviews with Drs. Mitchell Brown and Mitesh Badiwala, University of Toronto affiliated surgeons who are leaders in their respective fields. Drs. Brown and Badiwala discuss a variety of topics and help illuminate some of the challenges encountered in the delivery of surgical care.

This is an exciting time for Surgery, especially as technological advancements revolutionize the field and surgical care becomes more available to the world's population. It is with this same sense of duty and optimism that the 2016-2017 *UTMJ* team has endeavoured to compile this issue. We would like to express our appreciation for the dedication and hard work of our team of section reviewers, copy editors, associate editors, the interview team, cover artist, and web developers. We are grateful for ongoing patronage of the journal by our sponsors. Finally, we would like to thank you - the reader; we hope you enjoy reading this issue!

Sincerely,

Ahmad Mousa
Mark Shafarenko

Editors-in-Chief, UTMJ

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1. World Health Organization
2. The Lancet

Illuminating the Black Box of Surgery

Mitchell G. Goldenberg, MBBS¹; Teodor P. Grantcharov, MD, PhD²

¹Division of Urology, Department of Surgery, University of Toronto

²Division of General Surgery, Department of Surgery, University of Toronto

Everyday, surgeons are reminded about the potential impact of their actions, both positive and negative, on a person's life. In the operating room, the difference between a successful and debilitating outcome is often not more than the result of a single wayward movement of the hand. Despite the high stakes, many surgeons are permitted to carry on for the length of their careers without any recertification or even observation of their intraoperative performance. While all surgery will forever carry a certain adverse risk for reasons that are often outside of the surgeon's control, this should not quell our desire to constantly improve our outcomes for the benefit of our patients. Through analyzing and understanding the events and circumstances that lead to adverse patient outcomes, we can systematically target and improve deficiencies of skill and ability. This quality improvement (QI) mind-state is certainly not unique to medicine or surgery, and many of the initiatives described here draw their inspiration from non-medical sources.

Understanding human error and the role of 'human factors' in adverse events has been a central principle in aviation for over 4 decades.¹ The concept of the 'black box' was borne from this industry, specifically from the idea that all safety incidents deserve scrutiny to prevent repetition. The primary role of these devices is to amalgamate and record data from multiple inputs including navigation equipment, barometer and other sensor information, and communications between pilots and ground crew.¹ Analysis of airline black box data revealed that human factors were responsible for over 70% of adverse cases.¹ This and other impactful analyses of aviation data led to the development of the Crew Resource Management (CRM) concept. CRM compels users to utilize both human and technological sources of information during a flight to ensure 'safe operations'.² In essence, CRM speaks to the need to combine technical and non-technical skill (communication, leadership, decision making, etc.) in order to optimize outcomes. Furthermore, the CRM-style approaches to individual and system safety has been successfully implemented in other high-stakes industries, such as the nuclear energy sector.² Consequently, the success of the CRM-style led to the creation of the OR BlackBox[®] as a means to collect and analyze diverse forms of data in the surgical environment.

On the back of evidence showing that more than half of medical error occurs during surgery,³ the Institute of Medicine released a report in 2000, entitled *To Err is Human*.⁴ The purpose of this document was to spur the creation of strategies to prevent adverse outcomes across the healthcare spectrum. There has been some success in adopting these strategies in surgery, namely the operative safety checklist, which uses a pre-operative briefing style similar to the preflight check used in aviation.⁵ Additional methods to uncover the frequency of, and circumstances around, surgical adverse events have been explored, including chart/operative note reviews, surveys, and mortality and morbidity rounds.⁴ While this work has further revealed that surgical adverse events are prevalent and often preventable,^{6,7} these methods are all retrospective and are prone to bias. Additionally, these methods only demonstrate correlation rather than causation. As a result, this prevents a *root-cause analysis* approach to be taken, which focuses on the chain of events leading up to an adverse event.⁸

The evidence for human involvement in adverse outcomes during surgery is growing. In a seminal study in the *New England Journal of Medicine*,⁹ investigators were able to demonstrate that patient outcomes in bariatric surgery could be predicted by analyzing the objective technical performance of a surgeon. These findings have been replicated in pancreatic surgery, and early evidence from our group shows that global rating of technical performance, and error analysis in gastrectomy and radical prostatectomy is predictive of perioperative and patient-centered outcomes. However, human impact on patient safety goes beyond technical skill, with multiple studies showing a link between operative team communication and leadership measurements and outcomes.^{10,11} It is this evidence that necessitates the use of audiovisual capture in the operating room, as only through direct observation of performance can we hope to identify deficiencies in both technical and non-technical skill.¹³

In order to better recognize and examine intraoperative adverse events, the OR BlackBox[®] was created. This innovation is a comprehensive data collection system that includes both human and environmental operating room factors in a number of analytical processes. Audiovisual inputs include

laparoscopic or endoscopic video, as well as wall-mounted video cameras. These views allow us to analyze both the technical skill of the operating surgeon, as well as the non-technical skills of the operating room team, including nurses and anesthesiologists. Environmental factors are captured through multiple sensors and include decibel level, room temperature, time of day etc. Physiological inputs from the patient are also captured, as recorded by the anesthesia equipment. Future iterations of this technology will include capture of surgeon physiological parameters, to better understand the stress experienced by surgeons around adverse intraoperative events. This holistic data capture approach to surgery closely resembles the aviation black box, and will allow our analysts to perform complex statistical modeling to predict, and subsequently prevent, intraoperative adverse events. The routine capture of intraoperative data will lead to increased individual and organizational awareness of the impact of adverse events in surgery, and will drive further QI initiatives surrounding patient safety. Furthering our understanding of the factors that lead up to and trigger intraoperative errors will allow for a targeted approach to improving patient safety in the perioperative environment.

The few challenges around collecting this data are centered on research ethics, and include consenting patients and the surgical team, and the transfer/protection of patient data. However, working closely with hospital administration and ethicists ensures that patient privacy remains of paramount importance in this data collection and analysis process. In addition, routine collection and analysis of this data has medicolegal implications, as it is feasible that litigators could point to intraoperative video to verify either negligence or competence on the part of the surgeon.

Ultimately, the collection of this data can be used in a multitude of ways. The utility of this technology is really measured by its ability to bring about change, and improve the safety and functional outcomes of our patients. The OR BlackBox[®] serves as an unparalleled educational source for surgical trainees and surgeons alike. Systematic analysis of surgical procedures allows us to identify which steps of a case are more prone to errors, as well as the stages of a procedure wherein an error will most likely cause an adverse event. This ‘error-mapping’ gives educators the ability to target specific aspects of a procedure or domains of skill that require additional focus in training and recertification.¹³ Improvements in these areas can be addressed systematically as well, through a process termed ‘deliberate practice’,¹⁴ which utilizes specific goal-setting and task repetition. In addition, the routine capture of both technical and non-technical performance allows for accreditors to base assessments on all aspects of intraoper-

ative ability, rather than clinical knowledge or technical skill in isolation. Finally, an exciting area of surgical quality improvement that is gaining traction is ‘peer coaching,’ which incorporates concepts from high-level athletics to improve surgeon performance.^{15,16} There is already evidence for the effectiveness of coaching using operative video, and the OR BlackBox[®] represents an unrivaled means of facilitating this type of intervention in training and beyond.

The operating room culture is changing, and with public scrutiny of surgeons continuing to increase,¹⁷ there is a demand from stakeholders to improve the way we understand the role of the surgeon and the operating room team in determining patient outcomes. We have adopted the philosophies and practices of other high-stakes industries, in order to create a systemic culture of safety that minimizes the iatrogenic perioperative morbidity and maximizes patient safety and other important outcome metrics. It is our responsibility as clinicians to continuously strive to improve our performance and our environment to afford the greatest possible benefit to those we care for.

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Mind Over Gut: Reviewing the Role of Psychological Intervention in Acid Reflux Management

Johnny-W. Bai, BHSc, MD Candidate¹

¹ Faculty of Medicine, University of Toronto

Abstract

Gastroesophageal reflux disease (GERD) is a prevalent and burdensome condition, which may result in significant clinical burden and potential serious consequences such as esophagitis and esophageal cancer. Current therapies include lifestyle change, antireflux medications, and surgical treatment. In spite of the availability of excellent pharmacotherapy, many patients suffer from intractable symptoms and a subgroup have been shown to be at higher risk of depression, anxiety and sleep disorders. Patients with mental health co-morbidities can experience more severe GERD symptoms. The bi-directional influence between GERD and mental health warrants the exploration of psychological interventions in reflux management. There is a paucity of large, high-quality trials; however, current literature shows some promise for the addition of psychological interventions to existing therapies. Further studies with well-described interventions are needed to design and implement effective psychological therapies in the treatment of GERD.

Gastroesophageal Reflux Disease

Gastroesophageal reflux disease (GERD) is characterized by a reflux of stomach acid and proteases into the esophagus, leading to symptoms such as heart burn, gastric discomfort, chronic cough, and overall decreased quality of life. The etiology appears to be multifactorial and in part related to reduced lower esophageal sphincter tone, enhanced mucosal sensitivity, increased abdominal pressure (obesity), the presence of hiatus hernia, gastric hypersecretion, poor gut motility and emptying, and poor dietary and lifestyle habits.¹ If untreated, chronic acid exposure may lead to esophagitis, peptic stricture, and Barrett's esophagus, which predisposes patients to an increased risk of esophageal adenocarcinoma. There is poor correlation between clinical reflux symptoms and mucosal injury or complications, posing

a challenge regarding the implementation of screening and treatment strategies.¹ Current gold-standard management involves diet and lifestyle changes, acid suppressing pharmacotherapy using H₂-blockers, proton pump inhibitors (PPIs), antacids, and surgical therapy for patients with refractory symptoms.^{1,2} PPIs, which provide the most effective non-surgical therapy, do not always provide complete relief, incur significant cost as a daily therapy, and are associated with potential side effects such as respiratory and *C. difficile* infections.² Evidence demonstrating that GERD is associated with poor psychological outcomes such as anxiety and depression suggests that it may be insufficient to merely target the reflux component of GERD.^{3,4} Thus, there may be a role for more holistic and psychosocial management of GERD.

Psychological Comorbidity in GERD

A recently published population study estimates a three-fold hazard ratio in the risk of depression, anxiety, and sleep disorders amongst reflux patients.⁵ This study assessed non-onset psychological comorbidity in 3813 patients with GERD and 15,252 age- and sex-matched healthy controls. Conversely, evidence suggests that depression and anxiety also leads to increased occurrence and severity of symptoms such as retrosternal pain and "heart burn".^{6,7} Kessing et al. assessed anxiety and depression in 255 patients undergoing 24h pH-impedance monitoring, and found that patients with increased anxiety experienced more severe retrosternal pain and burning, without an associated increase in actual number of reflux episodes on monitoring.⁶ This suggests that psychological factors may enhance altered perception of reflux of gastric contents. To elucidate physiological mechanisms, animal studies have demonstrated that when mice were introduced to stress through physical-restraints (acute restraint stress), there is increased permeability of their protective esophageal mucosa, resulting in dilated intercellular spaces, enhanced acid exposure to nociceptors and resultant symptoms.⁸

The bi-directional influence of GERD and psychological outcomes suggests a need for complex interventions that target both physiological and psychological comorbidity. Depression and anxiety decrease efficacy of PPI therapy and even antireflux laparoscopic surgery, supporting the addition of a psychosocial component to current GERD therapies.^{9,10}

In their pooled analysis of three randomized control trials, Wilkund et al. found that high anxiety, high depression, and low sense of well-being were predictors for poor response to acid suppressing therapy.⁹

Burden of Disease

To appreciate the need for adjunct interventions, it is important to understand the burden of GERD on patients and societies, despite currently available treatments.

Socioeconomic

Approximately 10-20% of Canadians are affected by GERD, with at least 170,000 new diagnoses each year. In 2004, the health care system spent over \$50,000,000 for treatment of GERD and associated complications, in addition to further indirect costs such as days taken off work.¹¹ While the monetary cost of pharmacotherapy per individual patient is not extravagant (~\$1000-1500/person-year for PPI or H₂-blockers), the high disease prevalence, cost of work absenteeism, limitations to daily activities, and cost incurred because of complications results in high socioeconomic burden of this condition.¹²

Patient Quality of life

Patients with persistent GERD-related symptoms can have significantly lower health-related quality of life. In a systematic review, Tack et al. found that patients with frequent or severe reflux symptoms (“disruptive GERD”) have higher rates of work absenteeism, reduced sleep quality, lower physical and mental health, lower sense of well-being, and overall decreased quality of life.¹³ Furthermore, there is a high prevalence of patients (19-32%) in whom symptoms persist despite high dose of PPI;¹¹ this further affects quality of life and highlights the need of additional interventions beyond currently available treatments.

Psychological Interventions for GERD

Given the relationship between GERD and psychological factors, a reasonable strategy would be to implement psychological interventions into current standard antireflux treatments. Evidence in GERD and other functional gastrointestinal disorders shows promise, though there are few high-quality trials to date. Furthermore, a lack of consistency in defining “psychological intervention” in studies makes it challenging to draw strong conclusions and synthesize data.

Regarding pharmacotherapy, one meta-analysis showed that antidepressant medications could successfully improve symptoms of functional gastrointestinal diseases like dyspepsia and irritable bowel disease;¹⁴ however, antidepressants can have psychiatric, metabolic, and cardiovascular side effects which may outweigh potential benefits for GERD. Beyond medications, evidence suggests the possibility of using non-pharmacological psychological interventions to treat reflux. In a randomized controlled trial (RCT), post-antireflux surgery patients received individual therapy sessions with a clinical psychologist, focusing

on education about GERD and the antireflux surgery, the role of psychological stress in reflux, and coping strategies such as progressive muscle relaxation and breathing techniques. Compared to controls, these patients had lower reports of subjective dysphagia, less general impairment, and better quality of life, but no change in objective outcomes.¹⁵ Furthermore, a small non-randomized controlled trial in 1994 showed relaxation training to be effective in reducing objective esophageal acid exposure, in addition to subjective reflux symptoms and anxiety.¹⁶ In a larger randomized controlled trial of patients with functional dyspepsia, the introduction of brief psychodynamic-interpersonal psychotherapy also improved dyspepsia symptoms over supportive therapy; however, this improvement was not demonstrated 12-month follow-up when reflux patients were included in analysis, thus unlikely a long-term benefit for GERD.¹⁷ Other possibly effective therapies in GERD include hypnotherapy, biofeedback training, and cognitive-behavioural therapy, as identified in a comprehensive review by Mizyed et al. in 2008.¹⁸ Finally, psychological intervention may improve adherence to antireflux medications in GERD, based on literature in patients with diabetes, schizophrenia, bipolar disorder, and other chronic illnesses.⁽¹⁹⁻²¹⁾ Although there is a paucity of high-quality and long-term studies, existing literature suggests potential benefit of psycho-pharmaceuticals and various talk-therapies in GERD. Furthermore, these therapies may benefit even patients without apparent clinical depression or anxiety, thereby supporting the benefit of implementing psychological interventions in GERD management.

Discussion

In conclusion, GERD is a serious, disruptive, and costly condition which has a high prevalence in the Western population. Although there are several treatment options, many patients have persistent symptoms and complications related to acid reflux. A growing body of evidence supports the role of psychological interventions to enhance existing GERD therapies in the appropriate subset of patients. These may include various therapies, relaxation training, and anti-depressants, each of which has been shown to have some efficacy in the treatment of reflux symptoms.

Future research is needed to gather more high-quality and long-term data, especially through well-powered randomized controlled trials. Furthermore, there is a need for more clear definitions of “psychological intervention”, which includes types of therapies, participants and their baseline psychological status, healthcare providers to deliver the interventions, treatment duration, concurrent GERD therapies used, and objective outcome measures. Standardized descriptions of psychological interventions delivered will allow for the development of meta-analyses. Ultimately, the hope is to design and implement feasible and effective psychological interventions, along with standard antireflux management. The advancement of psychological interventions in GERD management would embody the biopsychosocial model of medicine and hopefully relieve suffering in those with severe and intractable reflux.²²

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Interview with Dr. Mitchell H. Brown

UTMJ Interview Team (Aidan McParland, Austin Pereira)



Dr. Mitchell H. Brown

Mitchell H. Brown, MD, MEd, is an associate professor in the Department of Surgery at the University of Toronto. He is the Residency Program Director for the Division of Plastic and Reconstructive Surgery at the University of Toronto, a program that includes 26 residents and more than 15 clinical fellows. Dr. Brown's plastic surgery practice is focused primarily on reconstructive and aesthetic breast surgery and body contouring.

He operates at Women's College Hospital as well as at The Cumberland Clinic™ surgery center.

Dr. Brown earned his medical degree from the University of Western Ontario Faculty of Medicine in London, Ontario. He completed his residency in plastic surgery at the University of Toronto and then received a master's degree in education.

A frequent lecturer in the areas of body contouring and reconstructive and aesthetic breast surgery, Dr. Brown is a member of the Canadian Society of Plastic Surgeons, the Canadian Society for Aesthetic (Cosmetic) Plastic Surgery, the American Society of Plastic Surgeons, the American Society for Aesthetic Plastic Surgery, the American Association of Plastic Surgeons, the International Society of Aesthetic Plastic Surgery, and the College of Physicians and Surgeons of Canada.

Dr. Brown served on the Expert Advisory Panel for Health Canada regarding the safety of silicone gel breast implants and has lectured extensively on his approach in the use of breast implants, both nationally and internationally.

Dr. Brown is the founder of Breast Reconstruction Awareness (BRA) Day, which he launched in Canada in 2011. Since that time, the movement has spread to over 30 countries worldwide.

UTMJ: Can you tell us a little about yourself and the surgical work you are involved with?

MB: Of course. I completed medical school at the University of Western Ontario, after which I completed a surgical internship at Toronto Western. I then went on into plastic surgery residency training here in Toronto. After residency, I completed a year-long fellowship in surgical education that involved a masters in education and some research work looking at acquisition and teaching of technical skills in a non-surgical en-

vironment. I opened my practice at Women's College Hospital and have been there for 20 years. I have been very involved in academic surgery during that time. Clinically, my focus has been on aesthetic and reconstructive breast surgery, and academically my focus has largely been on education. I have been the program director for plastic surgery at the University of Toronto for the past 10 years.

UTMJ: Out of the variety of surgical subspecialties currently present in the medical field, what drew you to plastic surgery?

MB: I think you are probably discovering now as medical students that you migrate into certain fundamental buckets pretty early. You are either a surgical personality or a medicine personality, or maybe a primary care personality, and it is somewhat easy to move in those directions. But then how do you move within those buckets? For me, I can't tell you exactly why but ever since I can remember, I wanted to be surgeon. To me that's what medicine was all about, so that was an easy choice, but figuring out what type of surgery was a bit more challenging. I was drawn to a bunch of things. I really liked vascular surgery. I really liked gynecologic surgery quite a lot at one point in time as well. In third year of medical school I did a plastic surgery rotation and the surgeon that I worked with was a very prominent hand surgeon. I just got blown away by hand anatomy. I thought it was the coolest thing, and the hand is a big component of plastic surgery so that was the initial draw. And of course, it's interesting that after 20 years of practice I no longer do any hand surgery, so you migrate in different directions, but it was probably hand surgery and the anatomy of the hand that drew me to plastic surgery.

UTMJ: You are quite involved in the plastic surgery program here as the program director, so could you talk a little bit about your work in medical education, or more specifically residency education?

MB: Most of my work in education today is primarily focused on administration work. The research I had done for the first half of my practice was largely based on technical skill development and technical skill

acquisition. Some of the research work that we have migrated to in the last few years has focused on the reliability of interviews and the use of interviews in the residency selection process.

UTMJ: Building off of that, The Royal College of Physicians and Surgeons has recently suggested that surgical residencies in Canada will be taking on a competency-based format in the future, rather than a traditional 5-year length. What are your thoughts on this change?

MB: So this is a reality. All training programs in Canada, starting this year, are moving towards a competency-based curriculum in a tiered way. We have been using competency-based assessments for a while, but competency-based teaching and curriculum is something new. So that is the new reality, getting away from a time-based model and moving towards a competency-based model. It is going to be a challenge, but it makes sense in principle for sure. From a practical point of view, there will be many challenges in terms of implementation, but the idea that trainees should go through and acquire a competency, and then once you have acquired that competency move on to the next one just intuitively makes sense. Each of the programs across Canada are working in their own unique way to plan for this; plastic surgery is targeted for implementation in 2019.

UTMJ: Do you know which program will be coming first?

MB: Programs that are starting this year, July 1st of 2017, are Otolaryngology head and neck surgery, and I believe Anesthesia might be the second one.

UTMJ: Are you for or against this type of residency educational training?

MB: I don't think you can be for or against, rather you have to be progressive in terms of change in education. There is great value in moving towards a competency-based system, but there are tremendous challenges as well.

UTMJ: What would you say is one of the major challenges?

MB: How do you schedule a whole group of residents when some may acquire a competency in two weeks, and some may take 6 weeks, and how do you move them from place to place from a practical point of view. And the number of assessments that are going to be necessary on a day-to-day basis for a competency-based curriculum is probably triple to quadruple what it is now,

so faculty engagement and faculty time is going to be a huge challenge.

UTMJ: Building on residency, what tips would you have for a medical student who is on the fence about pursuing a career in surgery? In plastic surgery?

MB: As it relates to plastic surgery specifically, or I would say that as it relates to anything, it has got to be passion. What I have told our residents for years, when you make a decision to go and do an undergrad degree and then work hard through that and reach a plateau, and become accepted to medical school and you get into medical school and work really hard for 4 years, and you graduate and you are going to work hard for 4 or 5 or 6 years in a residency program, you don't owe anyone anything, just yourself. So if you are going to do all that work and not end up practicing in something you are passionate about and that you love, then you have really made a big mistake. So you have to love what you are going to do, and how do you figure that out? Well you try to become exposed to it. The exciting things about plastic surgery are that it's a creative field. It's a field in which there is not a cookie cutter approach. In some surgical specialties, there are two to five operations that you just do over and over again, and there is nothing wrong with that; some people love that. I could do a surgery tomorrow that is something I have never done before, and I have been in practice for 22 years. That is because plastic surgery is a field that is based a lot on principles and then knowing how to apply those principles to each of the unique situations going forward. The other exciting thing about plastic surgery is that it is a quality of life specialty. It is wonderful to save lives and to extend lives; that is a tremendous thing and we would all applaud that. Treating cancer and treating disease is phenomenal. However, plastic surgery is more about improving people's quality of life, so you have very happy, very appreciative patients. I think that is one of the big draws for many people.

UTMJ: You have recently taken an active role with initiating/promoting Breast Reconstruction Awareness (BRA) Day, could you speak a little bit about your involvement with this event?

MB: A huge focus of my practice is reconstructive breast surgery and for quite a few years we would see patients come in who had undergone mastectomies for breast cancer and had worn a prosthesis for a period of time, and then came in to see me for breast reconstruction. And it would be a common question to ask

why are you here now. You had your mastectomy 10 years ago. What is it about today that is making you consider breast reconstruction? It wasn't uncommon for people's answers to be that they didn't know there was even such a thing as breast reconstruction, that they had just found that out now. That kind of shocked me. So it was really a recognition that when we looked at numbers, we saw that a very small minority of women who had had mastectomies were undergoing reconstruction. Lots of women just weren't even aware that it existed, which I felt was unacceptable. So the idea was to try to create at least a single day to promote awareness of breast reconstruction. So the acronym for Breast Reconstruction Awareness Day became 'BRA' Day. We decided to hold it on a single day during breast cancer awareness month in October, and we held the first one in 2011. After contacting a variety of colleagues across Canada, we said listen, let's just try to have something in every province across Canada. So I think in the first year we had seven or eight programs in different cities running all on the same day. It happens on the third Wednesday of October, and initially it was quite successful. The United States took notice of this and asked if they could start their own program in 2012, and it took off quite significantly from there. They had programs right across the country. It was promoted by several celebrities such as Patti LaBelle and Jewel, who actually wrote a song superficially for this event to help raise money. Then by the third year, it started to become much more global. In 2016, we had events really all across Canada and there were over 250 events in the United States. BRA day took place in over 30 countries world-wide, so it has been quite a nice success. It is really built on three main pillars: access, education, and awareness. And that is what we are trying to deliver: educate patients, educate women, make sure that there is access, and make sure that they are aware about their options.

UTMJ: Were you involved with any of the promotion of this day around the world?

MB: So, indirectly yes, but the short story is that when you have a good idea that makes sense, you don't need to promote it much. The idea that you should help to promote access and information for reconstructive breast surgery is a pretty simple thought, and who would think that's a bad idea? It's good for surgeons, patients, and it's good for their families. And I suppose that through my international work, I knew a number of plastic surgeons worldwide, and it was easy to send thoughts about this idea, and a number of surgeons jumped on the idea and wanted to start it in their

country. Thirty countries is a start, but there are a large number of countries in the world, and we are looking to triple that number moving forward.

UTMJ: Where do you think the field of plastic surgery is going in the future?

MB: It's a pretty evolving field. I would say that one of the big areas that will evolve is the concept of tissue engineering. Instead of repairing structures, the focus would be on replacing them, the ability to grow organs or structures. To some degree, we do that today with stem cell technology. You can take stem cells from fat and mix it in a mold with cartilage cells and grow in a template for a new ear. I think there is tremendous promise. We are trying to grow breast tissue today, but wouldn't it be amazing if we can replace those cells entirely. The transplant field is enormous, including facial and hand transplantation. The first Canadian hand transplant was performed in Toronto at the Toronto Western Hospital last year, and that was very exciting.

UTMJ: What are challenges facing plastics or some misconceptions facing the field as well?

MB: Misconceptions are easy. If you go out into the field and ask somebody about plastic surgery, they think of aesthetics. And there is nothing wrong with that because aesthetic surgery is an important part of what we do. I think a big part is branding plastic surgery. The division at Toronto is Plastic and Reconstructive Surgery to ensure people know that it's not just aesthetics, but also reconstructive. One of the biggest threats is fragmentation of the field. Plastic surgeons don't hold an anatomical autonomy on any part of the body. Neurosurgeons have the brain and the central nervous system and no one encroaches on that, orthopaedic surgeons treat the bones, and cardiac surgeons treat the heart and vessels, whereas plastic surgeons treat all anatomical parts of the body, so because of that, there is encroachment by various other surgical subspecialties. It is more a specialty of principals and practice than anatomical autonomy.

UTMJ: Do you think this will happen in our lifetime (the encroachment of different specialties leading to the endangerment of plastic surgeons)?

MB: No I don't think so but I do think that the field of plastic surgery must be very aware of what they are, how they function, and how they collaborate with other specialties.

UTMJ: Plastics has a significant amount of elective procedures, and one of the problems with the Canadian health care system is the wait time with elective health care procedures. Can you speak about this growing issue?

MB: I don't think this problem is specific to plastic surgery. There is a real erosion of elective surgery time. If you are an orthopaedic surgeon treating someone with chronic tendonitis injury and they are scheduled for surgery, it may be bumped for trauma. We deal with this all the time in plastics. In the end, I think it's a global problem. We have a health care system with a single payer [the government] that doesn't have enough money to pay for the health care required by the country. That's a much bigger picture that is not unique to plastic surgery.

UTMJ: You took a real leadership role in the Toronto Annual Breast Surgery Symposium. Can you expand more on that event and why you decided to take such a significant role?

MB: There was a real local expertise in breast surgery so my colleague Dr. John Semple and I decided to start an annual symposium for breast surgery. We have had great success with it. It is the largest breast surgery symposium of its kind in Canada, and we have drawn surgeons from all over the world to speak. I think that it has been very well received as a key annual CME [Continuing Medical Education] event within the Department of Surgery.

UTMJ: What are some of the major innovations in plastic surgery that can change the field moving forward?

MB: I think we have touched on some of them, tissue engineering, fat transplantation, hand transplantation, but I would look to one of our residents in the surgeon-scientist training program who is doing some phenomenal work on simulators, specifically on cleft palate repair. Creating high fidelity models to allow people to learn how to complete high impact surgeries on models rather than people. And I think there is a real need for that. Society is prepared to accept, only to a certain level, trainees to perform work on them. The budget limitation in hospitals requires us to get in and out and finish operations quickly, and our teaching time is limited. To find models to teach people to learn how to perform surgeries effectively is critical due to these limitations. I think this is one of the most important innovations in our field today.

UTMJ: You touched on passion as being one of the main drivers for any individual striving for any surgical subspecialty, and you have great longevity and success as a surgeon, so is it your passion for surgery that drives you?

MB: I think it goes back to you have to do what makes you happy and what you enjoy. I love what I do as a plastic surgeon. And you have to be malleable and flexible. I haven't done the same thing for the last 20 years. First few years I did sarcoma reconstructive surgery and trauma surgery, and spent a period of time travelling and teaching, and a period of time as program director. You make changes as you go along to adapt with your practice. But for most of us, the best days are the days you sit in the operating room and treat patients, so when that passion is gone it might be time to re-evaluate what you want to do.

UTMJ: How do you find the balance of clinical work, research, and administration, as well as a healthy life outside of plastic surgery?

MB: You have to be organized and find out what works for you. And times have changed; 20 years ago there were different expectations. Today, there is more awareness of work-life balance and young adults and new surgeons have a greater appreciation of work-life balance. The generation before me had even less. You have to be cautious and be sure that you carve out time for your personal life outside of medicine for family and personal time, or else you burn out. How do I do that? I have a great assistant that sets out personal block times for myself, and I stick to those block times or else they are filled with meetings and other obligations.

UTMJ: You mentioned burnout. How do you compare the burnout rates of plastic surgery to that of other surgical subspecialties?

MB: I don't know for sure, but I would say low. I think largely because there is a high job satisfaction in the plastic surgery field.

UTMJ: Any final remarks that you would like to add?

MB: In first year medical school, you have your whole careers ahead of you. I would tell the first year medical student to take your time, keep your eyes open, and look at many different things. And finally, find what drives your passion.

Interview with Dr. Mitesh Badiwala

UTMJ Interview Team (Sarah Kanji, Nicole Kim, Shubham Shan)



Dr. Mitesh Badiwala

Dr. Mitesh Badiwala is an Assistant Professor in the Department of Surgery at the University of Toronto and is a Staff Cardiovascular Surgeon at the Peter Munk Cardiac Centre at UHN. He is the Surgical Director of the Heart Transplant Program at UHN.

Dr. Badiwala completed his BSc in Arts & Science at McMaster University in 2000 and his MD at the University of Toronto where he was elected to the Alpha Omega Alpha honor society in 2004. He pursued a residency in Cardiac Surgery at the University of Toronto and became a Fellow of the Royal College of Physicians and Surgeons of Canada in 2013. Having received the prestigious Detweiler Travelling Fellowship from the Royal College, he travelled to Chicago where he completed an advanced fellowship at Northwestern University. As Chief Fellow, he specialized in mitral and tricuspid valve repair, minimally invasive aortic valve surgery, heart transplantation and mechanical circulatory assistance.

Dr. Badiwala completed graduate training in vascular biology research at the University of Toronto and holds a PhD in Cardiovascular Science. Dr. Badiwala is the recipient of several prestigious awards including the Vanier Canada Graduate Scholarship, the Vivien Thomas Young Investigator Award from the American Heart Association, as well as the Shafie S. Fazel Outstanding Resident Surgeon and Investigator Award and the Starr Medal from University of Toronto.

His main clinical interests are in valve reconstruction, minimally invasive cardiac surgery and heart transplantation. His primary research interest lies in the development of an Ex-Vivo Heart Perfusion system for regeneration and evaluation of marginal and DCD donor hearts.

Medical School Journey and Work

UTMJ: Tell us about your academic journey.

MB: I didn't want to limit myself, so I picked a broad-based undergraduate program at McMaster and I got into medical school at UofT in 2000. When I started medical school, I didn't know what kind of doctor I wanted to be. I think that's the case for a lot of medical students. There are innumerable things you can do in medicine.

So, my career path took an interesting turn when I first started medical school. There's a program where you get paired up with a mentor and request the specialty you want to be matched to. I requested cardiology because during anatomy, I liked the heart, circulation, and cardiac physiology best. They matched me up with Heather Ross, the director for the heart transplant program and past-president for the Canadian cardiovascular society; she's now a cardiologist here. She was my very first mentor in medical school. I used to come in on Saturday mornings and follow her around the CCU and when she would leave after the morning rounds, she would pair me with her fellow. I would watch them put the lines in and it was all very exciting to me. This experience really gave me insight into the area of medicine I enjoyed. Later that year, I decided that I wanted to do research in the summer. I had an NSERC studentship and I decided to conduct research in cardiology. I worked for Dr. Richard Weisel, who is now the editor-in-chief of the *Journal of Cardiovascular and Thoracic Surgery*. He luckily accepted me into his lab. That summer I got paired with his lab staff and did some cell-based projects. At the same time, I spent 2-3 nights in the OR watching with people like Dr. Cusimano, Dr. Yau, and Dr. Rao (now chief of staff), who had just returned from his fellowship with a new technology called ventricular assist devices and had become director of the transplant program. They all became my clinical mentors, but I spent many hours just watching them operate. Back then, you could scrub in as medical students simultaneously and I spent a lot of time with them. I pretty much fell in love with that career path at that point. I returned the following summer to Dr. Weisel's lab and he took me back because he knew I was interested and continued to spend time in the OR. As I went into clerkship, I made a point to tell myself that I should still keep other options open and look at diverse areas within surgery and medicine to see what else I would like. I tried to keep an open mind. I started with pediatrics and liked it, but not as much as cardiac surgery. I liked psychiatry, a very interesting field, but I wasn't fixing anything so it didn't appeal to me. No other real surgical specialty other than vascular, thoracic or HPB surgery appealed to me. At the end of my rotations, I said to myself "well I like

surgery” so I also applied for general surgery because cardiac surgery was very competitive at that time and you couldn’t get into vascular surgery directly. So when I applied for residency, I applied for cardiac surgery and general surgery, and luckily I matched to cardiac surgery. I did two years of residency and then I went to Dr. Rao’s lab. I was going to go back into Dr. Weisel’s lab, but Dr. Rao had a new lab and had a PhD student who was just finishing up, so there was an opportunity to follow in his footsteps and work in transplant research. Here, I did a PhD looking at endothelial injury related to transplantation and a particular protein related to endothelial cells and I characterized its vascular protective effects. I learned how to design research studies and conduct basic science research. More importantly, I still remained clinically active. Whenever a heart transplant came out, the team would send me to get the hearts and I became very independent and started doing it very early on. So in the first year, I went away and got about 100 hearts for our program and came back and slowly, as the years went by, they let me do more of the implanting. I had three years of residency left after that and then did my royal college exam. After that, they had expressed a strong interest in hiring me here, but they wanted me to go away and do an advanced fellowship in valve repair. I found a center where they did lots of valve repair and transplants at Northwestern in Chicago. I spent one year as chief fellow there and at the end of the day, I was recruited out here after taking the summer off with my family. I started in September 2014, and by January 2015, Dr. Rao passed on Surgical Transplant directorship to me. By summer 2015, I had recruited enough people to work on my lab interest, which is Ex vivo resuscitation and reanimation of hearts. Since Summer 2015, that is what we have been working on, in collaboration with the engineers from the university.

UTMJ: What was your medical school experience like? What is your best memory of medical school?

MB: Medical school was a great time in my life. The friends that I made in medical school are lifelong friends. We initially developed study groups and that developed into lifelong social relationships. Although, we are scattered across the country and world, we still stay in touch from time to time and when we meet, it’s like we never left each other. Those relationships are very meaningful and important to have. Medical school was a lot of information given to you very quickly. Reflecting back on it, it gave you an understanding of everything to a certain degree, but in the end, the area you practice in is the

one you’ve developed a sufficient depth of knowledge in. However, you still have an understanding of other things so you can collaborate effectively with the other groups. Medical school was fun. It’s very different now and it has gotten a lot better in terms of being comprehensive and blending different facets of medical education together.

One of the best memories was graduation. To see everyone that started four years ago make it and go on to the next step even though we were scattering. It was a milestone that was memorable because of all the things we went through to get to that point.

One of the most memorable things to happen was that I was on my OB rotation and I happened to be on call with the obstetrician that delivered me at St. Joe’s. I reminded him that he delivered me and I guess I made him feel old.

UTMJ: When did you decide to pursue a career in surgery? Why cardiac surgery? Was there anything in particular that motivated you?

MB: I liked the intensity of cardiac surgery. It was intuitive to me. I’m a mechanically minded thinker. In cardiac surgery there are different parts of the heart (to consider) and the way they interact. Additionally, there are many different operations in cardiac surgery from heart transplantation to microvascular surgery (coronary bypass). It really felt to me like there was a wide spectrum of things I could do and it would challenge me.

UTMJ: What are your main areas of interest in cardiac surgery?

MB: What I’m interested in and what I do are two very different things. My areas of interest are heart transplantation, mechanical assistance and valve surgery. What I do is very different from what I would like to do and that is simply because of what patients need. The average patient with heart disease needs coronary bypass surgery. There is a small fraction that need valve surgery and transplantation is a rarity. We did 37 heart transplants here last year and that’s a new record (when I was a resident we did 20-27, and my first year on staff we did 34). There are 4 of us for transplantation which is not a large number considering that I do 110-120 cases a year.

UTMJ: What are some bread and butter cases in cardiac surgery?

MB: Coronary bypass and aortic valve repair are the two most frequent operations that we do. The spectrum of cardiac disease has changed over the years and so have

the operations. Back in the day, when patients did not have acute reopening of coronary arteries and they had myocardial infarction that were treated late and not reopened in terms of vascularization, there were other mechanical complications like ventricular and papillary ruptures that we don't see very frequently anymore. We still see aortic dissections from time to time, but the frequency of mechanical complication of MI has changed. It was far more frequent in the 1980/1990s to have emergency bypass surgery, but it's very rare now because the cardiologists can open blocked arteries with balloons and stents.

UTMJ: What do you want to accomplish/long term goal with your research?

MB: My long-term goal in research is two-fold. First, to increase the number of transplants we can do to address end-stage heart failure. Second, to improve the quality of the transplants we do. There is a large number of patients who could potentially benefit from a transplant, but we just can't offer them to everyone. A day might come where we take a decellularized heart off the shelf and re-cellularize it for transplant. That may be science fiction right now, but it may be what we're doing 30-40 years down the road. Those types of far-fetched ideas that have some grounding in potential reality are long term aims for someone like me, with the end goal of trying to help more people.

Personal/Life

UTMJ: What are some challenges you face in work-life balance?

MB: There are many challenges. You have to pick and choose what you give and take. The scale will always tip one way or another. Having a family adds an entirely different dimension to you and your life. Halfway through my training, I got married, and there was a very big difference between what I could do before and after. Before I got married, I had no dependents, and no obligations. All I had was what I wanted to achieve – staying in the OR as much as I wanted, or working in the lab overnight. But when you have a family, you have obligations to them. You have to make the time to help your children grow, instill morals and values in them, and help with their education. Being a heart surgeon, it's not easy. My wife does most of that. She's providing for them in a different way, because I'm not there most of the time when it's their bed time, or to help them with their homework. When I first started in practice, I didn't pay much

attention to that because I was so focused into getting into practice. But within a year, I realized that it's not sustainable to come into work on weekends and not spend the time with my family. It's not going to make me happy. So I tried to switch the other way, because it's not fair to them. I'm off on weekends, because I cannot invest the time I need to during the week.

You also have to think of choosing what you say yes or no to. When I first started, I would never say no, because if I did I thought people would think ill of me. But the reality is, you have to say no to the things that are not that meaningful to you, and moreover, to the things that you will not invest the appropriate time in. You will not make everyone happy. People will be disappointed when you say no, but you can't win everything. You have to prioritize what is important in life. For me, my patients are always first. That's a duty that I have for anyone who's come under my care. My family knows this. It's disappointing to them. But they understand at the end of the day.

UTMJ: What is a typical day in your life?

MB: It starts early. I wake up around 5:30 am and get to work by 6:30 am. At 7 am, there's usually something going on – cardiac surgical rounds, committee meetings, transplant rounds, etc. By 8 o'clock, I'm usually in the operating room 2-3 days a week. A non-operating day could easily turn into an operating day in an unplanned fashion. If I'm operating, the first case usually ends around 1, and the second case runs from 2 pm to 7 or 8 at night, if everything goes well. If not, it could go much later. I have clinics one day a week, from 9 am to the afternoon. At the end of the day on some days, there are rounds as well, meetings, research meetings, resident teaching, etc. Some days I go to the research lab to give some help. On a non-operating day, I'm usually home by 6. It's very rare that I come home before that.

UTMJ: What are your long-term goals and where do you see yourself in 10 years?

MB: Hopefully in 10 years, things aren't too different from how they are now. In terms of career, I hope to be moving forward into molding my practice into more of a valve practice than coronary bypass. I'm looking forward to advancing the field of heart transplantation, increasing the number of transplants that we do, looking at new ways of getting more organ donors, new technologies, and using them in daily practice. Also, I hope that our patients in Toronto can have access to more minimally invasive surgeries.

UTMJ: What are some of your biggest achievements?

MB: When I was a resident, there was a guy 3 years ahead of me, a fourth-year resident in the program, named Shafie Fazel. He was incredible. You would just look at him and say “wow, this guy’s special.” He was essentially running his own independent lab, as a resident. He was the brightest guy I knew. He was going to be a superstar, academic surgeon, with an international reputation. In his second last year of training, he decided to do an elective, because an opportunity came up at Stanford. While he was out there, he developed melanoma. It had spread, and he died within a couple of years. That really affected a lot of us. He was the guy that the junior residents looked up to. And a lot of the faculty members were at a loss. After he passed, the Department of Surgery put together an award – the Shafie Fazel award – to honor his memory. It was to be given out every year by his wife and his children, to recognize some resident who resembled Shafie in some way in terms of research and clinical training to recognize someone who would be worthy of being compared to Shafie. And they decided to give me that award the first year. And that really affected me. And I knew him very well. He and I were good friends. For them to give me that honor, I think is one of my greatest achievements.

UTMJ: What do you think it takes to become a surgeon?

MB: You have to really want it. It goes the same for every aspect of medicine. It has to continually challenge you and you have to be fully committed to it. Know up front that it’s going to challenge your personal space. You have to be willing to put in the hours. As a resident, you have to be of the mindset that you’re going to try to be in the OR as much as possible – not to see the routine, but to see how to manage things that deviate from the routine. Because you may see those once a year. One day, you’re going to be in that seat where you will be the one doing it. That’s a different demand that is placed on you. You have to be able to manage them because otherwise, patients die. They truly die. If you go into surgery, you have to realize you have to make that effort up front, so that in the rest of your career, you are able to manage those situations and save patients from dreaded, rare complications. That’s very different, from a lot of other specialities. Also, you have to like to working with your hands.

UTMJ: What is the current workforce nature in cardiac surgery?

MB: It’s always changing. The pendulum swung in a very negative direction in the early 2000’s. Things were going really down. Cardiac surgery residency fell to historical lows in Canada and in the States. The pendulum has swung completely the opposite direction now. There are multiple job postings now in the US and Canada. Every year there are at least a few jobs because of people moving around and retiring, so the market is opening. But that shouldn’t be a driving force for you to choose a specialty. If you’re good at what you do, you’ll find a job. Because there’s always one job somewhere, for someone, and they want someone who’s good. So if you’re good, you’ll be sought after. When people tell you you’re good and giving a lot of positive feedback, then you should run with it because that means they are trying to root for you. That applies to every aspect of life.

UTMJ: What advice would you give to current medical students?

MB: Medical school is the one time in your life where you have an obligation to learn, but you don’t have many other obligations. It is your time to learn as much as possible and see as much as possible in such a diverse setting. Even if you won’t be practicing in that area, it’s important for you to learn. Take every opportunity. And it’s okay to say “I don’t know” because it’s your role to learn. One day you will be there, out in some hospital where someone will come to you and ask “what should we do?” and that’s not your time to learn. Your time to learn is now. And learn to pick and choose to maintain some balance in your life. You have to enjoy life, you live only once. You have to learn to give up on some minor opportunity to learn so you can have some personal time.

A Realistic View: Return to Sport and Patient Satisfaction following Anterior Cruciate Ligament Reconstruction in the Practice of a Community Subspecialist

Marshall Siemens, MD Candidate 2018¹; Megan Dash, MD, CCFP, Dip Sport Med¹; Jeremy Reed, MD, FRCS¹

¹University of Saskatchewan

Abstract

Background: There are varying conclusions in the literature on the utility and success of Anterior Cruciate Ligament Reconstruction (ACLR). There are also many different tools used to quantify benefit. In this study, we implemented phone surveys with patients who had undergone primary autograft ACLR. We used the Single Assessment Numeric Evaluation (SANE) rating tool and patient-centered questions regarding return to work and play, in the hope of providing physicians with results that will help them better communicate expected outcomes to patients.

Methods: 187 patients out of the senior authors subspecialist clinic were identified to be at least 1-year post-ACLR. Contact was made with eligible patients in June and July of 2016. After consent was granted, a series of seven questions were asked to determine satisfaction with the surgery, ability to return to work and sport, and the ability to return at pre-injury capabilities.

Results: We found a subjectively high rate of satisfaction of 87.5% as it pertains to work or daily activities and 72.1% as it pertains to sport or recreational activities. An impressive 95.2% of patients stated they were glad they had the surgery done. Interestingly, these positive results are despite the disappointing, but not surprising, 49.0% that were able to return to pre-injury level of sport, and 78.8% that were able to return to their pre-injury level of work.

Conclusion: We have shown that the majority of patients in our study are satisfied with primary autograft ACLR in terms of their ability to work and play. This is despite many not being able to function at a level equal to their pre-injury baseline. The information provided within this work gives sport and musculoskeletal providers helpful material with which to counsel their ACL-deficient patients on expected outcomes.

Introduction

Anterior cruciate ligament (ACL) injuries are very common and are typically treated with surgical intervention in active individuals.¹ There are varying conclusions in the literature on the utility and success of Anterior Cruciate Ligament Reconstruction (ACLR).² There are also many different outcomes used to define success.³ Lynch and colleagues identified a consensus criteria outlining six variables – effusion, giving way, muscle strength and function, activity, participation, and return to sport – as essential markers for a “successful outcome of ACLR”.³ While objective measures seem to be a viable option for measuring the outcome, Kocher and colleagues showed that subjective variables of symptoms and function have the most robust associations with patient satisfaction.⁴

There are two subjective patient surveys that have been validated to measure patient symptoms post-ACLR: the Cincinnati Knee Rating System (CKRS), and the International Knee Documentation Committee (IKDC).^{5,6} Although these surveys are useful and are valuable in identifying areas of patient satisfaction, the extensive resources needed to administer them make them unpopular in most non-academic clinical settings.⁷ Instead, a Single Assessment Numeric Evaluation (SANE) rating tool, in which the patient rates their knee on a scale from 0-100 (where 0 is completely abnormal and 100 is completely normal), has been shown to be an excellent surrogate for CKRS and IKDC total scores in patients post-ACLR.⁷

Another important consideration for patient satisfaction is being able to return to work and sport. This is not surprising, as work and simple recreational sport have been shown to reduce stress and enhance overall well-being.⁸ Ideally, ACLR would enable all patients to return to their pre-injury capabilities, or at a minimum allow them to continue to participate in their chosen sport at a level capable of bringing them satisfaction. In one meta-analysis, 69 studies reported on 7556 participants who underwent ACLR. They found that 81% of patients returned to some sport, and 65% returned to their pre-injury level of performance, but only 55% returned to a competitive level of sport after surgery.² Although this is informative data, to our knowledge, no study has sought to determine the percentage of patients who are satisfied with the level of sport to which they are able to return.

Corresponding Authors:
Megan Dash - dashmegan@gmail.com
Jeremy Reed - jgrreed@ucalgary.ca

In this study, we aimed to consider patient experience with ACLR and recovery within the practice of a fellowship-trained community subspecialist. We assessed patient satisfaction using the SANE rating tool, as well as binary measurements of return to sport, return to work, and patient opinion for whether they would have the procedure done again if presented with the same situation. We gathered this data via phone survey with patients who received ACLR with the senior author (JR). Our hypothesis was that patients undergoing ACLR have a high rate of satisfaction with return to sport and activity. Ideally, the results of this study can be used to guide practitioners and patients on what to expect following ACLR.

Methods

Ethics approval was obtained from the local research department Research Ethics Board (REB) (Regina Qu'Appelle Health Region REB-16-52) prior to the start of this project. Patients were identified through the Electronic Medical Record (EMR) of JR using a database search of billing codes from November 2010 to June 2015. 187 ACLR were identified from this process. Patients were excluded if their procedure was a revision (n = 12), featured an allograft (n = 23), or if they were less than one-year post surgery. Thus, 152 patients remained for our primary metrics. Patients were then contacted via telephone by the data collector (MS), explained the study and verbal consent was documented. Consenting participants were then asked a series of questions:

- 1) Have you returned to your pre-injury level of work or daily activities?
- 2) Have you returned to a level of work or daily activities that you are satisfied with?
- 3) Have you returned to your pre-injury level of sport or recreational activities?
- 4) Have you returned to a level of sport or recreational activities that you are satisfied with?
- 5) How would you rate your knee on a scale from 0-100 with 0 being completely abnormal and 100 being completely normal?
- 6) Are you glad you had the surgery performed?
- 7) Knowing what you know now, would you have had the surgery performed again?

Contact was made with eligible patients in June and July of 2016. Five separate attempts at contact, on different days, were made and if the patient still could not be reached, they were excluded from the study.

Results

After excluding ineligible patients from the original list including 40 (26.3%) who were unable to be reached, 112 patients with primary autograft ACLR were successfully contacted. 8 of these patients had some form of graft failure. They were not included in our results because some of them had already recovered from revision surgery while others were still

in the process of recovery, which would have made our results inconsistent. Therefore, 104 patients were included in our study as the final cohort.

Patient Demographics

Our patient demographics contained 53.8% males, 46.2% females, and average age was 27.5 years old (range 15-48). The mean time between surgery and contact via phone survey was 37.6 months.

Telephone Survey Results

Table 1.

	Yes	No	Percent of Patients Who Said Yes (%)
Have you returned to your pre-injury level of work or daily activities? (yes/no)	82	22	78.8%
Have you returned to a level of work or daily activities that you are satisfied with? (yes/no)	91	13	87.5%
Have you returned to your pre-injury level of sport or recreational activities? (yes/no)	51	53	49.0%
Have you returned to a level of sport or recreational activities that you are satisfied with? (yes/no)	75	29	72.1%
How would you rate your knee on a scale from 0-100 with 0 being completely abnormal and 100 being completely normal? (Rating Scale)	Mean: 81.6 Range: 4/100-100/100 4.1		
Are you glad you had the surgery done? (yes/no)	99	5	95.2%
Knowing what you know now, would you have had the surgery done again? (yes/no)	95	9	91.3%

Discussion

We have gathered data demonstrating patient satisfaction with their ACLR at least one-year post-operative follow up. We observed a high rate of subjective satisfaction of 87.5% as it pertains to work or daily activities and 72.1% as it pertains to sport or recreational activities. Patients rated their knee on the SANE rating at an average of 81.6/100. An impressive 95.2% of patients stated they were glad they had the surgery done and similarly, 91.3% of patients said they would do it again. Interestingly, only 49.0% were able to return to pre-injury level of sport and 78.8% were able to return to their pre-injury level of work. Although these results are disappointing, they were not unexpected.

Our results are similar to the meta-analysis performed by Ardern and colleagues, which found that 81% of patients returned to some sport, 65% returned to their pre-injury level of performance, and only 55% returned to a competitive level of sport after surgery.² Studies that have been published following the meta-analysis show similar statistics, including Ro-

driguez et al., who found that at 36 months follow up, 91% of patients had returned to recreational sport but only 52% had returned to sport at the same level.¹⁰ Subsequently, Ardern et al. went on to evaluate athletes who had not recovered at 1 year follow up and followed them for a subsequent year. At the year 2 follow up, 66% were playing sport, with 41% playing at their pre injury level of sport.¹¹ Finally, return to play rates for high school and collegiate football athletes were similar (63% and 69%, respectively). Based on player perception, 43% of the players were able to return to sport at the same self-described performance level.¹²

We felt it was important in our study to distinguish those who had returned to their pre-injury capabilities and those who had returned to a level that they found satisfactory. ACL injuries can be a traumatic and devastating event that may prevent the patient from returning to their previous level of work or sport, regardless of the treatment they receive. With knowledge of these numbers, the patient will be better informed with regards to the goal of returning to their pre-injury capabilities, as well as a realistic outlook of returning to a satisfactory level. Another noteworthy finding is that although over half could not return to pre-injury athletic function, and over twenty percent could not return to pre-injury work function, 95.2% are glad they had the surgery performed, and 91.3% state they would have it done again. We are unsure as to why exactly this difference exists; however, we postulate that the patients understood that the ACL injury changed their baseline status, and thus were pleased with the intervention bringing them back to a level of functionality with which they were satisfied. Finally, the SANE rating tool, which is a simple and effective tool, produced a mean of 81.6/100 for these patients. This is comparable to another study evaluating 279 young (13-23) female athletes employing the SANE rating tool at 12 months post-injury, who averaged 86.9/100.¹³ Our patients varied significantly in age (15-48) and athletic ability, so this is far from a homogenous sample. We feel, however, with a sample of 104 participants, this represents a generalizable patient group for the practice of a community sports surgeon. As the patient's goal should be to return to his or her personal baseline, the rating is individualized to them, and is therefore applicable to anyone across this demographic.

It was noted by MS while speaking with patients that many felt that they did not have an option other than operative management. It is the practice of JR to always offer both operative and non-operative options; however, when asked for counsel by a patient, he without question leans toward operative management if re-establishing an active lifestyle is desired. Although the literature suggests that operative management has superior outcomes compared to rehabilitation,¹⁴ non-operative options may allow the patient to return to sport, and should be considered in certain patients.¹⁵ Additionally, it should be noted that many unsatisfied patients who were contacted stated, unprompted, that they feel more

could have been done for physical rehabilitation and placed the responsibility on themselves, rather than any of the providers involved in their care.

While there are many subjective patient descriptions of sub-optimal surgical outcomes, including impaired functional performance, knee instability and pain, reduced range of motion, quadriceps strength deficits, neuromuscular dysfunction, and biomechanical maladaptations,¹⁶ one complaint that came up with some consistency was the sentiment, "I feel fine physically, but I'm apprehensive to push myself maximally". This mental disturbance is not a new concept. Previously, it has been shown that the most cited reason for not returning to sport is due to fear of reinjury.^{12,17} Overall, practitioners should consider these psychological concerns in order to best counsel the patient in the pre- and post-operative periods, enabling and encouraging patients to push themselves within reason, safety, and post-op guidelines.

Limitations

In this retrospective phone interview study, 26.3% of eligible patients were not able to be reached, despite five attempts. As a result, there is a potential for non-response bias, in which frustrated or dissatisfied patients would not answer or return messages regarding our study. Conversely, response bias can occur if patients are fond of JR as their treating surgeon and want to provide answers that reflect these feelings. Interviewer bias is another factor that needs to be considered, as the interviewer is a medical student who could unwittingly seek to elicit responses which would confirm JR's hypothesis. The investigators of this study are confident that this bias is not of significant concern due to an environment of openness and honesty. This study excluded the eight patients who had a failure of the graft. Since patients who have had a failure are more likely to have a negative experience, including their responses could have shifted the data. Lastly, digit preference should be considered as a limitation since most of the SANE ratings arbitrarily ended in a 5 or a 0.

Conclusion

There are many ways to determine the success of ACLR from the perspective of both the physician and the patient. Although multifaceted rating tools and surveys are useful from an epidemiology perspective, simpler modalities such as the SANE rating tool and patient-centered questions provide us with results that can be easily translated by community clinicians into terms that are easily understood by the general public. In our study, we have shown that the majority of patients are satisfied with the end result of ACLR, in terms of their ability to work and play post-operatively. This is despite many not being able to function at a level equal to their pre-injury baseline. Future research could build on this by using non-binary measurements of these parameters and by using a homogenous population to better characterize specific pa-

tient outcomes. It is our hope that the information provided within this work will give sport and musculoskeletal providers helpful material with which to counsel their ACL-deficient patients on expected outcomes. Also of note is that patient apprehension post-ACLR may be a major factor in patient inability to return to baseline function, and if providers are able to counsel in this area with simple encouragement, results may be improved.

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Hair-elastic Bead Artifact Demonstrating the Radiographic Appearance of a Single Pulmonary Nodule

John Kenneth Peel, BHSc¹; Nicolas Murray, MD²

¹Faculty of Medicine, University of British Columbia

²Department of Radiology, Vancouver General Hospital

Abstract

A solitary pulmonary nodule was identified radiographically in a 61 year-old female smoker complaining of dyspnea. Solitary pulmonary nodule (SPN) is a single nodular opacity on chest imaging, which may indicate malignancy. Workup of this finding may require initial evaluation by CT scan, subsequent multiple follow up scans, and may ultimately warrant surgical biopsy for tissue diagnosis. False positive diagnosis of SPN may result in unnecessary radiation exposure, patient anxiety, and resource use that could be avoided by careful consideration of the clinical picture. Here we present a case of a false positive SPN attributable to hair-elastic bead artifact. Hair artifact is a rare and avoidable phenomenon in which a patient's hair is visualized on chest imaging, causing focal opacification not attributable to lung pathology. Hair-elastic bead artifact has previously not been described. We report it as the phenomenon of a bead on a hair-elastic with the radiographic appearance of focal opacification. Clinicians should be conscious of hair and hair-elastic bead artifacts before other initiating next steps in a workup.

Introduction

A solitary pulmonary nodule (SPN) is an intra-parenchymal lung lesion without associated atelectasis or adenopathy. SPN is a common radiographic finding, present in up to 3.5% of all chest radiographs.^{1,2} While a broad differential diagnosis exists for this finding, including malignancy and granulomatous disease, the incidence of malignancy in SPN has been reported from 10-68% depending on patient characteristics and the size of the lesion.^{1,3,4} In the event that SPN is malignant, early resection is favourable, as 5-year survival post-resection of bronchogenic carcinoma is up to 80%.⁴

Misidentification of an SPN on initial imaging may expose patients to unnecessary radiation. Few cases exist in the literature in which an artifact present as a false positive SPN, though these cases remind clinicians of the importance of clinically correlating incidental radiographic findings. Here we present a case in which an external foreign body had the radiographic appearance of SPN.

Case Report

A 61 year-old female smoker, presented with four days of worsening dyspnea not responsive to supplemental oxygen. This patient had a prior history of giant cell tumor of the wrist, a usually benign tumor that has the potential to metastasize to the lung (1-6%) and undergo malignant transformation (less than 1%).⁵

Chest radiography revealed a 1 cm diameter, well demarcated nodular opacity in the left mid-upper lung (Figure 1), with no associated cavitation, or calcification. A poorly demarcated, wedge-shaped opacity was seen superior and medial to the nodule. The remainder of the radiograph was unremarkable.

Comparison to a study taken one month prior did not have evidence of this left lung nodule (Figure 2). No other interval change was remarkable. The rapid development of a new pulmonary lesion was determined to be unlikely, given the expected natural history of pulmonary malignancy.

On realizing this discrepancy between such a recent comparison study, alternative explanations were considered.

Corresponding Author:
John Peel
john.peel36@gmail.com

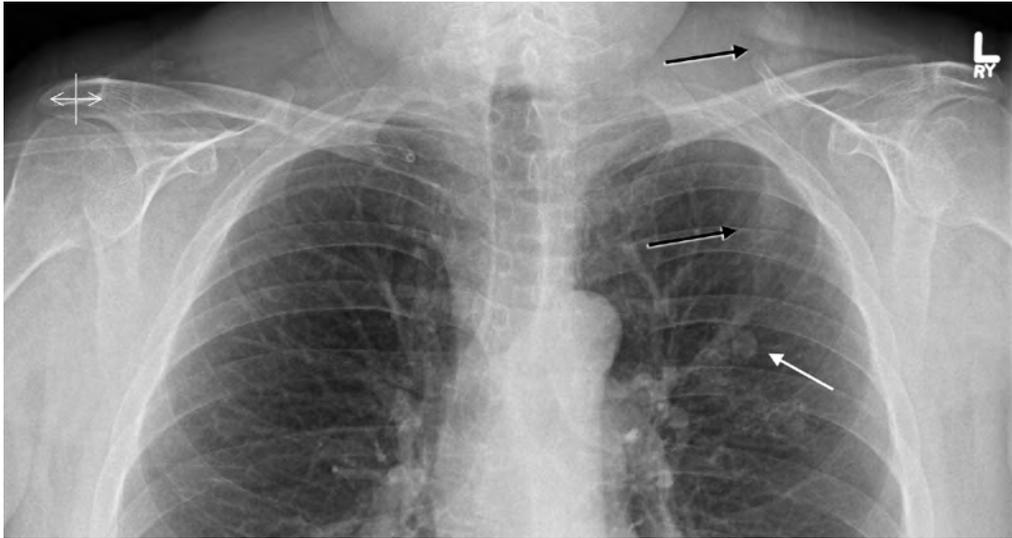


Figure 1. Initial chest radiograph demonstrating SPN. A well-demarcated nodular opacity 10 mm in diameter is well visualized in the left mid-upper lung (white arrow). An oblique, wedge-shaped opacity (black arrows) extends superiorly from this nodule. No other pathology is visualized.

The close proximity of the apparent nodule with the wedge-shaped opacity, as well as the subtle appearance that this opacification extends outside of the pleura was suggestive of an extra-pulmonary feature, most consistent with a hair artifact. Physical exam of the patient demonstrated a braided ponytail with a beaded hair-elastic (Figure 3).

Repeat imaging demonstrated normal lung pathology, and confirmed that the SPN was caused by this extracorporeal foreign body (Figure 4).

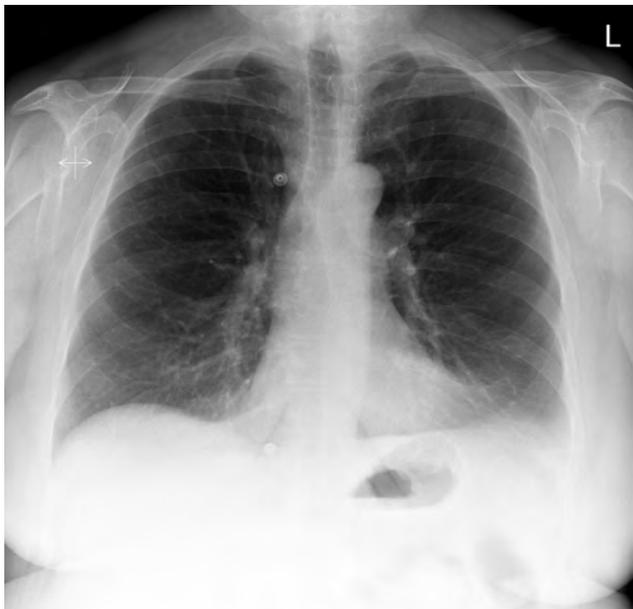


Figure 2. Comparison studies with no SPN. Comparison view of the patient taken one month prior to presentation. No nodular opacifications are observed. Subtle nonspecific blunting of the left costophrenic angle was noted.

Discussion

The differential diagnosis of SPN includes nonspecific inflammatory nodule, infectious granuloma secondary to tuberculosis or fungal infection, pulmonary hamartoma, abscess, arteriovenous malformation, congenital lesions including bronchogenic cysts, primary lung malignancy, and lung metastases.³ This patient also had a wedge-shaped peripheral opacity in the left upper lung, which may have been suggestive of pneumonia, segmental atelectasis, or pulmonary embolism with a Hampton's hump sign.



Figure 3. External foreign body identified on exam. The patient's hair was braided in a long ponytail, which was held together with a beaded hair-elastic, mimicking a solitary pulmonary nodule on the chest radiograph. Particular attention should be paid to the bead on the patient's hair-elastic, which resembles an SPN radiologically.

Identification of a SPN on chest X-ray typically merits further imaging on CT, because of the high incidence of malignancy and the favourable expected outcome with early resection of pulmonary neoplasia. Radiographic characterization of SPN is the mainstay of diagnosis and prognostication, with computed tomography (CT) as the imaging modality of choice. CT has a higher specificity and sensitivity for SPN as it allows for high-resolution characterization of the nodule's size, border characteristics, and density, as well as characterization of superimposed structures.^{3,4} Lesion diameter is predictive of cancer, with a linear correlation between size and prevalence of malignancy.^{3,4} Irregular, lobulated, and spiculated borders are similarly associated with an increased risk of malignancy in SPN. The presence of either internal dense or popcorn calcification, or a fatty component of the SPN are reassuring features associated with benign lesions.³

The workup algorithm of SPN depends on CT characterization: lesions greater than 8mm with low clinical risk of cancer require repeat CT scan annually for at least 2 years; lesions greater than 8mm with a clinical suspicion of malignancy warrant at least FDG-PET, invasive biopsy with mediastinal lymph node sampling, and radiographic surveillance.^{3,6} The subsequent workup of SPN exposes patients to additional radiation, and may require invasive procedures for tissue collection and pathologic diagnosis. In a study of patients with SPN identified on chest x-ray, greater than 70% required additional investigation with a mean cumulative addition dose of 10 mSv.² It is imperative that initial

radiologic diagnosis of SPN be certain to avoid exposing patients to radiation unnecessarily.

In this case, hair-elastic bead artifact with a foreign body resembled SPN in a patient at high risk for lung malignancy. Hair-elastic bead artifact, in which a beaded hair-elastic is visualized on chest imaging produces a false positive for SPN, is not well reported in the literature. Hair artifact has been described in three cases in which braided hair has been confused for lung pathology.^{7,9} The phenomenon is rarely observed because most technician protocols require hair and non-essential foreign bodies be positioned outside of the image frame. Reports of hair artifact have traditionally come from dental radiology and emergency department imaging of uncooperative patients; both of these scenarios make it more difficult for technicians to remove obscuring hair.⁸ In this case, the presence of hair artifact reduced the suspicion of malignancy and signaled an alternate cause of the nodular opacity: hair-elastic bead artifact.

The pre-test suspicion of lung malignancy was high for this patient, an elderly smoker presenting with dyspnea and with a prior history of bone neoplasm.³ A new lung malignancy could have explained the patient's dyspnea had it represented decompensation from an impaired baseline, however a malignancy would not be expected to develop in the one-month interval between available imaging. The identification of a nodular pulmonary opacity nearly initiated a series of unnecessary testing and radiation exposure were it not for consideration of the natural history of malignancy, a correlation to physical exam, and an awareness of hair artifact. It is important that radiologists and clinicians consider potential false positives, especially when the diagnosis would initiate an extensive subsequent workup.



Figure 4. Repeat imaging demonstrates no lesion. Repeat imaging after the patients hair had been positioned outside of the image frame demonstrates no true pulmonary nodule. No hair artifact or hair-elastic head artifact are visualized overlying the lung. A braid of hair is visualized above the left shoulder (white arrow). No acute lung or mediastinal pathology was identified.

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Normothermic Ex Vivo Lung Perfusion: A Review of the Toronto Protocol

Aadil Ali, HBSc¹; Cara Summers, HBSc¹; Shaf Keshavjee, MD, MSc^{1,2}; Marcelo Cypel, MD, MSc^{1,2}

¹Latner Thoracic Surgery Research Laboratories, University Health Network, Toronto, ON

²Division of Thoracic Surgery, University Health Network, Toronto, ON

Abstract

Traditional methods of lung preservation include cold storage of lungs on ice prior to transplantation. Previous reports have identified deleterious outcomes with regards to prolonged cold ischemic time. Herein, a novel technique has been developed to perfuse lungs at normothermia. This review highlights a Toronto team's experience with developing and utilizing this system known as normothermic ex vivo lung perfusion (EVLP). EVLP allows for the assessment of marginal lungs and for reconditioning through therapeutic intervention. Various clinical studies have shown equivalent post-transplant outcomes when using the system on lungs that would have initially been declined for transplantation. EVLP ultimately expands the pool of available donor lungs for transplantation and its potential is addressed in this review.

Introduction

Over the past 25 years, lung transplantation has become an established and increasingly successful treatment for patients with end-stage lung disease. However, the waiting list for donor lungs has progressively increased and currently exceeds the number of available organs. As a result, large transplant registries in Europe and the United States have reported wait list mortalities as high as 30-40%.¹⁻⁴ One of the main driving factors contributing to the lack of organs is the small quantity of potential donor lungs that fulfill donation criteria. This can be attributed to the fact that physicians are often conservative in selecting lungs for transplant due to the risk of graft dysfunction. Indeed, 15-20% of lungs continue to transplant from multi-organ donors, inferring that up to 85% of lungs are rejected in some regions for lung transplantation.⁵

The current standard clinical method of lung preservation is cold hypothermic static preservation, which offers very limited opportunities for physicians to assess graft quality and function.⁶ Briefly, this method involves performing a cold pulmonary flush using a low potassium dextran solution, paired with lung ventilation during organ retrieval. The lungs are then inflated, explanted, and stored at 4°C until they are ready to be transplanted into the recipient.⁶ During this time, there is a rapid decline in lung metabolic function, which is the primary reason for low assessment ability.⁷

One strategy developed to overcome this limitation is normothermic ex vivo lung perfusion (EVLP). This technique allows for the maintenance of donor lungs in a physiological state, allowing lung cells and tissues to maintain their metabolic activity and viability for extended periods of time.⁸ As a result, marginal graft lung function can be assessed prior to transplantation, allowing for higher organ utilization rates. The addition of EVLP also provides the opportunity for therapeutic intervention. The option of reconditioning marginal or otherwise declined lungs can greatly enhance organ viability and expand the pool of potential donor lungs. Figure 1 illustrates the potential increase in available transplantable lungs through the use of EVLP.

This review will provide a background on the EVLP technology and its current and future potential clinical applications. We will focus on the protocol developed by a group from Toronto known as the Toronto EVLP method. Initial strategies using EVLP were only able to preserve lungs for 60 minutes prior to the development of circuit-induced lung injuries.⁹ The Toronto group has mastered the EVLP technique, becoming the first to achieve long-term stable perfusion times of over 12 hours.¹⁰ As a result, this method has generated a large amount of research and clinical data in the literature.

The Toronto Protocol

There are currently three EVLP methodologies being used internationally. Similarities and differences between them are summarized in Table 1.

To begin the procedure, the donor lungs are retrieved and stored at 4°C in a cooler for transport. The pulmonary lung bloc is dissected to prepare for cannula insertion. A specific

Corresponding Author:
Aadil Ali
aadil.ali@uhnresearch.ca

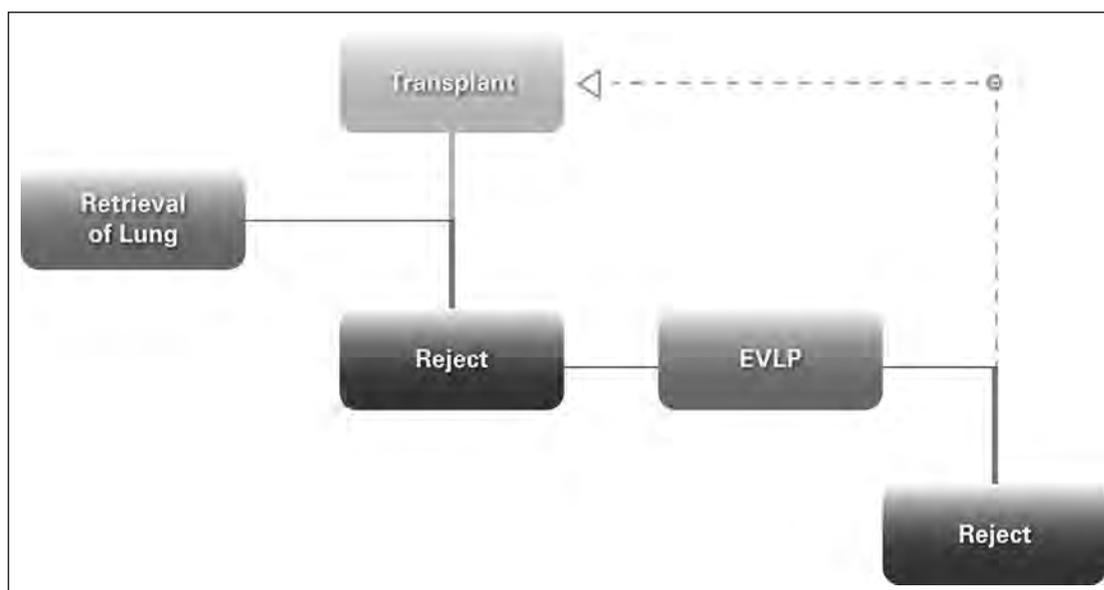


Figure 1. Flowchart of transplantable donor lung expansion using ex vivo lung perfusion (EVLP)

Table 1. Ex vivo lung perfusion methodologies¹⁰⁻¹²

	Protocol		
	Toronto	Organ Care System (OCS)	Lund
Flow			
Pump type	Centrifugal	Pulsatile	Roller
Flow at start of perfusion	150 mL/min	200 mL/min	100 mL/min
Target flow total	40% cardiac output	2.5 L/min	100% cardiac output
Ventilation			
Mode	Volume control	Volume control	Volume control
Tidal volume	7 mL/kg	6 mL/kg	3-8 mL/kg
Frequency	7 bpm	10 bpm	12 bpm
PEEP	5 cmH ₂ O	5 cmH ₂ O	5 cmH ₂ O
FiO ₂	21%	21%	50%
Pressure			
Pulmonary artery	< 15 mmHg	< 20 mmHg	< 20 mmHg
Left atrium	3-5 mmHg	0 mmHg	0 mmHg
Temperature			
Perfusion start	25°C	32°C	25°C
Ventilation start	32°C	32°C	32°C
Evaluation start	37°C	37°C	37°C
Perfusion solution	STEEN™ solution	OCS solution + red cells (Hct 15-25%)	STEEN™ solution + red cells (Hct 10-15%)
Total perfusion time	Up to 12 hours	Transport time only	2-7 hours

cuffed cannula is stitched to the left atrium using two 4-0 polypropylene running sutures. A cannula is also inserted into the main pulmonary artery and secured using two heavy silk ties. The trachea is clamped and the tracheal staple line is opened to keep the lungs inflated. An endotracheal tube is inserted into the trachea and secured using two heavy silk ties, similar to that of the pulmonary artery. The endotracheal tube is then clamped, allowing for the release of the tracheal clamp. Before attachment to the circuit, the lungs are flushed (retrograde) with 1 L of a low-potassium dextran solution (Perfadex®). The full protocol is described by Cypel et al.¹⁰

The Toronto EVLP circuit consists of six components: an outflow line, a hollow-fiber-gas-exchange membrane, a centrifugal pump, a hard-shell reservoir, a leukocyte filter, and an inflow line. Additional components include a ventilator, a gas mixture (86% N₂, 8% CO₂, 6% O₂) cylinder, a heater, and a roller pump to recirculate leaked perfusate from the lungs (Figure 2).

The pulmonary artery and left atrial cannulas are connected to attachment sites on the circuit. The endotracheal tube is connected to a ventilator. Ventilation parameters are set to a tidal volume of 7 ml/kg of the donor's bodyweight, respiratory rate of 7 beats per minute, positive-end expiratory pressure of 5 cmH₂O, and FiO₂ of 21%. Ventilation is initiated only once the circuit has been primed.

The Toronto EVLP method uses an acellular perfusion solution known as STEEN™ solution. This is a low-potassium dextran solution supplemented with approximately 40% albumin. The addition of albumin optimizes the colloid pressure of the solution, allowing for fluid maintenance within the intravascular space. This perfusion solution was designed to prevent pulmonary edema, and provides nutrients for pulmonary homeostasis during perfusion.¹⁴⁻¹⁶

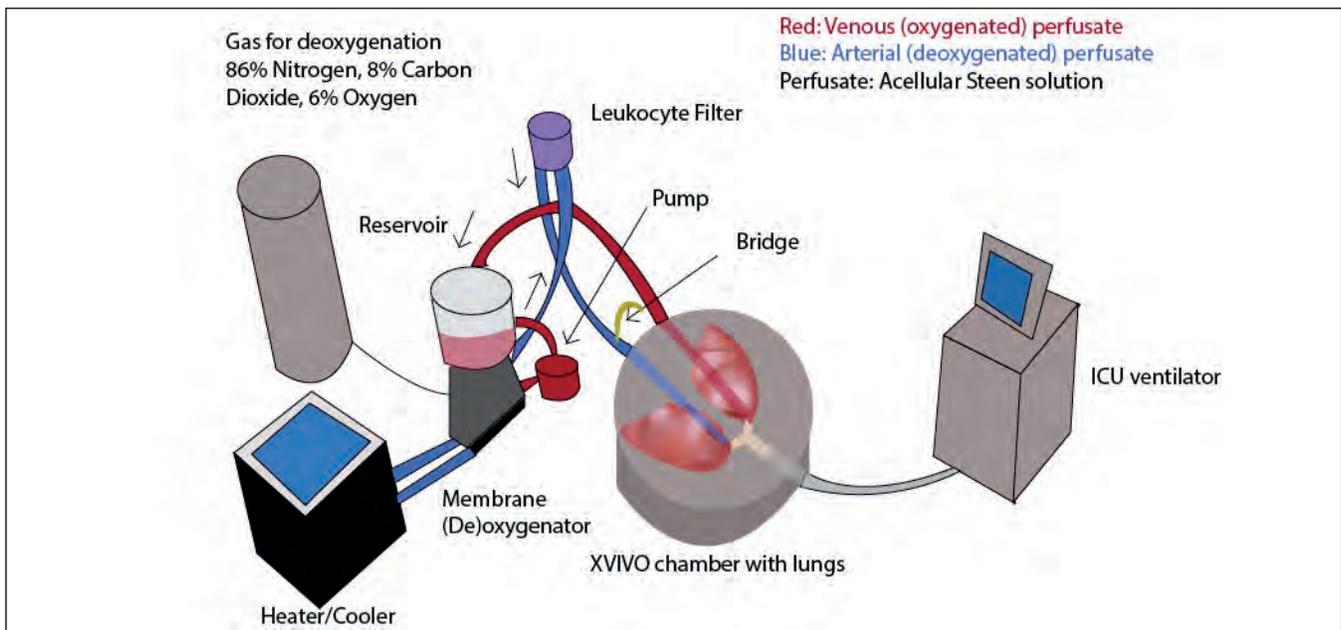


Figure 2. Schematic of the ex vivo lung perfusion circuit¹³

The EVLP circuit is primed with 2 L of STEENTM solution, 500 mg methylprednisone (Solumedrol; Sandoz Canada, Boucherville, Canada), 3000 IU of unfractionated heparin (Organon, Canada), and 500 mg antibiotic (imipenem/cilastatin, Primaxin; Merck, Whitehouse Station, NJ, USA). The lungs are gradually warmed to 30°C after 10 minutes, and to 37°C after 20 minutes of perfusion. Perfusion flow rates are also gradually increased from 20% of the target flow rate, reaching 100% at the 1-hour perfusion mark. Once the lungs have reached 32°C, ventilation is initiated. Upon the initiation of ventilation, the gas mixture (86% N₂, 8% CO₂, 6% O₂) is turned on and applied at a sweep of 1 L/min. The target post-membrane partial pressure of carbon dioxide (CO₂) is between 35 and 40 mmHg. The first recruitment maneuver (up to 25 cm H₂O) is performed after 60 min of perfusion. STEENTM solution in the circuit is partially exchanged hourly (500 mL the first hour, and 250 mL/hour thereafter).

The EVLP platform allows for the assessment of pulmonary artery pressure, left atrial pressure, peak airway pressure, plateau pressure, static compliance, and dynamic compliance. Perfusate gas analysis can be done in order to monitor glucose levels, lactate levels, and the standard blood gas analysis readings.¹⁷

EVLP as a Therapeutic Platform

Besides lung assessment, EVLP provides a platform for the use of a variety of therapeutic applications between the time of lung harvest and transplantation. More specifically, treatments can be administered to the airways with a bronchoscope or systemically through the perfusion solution. Strides have been taken to treat inflammation, pulmonary edema, infections, aspiration injury, and pulmonary emboli.¹⁸⁻²⁹ These studies will be discussed below. However, they are not exclusive to the Toronto EVLP method.

Inflammation

In 2009, Cypel et al. investigated the functional repair of human donor lungs using interleukin-10 (IL-10) gene therapy. Lung inflammation can lead to endothelial dysfunction and ultimately results in poor lung function. Therefore, methods to suppress inflammation to preserve lung function are attractive and effectively expand the donor lung pool. IL-10 is a known anti-inflammatory cytokine that is thought to function by inhibiting pro-inflammatory cytokines through inactivation of antigen presenting cells. Using adenoviral vectors, human IL-10 gene therapy was administered to human lungs unsuitable for transplantation. Gene therapy was able to improve lung respiratory properties and pulmonary vascular resistance.¹⁸

The issue of inflammation has also been addressed using mesenchymal stem cells (MSCs) in the EVLP circuit. Previous studies have shown that MSCs avoid allorecognition by generating an immunosuppressive environment through cytokine production and disrupting T cell and dendritic cell function.¹⁹ One group investigated the use of MSCs to manage inflammation-induced symptoms in a human acute lung injury model. These pathologies include the destabilization of alveolar epithelial fluid transport.^{30,31} Results showed that through the instillation of bone-marrow derived multipotent MSCs, these lungs exhibited a reduction of extravascular water, improved lung endothelial permeability, and restored alveolar fluid clearance.²⁰

Pulmonary Edema

Pulmonary edema can be described as an excessive amount of fluid within the lungs. Weakening of the endothelial barrier leads to a leakage of fluid into the interstitial space and eventually across the epithelial barrier into the alveoli. This decreases the lung's ability to oxygenate blood. One tech-

nique aiming to address this issue is known as air space fluid clearance. In 2007, a group published data showing that a 43 +/-13% basilar alveolar fluid clearance per hour could be achieved using a β 2-adrenergic receptor agonist (terbutaline).²¹ Interestingly, rates were still as high as 19 +/- 10% per hour without the drug treatment.²¹

Another group sought to explore the effects of a β -adrenergic receptor agonist (salbutamol) on reducing edema in a pig EVLP model. This molecule works by increasing the amount of fluid clearance in the lung. The study found a reduction in pulmonary pressure upon administration of the drug during EVLP, as well as improved lung dynamic compliance.²²

Infection

As previously mentioned, EVLP serves as a platform for the introduction of treatment through the lung's systemic circulation. The presence of bacteria and other pathogens can potentially injure lungs and lead to sepsis in the recipient. Removal of these species is advantageous in preventing these potentially negative outcomes. Researchers have aimed to provide high-dose antimicrobial agents during EVLP to reduce bacterial burden. A study investigating the use of broad-range high dose antimicrobial agents and anti-fungal treatments showed a reduction of pathogenic species in the bronchoalveolar lavage.²³

In addition, a recent study was completed by Nakajima et al. using high-dose antibiotics (ciprofloxacin or azithromycin, vancomycin, and meropenem). They found a total decrease in bacterial counts and perfusate endotoxin levels in the bronchoalveolar lavage upon treatment instillation.²⁴ Treatment groups also had improved pulmonary oxygenation, compliance, and a reduction in pulmonary vascular resistance.²⁴

Treatments for infection have also been addressed using multipotent MSCs. In a study mentioned above with regards to the treatment of inflammation, the researchers also observed bacterial killing with the use of multipotent MSCs.²⁰ They hypothesized that this was attributed to upregulation of a bacterial killing mechanism through keratinocyte growth factors.²⁰

Aspiration Injury

In critically ill patients, it is common for gastric or oropharyngeal contents to aspirate into the lower respiratory tract. Consequently, these patients can develop pneumonia. This can contribute heavily towards the development of acute lung injury or acute respiratory distress syndromes. Surfactant therapy aims to protect patients from respiratory distress through administration of exogenous surfactant. Using a pig model, a group created an artificial lung injury with the use of a betaine-HCL/pepsin mixture. In this study, surfactant lavage was administered during EVLP of the aspiration-induced injured lungs. Results showed that surfactant therapy improved pulmonary vascular resistance, lowered oxygen indexes, and improved PaO₂/FiO₂ ratios in comparison to control groups.²⁸ Similar results were shown in a gastric juice induced aspiration ex vivo pig lung model, where surfactant therapy was able to recover lung properties such as PaO₂, pulmonary vascular resistance, and apoptotic cell percentage.²⁶

The use of steroids to treat aspiration injury has also been explored. Using pig EVLP, Meers et al. explored preemptive therapy to aspiration-induced injured lungs using methylprednisolone. Aspiration injury was induced by instilling gastric juice into the airways. Results showed an improvement in lung gas exchange using steroid treatment prior to EVLP.²⁷

Pulmonary Emboli

A pulmonary embolism can be described as a blockage of a lung artery. This can occur by many mechanisms, but is usually caused by the formation of blood clots. Fibrinolytic agents have been developed to dissolve these clots. Donation after cardiac death (DCD) donors run the risk of developing these clots as their lungs are exposed to deoxygenated blood circulated before retrieval. Acute pulmonary embolism formation can lead to graft dysfunction upon transplantation. A study published using a class of fibrinolytic agents known as urokinases showed improved pulmonary vascular resistance, gas exchange, and reduction of edema in DCD lungs.²⁵ A clinical case report published by Machuca et al. demonstrated the use of a fibrinolytic agent known as alteplase in order to successfully treat donor lungs with pulmonary emboli.²⁹

Improving Transplantation to Date

Several promising studies using the Toronto EVLP technique are currently underway or have been recently completed. These studies are listed in Table 2. While the NOVEL, HELP, and Perfusix trials include extended-criteria donor lungs, the Vienna trial evaluated standard-criteria lungs.³² In general, the results from these trials are encouraging.

Table 2. Four clinical trials using the Toronto EVLP technique³²⁻³⁵

Trial Name	Location	Donor Type	Portable	Sponsor	Status
NOVEL	United States	Extended-criteria	No	XVIVO	Completed
HELP	Toronto	Extended-criteria	No	Vitrolife	Completed
Vienna	Vienna	Standard	No	XVIVO	Completed
Perfusix	United States	Extended-criteria	Lung perfusion centre	United Therapeutics	Recruiting

The results from the HELP trial were published in 2011. Twenty lungs from 23 high-risk donors were transplanted after EVLP. In comparing the EVLP group to standard criteria lungs, there were no significant differences in hospital stay, ICU stay, 30-day mortality, primary graft dysfunction, or day in mechanical ventilation post-transplant.³⁴

The group in Vienna published their EVLP experience in 2012, chronicling the results of 13 clinical EVLPs resulting in nine double-lung transplants.³⁵ Similarities were found in post-transplant outcomes including days on mechanical ventilation, hospital stay, ICU stay, and 30-day mortality when compared with 119 standard transplants without EVLP.

The NOVEL trial is a multicenter clinical trial, assessing EVLP for marginal donors. Their preliminary report outlined

results from 31 patients who received EVLP lungs. Results were comparable to 31 (non-EVLP) controls.³⁶ Updated results were described in 2014, after the completion of 42 lung transplants using EVLP.³³ Compared to 42 controls, early outcomes and 1-year survival rates were the same.

Most recently, a retrospective study by Yeung et al. investigated outcomes after transplantation of lungs preserved for more than 12 hours, including EVLP time.³⁷ The study reviewed 906 patients who received lung transplants at Toronto General Hospital from 2006 to 2015. Average preservation time outside of the body was 14.6 hours for 97 patients who received lungs after over 12 hours of preservation time, while 6.7 hours was the average preservation time for 809 patients in the under 12 hours of preservation time group. Early post-transplant outcomes were similar between the two groups despite high-risk lungs. No differences were seen in primary graft dysfunction or length of hospital and ICU stay between the two groups. These results are extremely encouraging, as lifesaving transplants can now be performed across larger geographic areas without the risk of poorer outcomes.

Future Potential

As technology continues to advance, it is evident that the applications of EVLP will expand along with it. Realistically, EVLP will be enhanced as a therapeutic platform to treat many other health-related conditions. In addition, it is realistic to believe that external organ repair centers will be made around the world. These centers will take on the responsibility of receiving marginal lungs and repairing them using the EVLP system. If deemed transplantable, these lungs will then be retrieved at the recipient's hospital. This concept has already been shown to be safe.³⁸

The increased establishment of standard EVLP biomarker use is also expected to aid in lung assessment. Clinical assessments have their limitation, while lung biomarkers provide a more definitive approach for monitoring lungs during EVLP. Studies have been performed to find potential biomarkers of dysfunctional lungs through analyzing primary graft dysfunction (PGD) grade 3 lungs that were accepted for transplant, and lungs declined after EVLP.^{39,40} Although promising, further validation studies must be done.

One aspect of EVLP currently being studied is extending perfusion times on the circuit. Keeping lungs stable using EVLP for over 12 hours will incur many benefits, including the consideration of a new range of therapeutic opportunities. For example, prolonged EVLP could become an optimal research platform to study acute lung injury. Studying acute lung injury ex vivo is attractive as it offers a clinically-relevant scenario of disease development and healing. Moreover, treatments with longer implementation times such as gene and cellular therapies can be considered, allowing for increased reconditioning potential.

EVLP has successfully increased the number of transplantable lungs and offers a range of potential opportunities for further expansion of the donor pool. As novel procedures and potential therapeutics in EVLP are developed, lung transplantation is set to become a reality for more patients suffering from end-stage lung disease.

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Global Neurosurgery – What are the Current Barriers to Neurosurgical Care in Low-Middle Income Countries

Armaan Kush Malhotra, MD Candidate, 2019¹

¹Faculty of Medicine, University of British Columbia

Abstract

Surgical access inequities in low-middle income countries substantially contribute to global morbidity and mortality. The objective of this article was to examine the barriers to implementation of neurosurgical infrastructure in currently underserved countries. Specifically, barriers in neurosurgical education programs, medical equipment availability, diagnostic imaging quality, and presence of adjunct services such as intensive care and anesthesia are discussed throughout this review. Current improvements and solutions to historic methods of delivering neurosurgical education are elaborated. Finally, the sustainability of neurosurgical programs in low-middle income countries is called into question, and benefits to a data-driven approach to elicit governmental support are described.

Introduction

In January of 2014, the *Lancet Commission on Global Surgery* was formed in an effort to assess the need and establish a plan to improve surgical, obstetric, and anesthetic infrastructure in low-middle income countries* (LMIC). This Commission published a document titled *Global Surgery 2030: evidence and solutions for achieving health, welfare and economic development*. Outlined in this report were five key findings that underscore the importance of a concerted effort to establish and optimize surgical practice in underserved LMICs.¹ Some of these findings include the fact that five billion people worldwide are entirely lacking access to safe and affordable surgical or anesthetic care. Over 300 million operations take place annually, of which only 6% occur in LMICs, where case outcomes are amongst the worst in the world. In 2010, it was estimated that 33% of global mortality was related to medical conditions requiring surgical intervention.² The Commission

predicts this lack of safe surgical access in LMICs will translate to an economic productivity loss of 12.3 trillion US dollars between 2015 and 2030 if these issues remain unaddressed.¹

The World Bank independently released a series of documents describing worldwide *Disease Control Priorities*, which aim to capture global burden of disease through a socioeconomic lens. In the first volume, which focused on essential surgery, a list of 44 surgical procedures are described as having favorable cost-benefit profiles, being feasible to implement, and as being capable of addressing a substantial burden of disease. If these essential procedures were accessible to patients worldwide, an estimated 1.5 million deaths, equivalent to 6-7% of global annual mortality, would be averted in LMICs.³ Two of these essential procedures fall within the neurosurgical scope of practice. These include burr holes for management of intracranial hematomas and shunt placement for congenital hydrocephalus.^{3,5} Other literature includes management of unstable cervical spine injuries and neural tube defects in the list of essential neurosurgical procedures.^{6,7} The above reports highlight the role that global neurosurgery is poised to play in the management of neurotrauma and congenital neurological malformations – both of which are socially and economically devastating for patients, families, and countries.

A brief discussion about the impact of global neurotrauma will further underscore the scale of neurosurgical care requirements worldwide. Traumatic brain injuries (TBI) and spinal cord injury (SCI) represent an enormous source of disability and mortality in young adults around the world. In the United States alone, approximately 100,000 patients will undergo intracranial hematoma evacuation and about 50,000 will suffer fatal TBIs.^{8,9} The epidemiological data to assess these numbers in LMICs is drastically less reliable due to low levels of TBI reporting.⁹ The WHO predicts that by 2020, the third leading global cause of death will be motor vehicle accidents.² It has been shown that treatment of patients with severe TBI in centers capable of offering neurosurgical support reduces the odds of death by 2.15 compared to a non-neurosurgical centers, further underscoring the importance of neurosurgical access in LMICs.¹⁰

Based on estimates made by the WHO in 2004, the median number of neurosurgeons in countries (that responded to their national survey) is 0.56 per 100,000 people. In low income countries, the same survey showed 0.03 neurosurgeons per 100,000 while there were 0.97 in high income countries.¹¹

*Low-Middle Income Countries are economically defined by the World Bank as having a Gross National Income (GNI) per capita below \$4,035 for the fiscal year of 2015.²

According to the Study on Surgical Services for the United States, the target neurosurgeon per population ratio should be 1 per 100,000, which LMICs are not close to attaining.¹² One barrier to fulfilling these neurosurgical care requirements is access and quality of education. When considered in the context of a growing demand for global neurosurgical care, this scarcity of trained neurosurgeons in LMICs reveals the true magnitude of global neurosurgical demand and suggests the benefit of timely access to basic neurosurgical care. This review will serve to outline the broad barriers that currently exist around the implementation of basic neurosurgical care in LMICs. Specifically, the current state of neurosurgical education, medical equipment, diagnostic services, and program sustainability will be discussed.

Neurosurgical Education

It is imperative that a comprehensive needs assessment is done prior to a neurosurgical training partnership in order to understand the context of current surgical capabilities in the LMIC. Depending on the state of neurosurgical infrastructure, resources are allocated to either completion of neurosurgical training or to supplementation of general surgeon skills to perform basic life-saving interventions such as brain abscess drainage, ventriculostomy placement, or intracranial hematoma evacuation. It was reported that centers in Nepal along with many of the African countries continue to prioritize this latter training methodology.^{10,13,14}

The traditional top-down neurosurgical training methodology is arguably outdated in the current climate of global connectivity. Both the World Federation of Neurosurgical Societies (WFNS) and Foundation for International Education in Neurological Surgery (FIENS) have historically applied a top-down visit-based model of neurosurgical education outreach.¹⁵⁻¹⁷ During these camps, trained neurosurgeons travel to LMICs and work with local surgeons or medical graduates to develop neurosurgical skills. It has been shown that prolonged visitation to an LMIC center correlate with more effective training and long-term neurosurgical care.¹⁸

Despite the important role for this approach, the top-down model has been criticized because foreign surgeons are generally unwilling to spend multiple years in an LMIC to establish a comprehensive neurosurgical training program. As a result, these education camps are often sporadic and fail to provide longitudinal learning environments for local surgeons, leading to a lack of self-sustaining programs and brain drain when surgical graduates seek further training in established neurosurgical centers.¹⁹ In a survey of Sub-Saharan African neurosurgical programs (43% of were affiliated with WFNS, 23% were affiliated with FIENS), the self-reported level of training was deemed inadequate in the majority of respondents.²⁰ Surgical trainees often become fully dependent on the availability of neurosurgeons to physically visit their sites.¹⁴ Furthermore, there have been reports that these camps are associated with a bias towards elective and non-fatal illnesses, which entirely exclude the population of patients suffering from neurotrauma and severe congenital disease.²¹

Agrawal et al. published an article examining barriers to neurosurgical care in Nepal and further cited lack of organizational infrastructure within the hospital as reasons for sub-optimal neurosurgical care. They describe a lack of a centralized patient safety and record keeping to adequately maintain accountability of the service to the patients.²² In a qualitative study that sought to interview Ethiopian neurosurgeons, this issue of accountability and communication between professional groups arose. Interestingly, it was linked to a core educational issue related to a lack of clinical decision making teaching and inter-professional collaboration methods. In the low resource setting, when the ratio of residents to faculty is far in favour of residents, there is insufficient time for trainees to develop their ethical frameworks for care and critical thinking related to care plans. A more feedback-centered approach was suggested to potentially mitigate this issue.^{23,24} It has been shown that a standardized trauma care protocol in LMICs is capable of yielding improved clinical outcomes in the teaching hospital setting.²⁵

The above studies underscore the inherent flaws with traditional top-down education approaches. Issues of clinical decision making and ethical frameworks have been under-emphasized in these programs. Recent literature has made the suggestion that supplementation of site-visits in combination with comprehensive online teaching materials may more appropriately address the needs of an LMIC neurosurgical training program.^{15,20} Feasibility studies of online educational programs for global neurosurgical development have been previously conducted. These report improved accessibility, longitudinal development, and standardized curricula as major benefits for this model with few user-perceived barriers to online curriculum implementation.^{26,27} We believe that the ethical and clinical decision making deficits, as well as a lack of standardized feedback, would be amenable to remedy through supplementation using longitudinal online resources in combination with traditional outreach training modalities.

Neurosurgical Infrastructure in Low-Middle Income Countries

Neurosurgical care requires a complex multi-disciplinary team in conjunction with numerous medical resources to perform safe surgical procedures and appropriate perioperative patient care. Translation to a resource-poor environment is expectedly challenging. Specific infrastructural barriers to care include medical equipment availability and quality, diagnostic imaging access, and presence of trained adjunct services such as anesthesiology and nursing support.

Medical Equipment and Neuro-imaging

The Tribhuvan University Teaching Hospital has had developed neurosurgical capacities since the 1960s and is currently one of the leading hospitals in Nepal. In 2004, a report was released outlining barriers to care moving forward. Many of their concerns surrounded access to imaging and reliable medical equipment.²⁸ Due to the complex and resource-intensive nature of peri-operative neurosurgical care, access to ventilators and appropriate vital monitoring was noted to largely limit care.

In a study assessing neurosurgical care in Papua New Guinea - an LMIC that has slowly improved its neurosurgical capacity through mentorship by Australian-certified surgeons - Park et al. show that over 1,020 procedures were performed over the past decade, marking a substantial improvement in capacity.²⁹ The two most frequently consulted cases were TBI in adults and hydrocephalus in children. This study evidenced the potential positive outcomes of a competent neurosurgical service as they were able to manage a spectrum of neurotrauma, CNS infections, and complex congenital neurological disease. However, they cite the largest barrier to improved outcomes as the lack of imaging access, which drastically limited their ability to assess acute TBI. This shift of priority to imaging and medical equipment infrastructure seems to be characteristic of centers that have achieved a level surgical competence in the management of common neurosurgical cases.

A one-year review of cases managed in the Black Lions Hospital of Addis Ababa, Ethiopia (affiliated with the FIENS initiative) was conducted between 2006-2007 to establish a baseline profile of neurosurgical capacity prior to renewal of their residency training program. In their review, it was noted that there is no CT scanner at the hospital and therefore 54% of patients consulted for head trauma underwent exploratory burr holes. In general, the lack of diagnostic imaging was a main finding of this study.²³ Many centers suffer from a lack of sterile gowns and sterilization machines, which prevents multiple neurosurgical cases from taking place each day.³⁰ The above examples taken from Nepal, Ethiopia, and Papua New Guinea provide a snapshot of the role for medical technology as an important commodity for neurosurgical infrastructure development. Our intention is not to delve into the ethics of medical equipment donation (as that would be an entirely separate review), but to underscore the theme of medical equipment as a limiting factor for neurosurgical care in LMICs.

Ramamurthi – a neurosurgeon with over 50 years of LMIC experience – counters the above points by criticizing international training programs for fostering the dependence of LMIC surgeons on medical technology available in high-income countries.³¹ A concerted effort must be made to develop clinical decision making within the environment of intended clinical practice. This criticism provides more merit to a hybrid online education model in which surgeons have access to both traveling neurosurgeons and online resources as the optimal training approach. There is a demonstrated need for creative problem solving within the low-resource setting, which may not be best fostered through a top-down teaching model. One such example is the implementation of the awake-craniotomy for brain tumour resection in Indonesia, Ghana, China, and Nigeria, which allows for the circumvention of general anesthesia in these patients.³² We suggest that some of the resource limitations faced by LMIC surgeons are amenable to this style of problem solving. Development of these abilities and acknowledgement of the low-resource environments must be preserved in the didactic teaching methods of international surgical programs.

Adjunct Services

Beyond imaging, the resource limitations of anesthesia services, operating rooms, and trained ICU staff - among others - also limit neurosurgical care. This is demonstrated by Fuller et al. who document the outcome of an eight-year top-down collaboration between Duke University Medical Center Neurosurgery Department and Mulago Hospital in Kampala, Uganda that was aimed at improving neurosurgical care.¹⁴ They employed a “technology, twinning and training” approach, whereby medical equipment was sent to Uganda (including equipment ranging from ICP monitors to microscopes and anesthesia machines) with concurrent training efforts targeted at biomedical engineers to ensure maintenance of this equipment.³⁰ The “twinning and training” phases transition from surgical camps to an established residency program. Despite the improved neurosurgical care and more trained residents, equipment remained a limiting factor, echoing the challenges expressed in the previous section. Anesthesia, ICU, and nursing services were further cited by the Mulago Hospital local chief of surgery to be the single most important element of infrastructure to providing surgical care. Contrary to the United States, ICU patients in LMICs are typically much younger and afflicted with curable surgical conditions. The systemic shortage of trained ICU staff remains a challenge for neurosurgical care.³³ This emphasis on anesthesia was echoed by the *Lancet Commission* in their meetings on essential surgery.¹

Following appropriate operative and peri-operative care, rehabilitation services are essential in the field of neurosurgery. Without these services, there is a tremendous socioeconomic strain placed upon primary care providers and caretakers of patients afflicted with neurosurgical conditions. Inadequate rehabilitation access has been shown to delay discharge, result in health deterioration, increase dependence for assistance, and decrease quality of life.^{34,35} The extent of rehabilitation challenges is largely unknown due to the overall scarcity of reliable data from LMIC rehabilitation services.³⁶ Some evidence has shown the promise of cognitive rehabilitation via tele-rehabilitation in post-traumatic brain injury patients.³⁷ This further emphasizes the role that internet connectivity plays in circumventing access issues faced by many patients in LMICs.

Sustainability of Neurosurgical Programs

It is at this point of our discussion that we must critically evaluate the role of foreign surgeons and health care providers in LMICs. Despite the demonstrated ability to improve a country's neurosurgical capacity as described above, there is a notable lack of sustainability stemming from a deep dependency on the international relationship. From the moment that a country receives subsidized medical equipment and surgical expertise from another country, a cycle of dependence is propagated. This theme is well described in the literature.^{13,14,38} Furthermore, international collaborations tend to focus on medical care output rather than the larger health ecosystem of the LMIC they are aiming to develop. As an example, Fuller et al. explain that there was still minimal government inter-

est in neurosurgical care following 8 years of international collaboration and care improvement.¹⁴ Viswanathan describes the crippling costs facing patients when complex care is delivered in an environment of insufficient health insurance and haphazard governmental commitment to life-saving medical support.²³ Beyond discharge, these staggering healthcare costs and lack of social supports are capable of economically crippling a family for numerous years following their care.

In LMICs, the average gross domestic product allocated to healthcare is about 60% less than that of their high income country counterparts – much of which is dedicated to primary care, infectious disease, and maternal health.³⁹ In a review of initiatives focused on pediatric surgery in Sub-Saharan Africa, Ekenze et al. conclude that sustainability is frequently not a focus of international surgical collaborations.⁴⁰ The challenges with sustainability of neurosurgical infrastructure are attributable to a general lack of funding, lack of governmental motivation to focus on neurosurgical illness, and a propensity for international fellows to remain in the country of their fellowship following completion of their training.⁴¹ Many of the sustainability issues discussed above may be mitigated through a more collaborative approach with the LMIC government in order to understand sociocultural perceptions and political climates that affect disease management, funding, and government commitment.

Ibrahim et al. conducted an international qualitative study surveying 31 surgeons currently involved with international partnerships and outreach programs in LMICs. The objective was to develop a framework for monitoring and evaluating these initiatives.⁴² In their evaluation criteria, they cite a strong indicator of a program's self-sufficiency to be the degree of funding the program receives from the government in the LMIC. The theme of prospective data acquisition was also discussed. The authors suggest that reliable collection of data would more effectively allow the LMIC health care providers to lobby their local governments for improved resources and funding. Many of the studies cited throughout this article demonstrate the effectiveness of neurosurgical programs in LMICs. However, underreporting related to socioeconomic impacts of neurosurgical illness, traumatic brain injury, and spinal cord injury in unequipped care centers remains a pervasive issue.

Conclusion and Important Takeaways

Through this review, several barriers to neurosurgical care in LMICs were discussed. The literature summarized above suggests that education, imaging access, medical equipment quality, adjunct service development, and sustainability must be integral components of LMIC neurosurgical initiatives. These findings underscore the necessity for a comprehensive neurosurgical needs assessment prior to offering support. This review demonstrates the phases of neurosurgical development in an LMIC. Beginning with training of general surgeons to perform life-saving procedures such as ventriculostomy placement and intracranial hematoma evacuation allows a country to provide care for common acute neurosurgical problems in

relatively low resource settings (this still requires a minimum level of medical equipment). Progression to specific neurosurgical training programs requires a concerted effort by local leaders with international support to ensure a high quality of record-keeping, standardized training, and quality of care evaluations. As suggested, this process may benefit from a hybrid approach combining online education resources and international collaboration from established neurosurgeons.

Current initiatives have adopted this notion of hybrid education platforms to supplement traditional methods of physical outreach. Described by Blankstein et al.,²⁷ there are numerous modalities of online educational materials in current use. These range from listservs that circulate case reports and clinical teaching through open access email threads to modular courses that deliver seminar-style information. The American Association of Neurological Surgeons (AANS) offer these webinar sessions directly through their website on a multitude of topics.⁴³ Despite this great resource, there is a lack of feedback capability as participants are led through cases in an online module or video format that does not allow for collaborative learning. Further access issues exist as these videos are restricted to AANS members. At present, the most recently developed modality for online education is achieved through structured online courses.^{15,27} These courses adhere to a traditional curriculum with determined deadlines for assignments, quizzes, and other assessments. There are students and faculty that enroll in the course, participate in discussion, pose questions, and provide feedback through a defined virtual classroom. This model has been applied through the WFNS with excellent qualitative feedback from participating students. This continues to be an area of current educational focus for institutions affiliated with global neurosurgical development.¹⁶

A paralleled emphasis on infrastructure development including anesthesia, nursing, and ICU services will further augment the quality of neurosurgical care offered. Throughout the entire process, larger societal initiatives may help prevent injury. Studies have shown that trauma related to motor-vehicle accidents in LMICs is a leading cause of disability and death.⁴⁴ With specific regard to pediatric and young adult neurotrauma, motor-vehicle accident prevention initiatives as well as helmet campaigns are an important element of public awareness - commuting to and from school is often the most dangerous part of a child's daily activities.^{45,46} Finally, as the service becomes more competent in its ability to handle neurosurgical disease, refinements to imaging modalities and cutting-edge surgical equipment become important to the management of more complex neurologic pathology.

The ultimate goal of neurosurgical infrastructure development is to create a self-sustaining program that is able to service the population whilst producing qualified neurosurgical graduates. For an LMIC government to prioritize neurosurgical care in the context of the myriad other health and economic issues in their country is challenging. It remains difficult to transition the current model of foreign collaboration for LMIC neurosurgical training to a local government-support

neurosurgical program. However, evidence summarized in this review suggests the prospective collection of data related to outcomes, epidemiology of disease, and neurosurgical specialist training may be useful in eliciting governmental support of international neurosurgical collaborations. We posit that adherence to strong data collection is paramount to subsequent partnership and relationship building with local governments to improve sustainability and care in the long term.

The specific barriers to an LMICs neurosurgical development must be closely considered within socioeconomic and cultural climates of a particular country. A strong understanding of barriers to implementation of specialized surgical care is essential to the targeted and high yield deployment of resources in LMICs. The *Lancet Commission* of Global Surgery explains that a paradigm shift is required for achievement of the 2030 milestone goals.¹ It is imperative that we transition from a traditionally disease-oriented global health approach to a more holistic integrated care model that is able to support accessible surgical care. In order to make this transition, a concerted effort must be made to address the barriers discussed previously. Sustainability must be central to the steps we take towards the 2030 goals. Government ownership of international surgical programs will galvanize our progress moving forwards. Global neurosurgical development must continue to be a priority of health infrastructure development in the future so that we may adequately face one of the fastest growing and underserved patient populations on the planet.

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Surgical education for the 21st century medical trainee: Evidence-based considerations to optimize quality in surgical workshops for pre-clerkship medical students

Neil D'Souza, MD, MHSc¹; Joel Davies, MD, MSc¹; Thomas Gregory, MD²; Vishaal Gupta, MD¹; Andrew Kapoor, MD, MSc³; Rushika Perera, MD, MSc⁴; Khaled Ramadan, MD¹; Caleb CJ Zavitz, MD, PhD^{1,5}; George Christakis, MD, MSc, FRCSC^{6,7}

¹Department of Postgraduate Medical Education, University of Toronto

²Department of Postgraduate Medical Education, Queen's University, Kingston, Ontario

³Department of Postgraduate Medical Education, McMaster University, Hamilton, Ontario

⁴Department of Postgraduate Medical Education, Western University, London, Ontario

⁵Department of Pathology and Molecular Medicine, McMaster University, Hamilton, Ontario

⁶Department of Cardiac Surgery, Sunnybrook Health Sciences Centre, Toronto, Ontario

⁷Department of Surgery, University of Toronto

Abstract

Background: Pre-clerkship medical students in Canada receive little formal exposure to surgery during their undergraduate medical education. Hands-on workshops and simulations may be key surgical education experiences for students addressing this lack of exposure. However, little evidence exists regarding which components provide the best hands-on experiences. The purpose of this study was to present a qualitative evaluation of a hands-on surgical experience intended for pre-clerkship medical students.

Methods: We used the workshop component of the Surgical Education and Discovery (SEAD) Program at the University of Toronto to conduct our evaluation. Twenty program participants were asked to complete surveys eliciting workshop feedback. Data was compiled and prevailing themes were drawn from survey responses.

Results: Nineteen surveys were completed (N=19). The overall impression of the SEAD Program was either "very good" or "good" (19/19). When asked about the favourite component of the SEAD Program, "workshops" was cited 16 times (16/19). The 3 most prevalent positive themes from the feedback were "the personnel present", "the types of skills taught", and "the hands-on experience provided". The 3 most prevalent negative themes were "inadequate time", "unmet equipment/resource needs", and "poor teaching/instruction".

Conclusion: This preliminary analysis identified key aspects contributing to the quality of a surgical education experience. Such aspects may be of value to surgeon educators creating similar experiences for pre-clerkship medical students. Further study is needed with larger participant numbers, long-term data, and CaRMS match results, to ascertain any impact the identified themes have on pre-clerkship students choosing a surgical career.

Introduction

Medical students in Canadian medical schools receive little formal exposure to surgical specialties prior to clerkship. Yet medical students often form their career choices either before or early within the pre-clinical training years.^{1,6} Positive encounters between first-year medical students and surgeons have been found to confer favorable perceptions towards a career in surgery.⁴ These early positive perceptions are particularly relevant considering the potential barriers to students pursuing careers in surgery, namely perceived poor life style, technical demand, and lack of mentorship opportunities.^{3,7} As such, surgical departments have an interest in, and actively pursue the creation of, opportunities for career exploration to attract potentially interested medical students. In 2012, the University of Toronto's Department of Surgery developed the inaugural Surgical Exploration and Discovery (SEAD) Program to provide comprehensive surgical exposure to pre-clerkship medical students through formal operating room (OR) observerships, organized informal career discussions with staff surgeons and residents, and hands-on workshops and simulations.⁸ This program also implemented the recommendations put forth by the American Surgical Association's "Blue Ribbon Committee Report on Surgical Education", which call for increased involvement of surgical departments in the educational activities of pre-clerkship students, exposure to surgical role models as early as possible, and greater utilization of surgical simulation tools in pre-clerkship education.⁹ Prior research has demonstrated the use of simulation-based learning can foster a positive attitude towards a career in surgery.^{10,12}

Given the importance of early surgical skill exposure to pre-clerkship medical students' interests in pursuing careers in surgery, the objective of this study was to determine the key components contributing to a quality workshop experience, as well as to provide an initial reference point to establish quality control and quality assurance. Specifically, our goal was to evaluate participants' perceptions of the positive

Corresponding Author:
Neil D'Souza
neil.dsouza@mail.utoronto.ca

and negative aspects of a comprehensive hands-on surgical simulation experience intended for pre-clerkship medical students, and to identify critical aspects surgical educators should consider when designing their own surgical exposure programs in the future.

Methods and Materials

Study Background and Setting

The SEAD Program's major focus is on increasing participant exposure to practical surgical skills and procedures common to the surgical subspecialties. Medical students in their first year of studies at the University of Toronto spent approximately two weeks engaged in practical learning in the OR each morning, followed by didactic and practical training sessions each afternoon organized by each of seven divisions in the Department of Surgery (Cardiac, General, Neurosurgery, Orthopaedic, Plastic and Reconstructive, Urology, Vascular). Each division hosted a three-hour hands-on simulation workshop led by residents, fellows and staff surgeons. The primary purpose of these workshops was to introduce and teach basic surgical principles. Participants had an opportunity to work through one to four stations, each lasting between 45 to 180 minutes, and focused on skills which were relevant to each discipline (Table 1). Workshop topics were selected by the staff surgeons chosen to lead the workshop, in collaboration with a second-year medical student division coordinator.

Study Design and Recruitment

This was a prospective study involving SEAD Program participants, from which study recruitment was drawn. Participation in both the Program and the study were voluntary, and the decision to participate in the study did not impact their involvement in the Program.

Sample Size and Sampling Methods

Medical students in their first year of studies at the University of Toronto had the opportunity to apply to the pro-

gram on a competitive, voluntary basis outside the formal medical school curriculum. From this group of first year medical students, 52 written applications were received and a total of 20 students were ultimately accepted to the SEAD Program. These 20 students comprised the study sample, and were asked to complete questionnaires on a voluntary and anonymous basis.

Questionnaire

After each workshop, a brief questionnaire was provided to each participant. The questionnaire was developed by the SEAD Program Director and supervising SEAD faculty members. The questionnaire consisted of four questions (1-4) to be answered on a five-point Likert scale, and three questions (5-7) that solicited free-form responses, for a total of 7 questions. The following statements were posed to the participants:

1. I enjoyed the workshop.
2. I am now more interested in this sub-specialty.
3. I am now less interested in this sub-specialty.
4. This workshop should be continued next year.
5. Things that I liked.
6. Things that can be improved.
7. Other comments.

In addition, we also asked participants the following questions at the end of the Program:

- 1) What was your overall impression of the SEAD Program? (five-point Likert scale)
- 2) The SEAD program increased my interest in surgery. (five-point Likert scale)
- 3) What was the most favourite component of the SEAD Program? (free-form response)

Data Collection, Outcome Measures, and Analysis

The questionnaires were administered and collected without any participant-identifying data. Responses were entered manually into a Microsoft Excel database for analysis (Microsoft, Redmond, WA). Quantitative responses from

Table 1. Topics covered during hands-on simulation workshops by sub-specialty.

Station	General Surgery	Urology	Plastic Surgery	Neuro-Surgery	Orthopaedic Surgery	Cardiac Surgery	Vascular Surgery
1	Simple interrupted suturing	Laparoscopy simulator	Z-plasty	Neurotrauma seminar	Small bone fragment plating	Aortic valve replacement	Femoral anastomosis
2	Simple continuous suturing	Pelvi-trainer	Modified Kessler tendon repair	Neurotrauma simulator	Arthroscopy simulator		
3	One-handed knot tie	Virtual reality laparoscopic simulator	Microsuturing	Craniotomy and burr hole drilling			
4	Subcuticular suturing	Laparoscopic instrument review	Vertical and horizontal mattress suturing				

Likert scale questions were compiled into histograms in Excel, while free-form responses were analyzed by three independent and blinded researchers. Each researcher performed thematic analysis using Grounded Theory to uncover the major ideas that emerged in participants' responses. These themes were then compared to generate consensus key words. The frequency with which these key words or phrases were repeated in participants' answers was then examined using KWIC Concordance Version 5.1.0 (Satoru Tsukamoto, Tokyo, Japan). The phrases in which these key words were repeated most frequently were analyzed to explore the characteristics making the hands-on workshops effective. Upon completion of the analysis, the three independent researchers compared findings for triangulation, and consensus results were gathered.

Ethics Statement

Approval for this study was obtained through the University of Toronto Research Ethics Board. Participants received a briefing explaining the purpose of the study, that participation was voluntary and anonymous, and that participation would not impact their scholastic or SEAD Program opportunities. Participants consented implicitly by anonymously completing the questionnaires.

Results

Of the 20 participants, 19 completed questionnaires. Overall results showed all 19 respondents indicating a "very good" or "good" overall impression of the SEAD Program (Figure 1), and a total of 17 participants "strongly agreed" or "agreed" that the Program increased their interest in surgery (Figure 2). When asked "What was the most favourite component of the SEAD Program?", free-form responses showed the word "workshops" appearing 16 times out of a total of 19 responses.

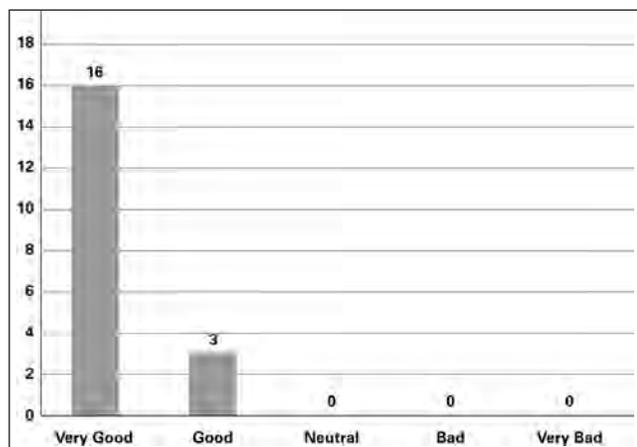


Figure 1. Overall impression of the SEAD Program (N=19)

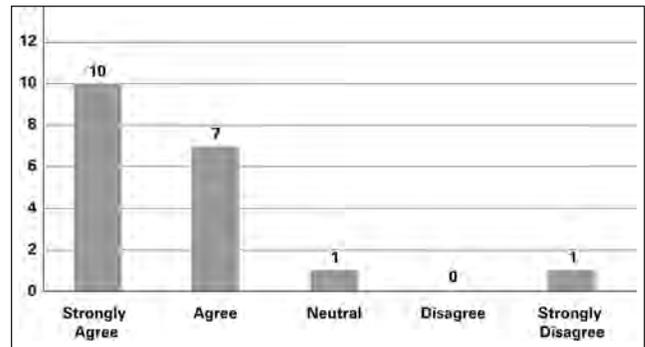


Figure 2. Responses to "The SEAD Program increased my interest in a career in surgery" (N=19)

Workshop Questionnaire Results

Thematic analysis uncovered three positive and three negative themes. Positive themes were those which students associated with the success of the program, or those which they felt should be sustained in future iterations of the SEAD program. On the other hand, negative themes were those which participants identified as areas for improvement, or which they thought decreased the effectiveness of the program. The most commonly cited positive and negative themes are listed in Table 2.

Table 2. Summary of Themes

Positive Themes	Negative Themes
Staff/residents	Time
Type of skills	Equipment/resources
Hands-on experience	Quality of teaching/instruction

Positive Themes

The most commonly identified words associated with positive participant feedback were "residents" (13 occurrences), "skills" (8 occurrences), and "hands" (7 occurrences). These corresponded to the themes of "the personnel present", "the types of skills taught", and "the hands-on experience provided".

Negative Themes

The most commonly identified words associated with negative participant feedback were "more" (14 occurrences), "time" (5 occurrences), and "instructions" (3 occurrences). These corresponded to the themes of "inadequate time", "unmet equipment/resource needs", and "poor teaching/instruction".

Discussion

Hands-on surgical experience has been shown to have a positive influence on medical students choosing to pursue a surgical career. Using the University of Toronto's SEAD Program as the means to carry out the study, our purpose

was to ascertain the aspects of surgical simulation activities contributing to a quality experience for pre-clerkship medical students. The results from our thematic analysis suggest participants enjoyed the hands-on experience, the variety of skills taught, and the informal teaching from staff and residents. Areas where participants desired improvement include an inadequate amount of allotted time, poor instruction from some workshop teachers, and poor quality of some of the workshop materials.

The access to hands-on skills training was crucial to the success of the program, as most students particularly enjoyed the workshops. The benefits of hands-on experience through simulation-based learning has been shown to foster a positive attitude towards, and increased interest in, a career in surgery – a trend further supported in this study. Hands-on sessions allowed participants to learn by active participation, in contrast to the majority of their didactic lecture-based curriculum during the pre-clerkship years.^{2,10-12} The immediate feedback given by staff and residents provided an opportunity to improve students' skills, and familiarized them with the learning process inherent in surgical and procedural education. Consequently, students gained insight into their own preferences towards kinesthetic learning and the immediate gratification associated with physical interventions such as surgical procedures. This connection between kinesthetic learning and immediate gratification is important in surgical training. As such, educational components of surgical programs could benefit from the inclusion of introductory simulation for their undergraduate medical students.

Furthermore, the variety of skills taught from each of the surgical programs were viewed positively. The SEAD Program workshops followed a design of progressive skill attainment and complexity – advancing from basic suturing to laparoscopy, z-plasty, and microsuturing, before transitioning to specialty-specific skills such as arterial anastomosis. This facilitated the involvement of relatively inexperienced students in the more advanced workshop skill sessions. Furthermore, access to a state-of-the-art surgical simulation centre used by the Department of Surgery at the University of Toronto provided a high-quality experience with activities that are rarely, if ever, available to students in their pre-clerkship years (e.g. laparoscopy, robotic simulations, artificial valve replacement). Overall, students gained exposure to the basic skill set relevant to various surgical subspecialties. This enabled students to self-select the complement of skills they most enjoyed, and may have provided some insight into which surgical subspecialties they might be interested in. This is concordant with studies that investigated medical student focused educational programs in vascular surgery, which exposed participants to endovascular simulator train-

ing.^{11,12} These studies conclude that mentored exposure to simulated procedures in specific skill sets positively impact the long-term attitudes and interest of medical students towards vascular surgery. Thus, simulation variety, useful models, and quality of facilities and materials are important for a positive workshop experience.

In addition, effective staff and resident teachers were imperative to the success of a simulation pre-clerkship surgical program. Career talks, which were integrated in the workshops preceding the skills sessions, were viewed as an informative overview of each surgical specialty. All instructors were recruited on a volunteer basis, and thus those who participated were greatly motivated. Accordingly, their strong advocacy for – as well as honest critiques of – their respective programs was well received by the participants. Students also expressed positive feedback with regards to the teacher-to-student ratio. The one-on-one time with staff and residents in an informal environment gave the opportunity for personal and career questions to be discussed.

Participants expressed constructive feedback regarding several aspects of the program, namely time constraints, resource needs, and variability in the quality of instruction. While many stations seemed to provide students with an introduction to the skill, some did not necessarily allow sufficient time for a full experience or skill acquisition. Students described frustration with having only a few attempts to try a skill before having to move on. There will inevitably be a compromise between the quantity of time spent at each station and the number of stations that the program can accommodate. In the future, exploring the possibility of expanding the timeframe of the program may remedy this issue.

Another negative aspect identified by students was some stations having a high learner-to-simulator ratio, preventing them from receiving sufficient hands-on time and adequate immersion. Additionally, some concerns were raised regarding the quality of some training materials made available by the simulation center. These materials, which had been previously used by senior medical students in their own training, were described as being in poor condition, thus impeding learning. A significant resource investment is required to build and maintain a high-quality experience that meets the learning needs of all 20 participants. Thus, expansion and quality control of seminar materials is required and may be an issue to focus upon for subsequent years.

Finally, with regards to the workshop instruction quality, several factors may have been responsible for the negative feedback from some students. The workshop activities were adapted from resident surgical training programs, and may have been too advanced for first year medical trainees. Yet we feel it is still valuable to provide early experience to

some of these skills at a lower level. In addition, while workshops were designed to cover similar topics, the program did not have a formal curriculum with objectives to ensure consistency of each workshop iteration. Therefore, clearly outlined goals and objectives for each session would be helpful. Similarly, a combination of structured and unstructured time with the equipment may yield a good balance, and achieve maximal results. Overall, there may be a need for a formal mini-curriculum to help guide consistent quality instruction and teaching of these skills, while being adapted at a more appropriate level.

All students had a favourable impression of the Program, and the majority stated that it increased their interest in a surgical career. Though not the focus of this study, this feedback is promising as it demonstrates an overall positive impact of the Program on pre-clerkship medical students. Furthermore, only a select number of students could participate due to resource limitations. As our colleagues Gawad et al. identify, additional resources to allow running multiple iterations of the program could remedy this issues.⁸ Going forward, awareness of the positive and negative themes borne from this study would be helpful in the creation of quality surgical simulation workshops for pre-clerkship medical students.

Study Limitations

Due to inherent resource limitations, there was a small participant size (20 students) and in turn, a small sample size (N=19). As the SEAD Program is the first of its kind in Canadian undergraduate medical education, there is a lack of generalizability. In addition, the nature of recruitment for the program may have led to a selection bias of participants, with those already having an interest in surgery likely self-selecting to be involved in the program. However, this degree of homogeneity amongst the study cohort does allow for comparison of responses.

As mentioned previously, there was a lack of formal educational objectives, which may have prevented evaluation of whether students met specific objectives. Finally, data collection involved only a short survey, while more rigorous tools such as focus groups or interviews may have yielded greater findings. Also, data triangulation was performed between only three co-investigators, limiting the depth of the analysis. Overall, the study results would have greater generalizability and applicability had there been a greater sample size, more variability in participants (e.g. inclusion of more students not initially interested in surgery), tracking surgical interest over time with several iterations of the program, and comparing data with CaRMS match results.

Conclusion

Given the importance of hands-on involvement on increasing interest in and exposure to surgery, optimizing the quality of surgical education experiences among pre-clerkship medical students is an essential consideration. In this preliminary analysis, we identified three positive themes (high-quality instructors, type of skills, and hands-on experience), and three negative themes (minimizing time limitations, resource limitations, and poor instructors) worth considering to help improve the quality of simulation activities. Further study is needed to include larger and more varied sample sizes, coupled with long-term and CaRMS match data to support the quality factors we have identified as being important to introductory surgical simulation experiences.

Acknowledgements

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Investigating Barriers to Volunteerism in a Medical School Volunteer Patient Program: A Program Development Project

Travis Schroeder, MD¹; Ravjot Dhatt, MD¹; Jean Hudson, MD¹; Joyce Nyhof-Young, PhD¹

¹Faculty of Medicine, University of Toronto

Abstract

Background: Volunteer patients (VPs) are commonly used for the education of pre-clerkship medical students to facilitate realistic, one-on-one learning. They are available at no cost and are often enthusiastic educators of future physicians. Exposure to socio-culturally diverse VPs will help to prepare students for the patient diversity of medical practice.

Methods: In June 2012, the Mississauga Academy of Medicine in the Faculty of Medicine of the University of Toronto launched a volunteer patient recruitment program to recruit more socio-culturally diverse VPs. To understand barriers to volunteerism and garner suggestions for improving and expanding the program, the existing 85 VPs were surveyed in the spring of 2013 using semi-structured questionnaires.

Results: The response rate was 41%. Most VPs were Caucasian (74%), spoke English as their first language (83%), and had post-secondary education (85%). Most VPs agreed or strongly agreed that they enjoyed the volunteer experience (89%) and were likely to volunteer again (94%). Top perceived participation barriers were lack of program awareness in the community, educational session timing during working hours, and privacy concerns. Key program improvement suggestions were advertising, recruiting, improving communication with volunteers, and accommodating cultural preferences.

Conclusions: The majority of VPs had a positive experience and they provided constructive recommendation for program improvement. Targeted recruitment strategies to increase VP diversity are being developed.

Introduction

The Mississauga Academy of Medicine (MAM) in the Faculty of Medicine of the University of Toronto opened in the fall of 2011 with 54 first year medical students. As a new satellite campus, MAM strives to prepare medical students for rewarding careers as knowledgeable, competent, and culturally sensitive physicians.¹ Mississauga is one of the most diverse communities in the Greater Toronto region and has the highest percentages of Roman Catholic, Muslim, Hindu, and Sikh populations in Ontario.² Almost half (47%) of the population has a mother tongue other than English or French, and 27% speak a non-official language at home.³ The top five non-official languages spoken in Mississauga are Chinese languages, Urdu, Polish, Punjabi, and Arabic.³ To help better educate and prepare trainees for such diversity, students need opportunities to interact with and learn from the different cultural and linguistic communities they will be caring for.

Because University of Toronto medical students spend most of their first two years in a didactic learning environment, exposure to diverse patients reflective of the surrounding community is critical during their clinical skills courses to improve their knowledge and practical skills and help them better understand their therapeutic roles.⁴ Therefore, first and second year students at the MAM also have educational interactions with standardized patients (SPs), inpatients, and volunteer patients (VPs).

Standardized Patients, Inpatients, and Volunteer Patients

SPs are paid professional actors who generally participate in more difficult or invasive sessions such as psychiatric interviews or breast examinations. They can be an expensive resource and while reliable and relatively easy to schedule, can sometimes lack authenticity.⁵ Conversely, although inpatients have authentic medical histories and physical findings, they are unpredictable to schedule, given unpredictable timing of therapeutic procedures and tests, and are often too ill to participate in certain physical exam maneuvers. Furthermore, finding appropriate inpatients for student interviews can be time consuming for instructors.

VPs combine the educational strengths of both SPs and inpatients. They are available at little or no cost, are generally in

stable or good health, can be booked in advance, and are often enthusiastic participants in physician education. Furthermore, exposure to local VPs from a wide range of ages, races, cultures, religions, and illness experiences helps prepare students for the diversity of patients they will encounter in clerkship and medical practice. The benefits of VP involvement led the MAM to found a program called “Patients Playing a Part” (PPP) to recruit and retain VPs.

Patients Playing a Part Program

The PPP program consists of 85 community volunteers who are healthy or have a range of diseases or conditions. They act as ‘patients’ in simulated clinical encounters with first and second year medical students, thereby enabling the students to practice history taking and physical examination skills. All information shared by the VPs in these educational sessions is confidential. VPs are booked two to three weeks in advance by the Medical Education Office at Trillium Health Partners for three-hour sessions. Clinical skills classes are held twice per week during the school year and volunteers are free to share as much or as little of their medical histories as they feel comfortable with, making the encounter highly authentic.

Benefits of Medical Student Interaction with Diverse Patient Populations

Medical students can benefit from practicing examination skills with refugee and minority patients by developing more effective communication skills and awareness of potential clinical power imbalances.⁶ Such understandings are crucial for the development of culturally competent physicians, which is a prioritized outcome of both Canadian and American medical curricula.⁷ In addition, participation in volunteer patient programs appears to positively impact the health of the volunteers themselves. For instance, members of minority populations involved in healthcare training can become more responsive to and understanding of health programs and health recommendations.⁸

Study Rationale

In light of the importance of the PPP program, this investigation aimed to categorize the existing VPs and identify participation barriers, motivators, and strategies to increase participation in the PPP program. Secondary objectives were to assess the volunteer experience and to increase the number and diversity of VPs. Our overarching goals were to improve community engagement in the PPP program and thereby increase exposure of MAM students to a more diverse VP population. Knowledge of the barriers to VP participation and how to address them could improve recruitment and retention of this low-cost and reliable pool of patients, improve community engagement with the medical school, and, in the long run, improve health generally through the development of more competent, knowledgeable physicians. We sought to determine

what the barriers and motivators are for VP participation at the MAM and assess how their characteristics influence engagement in the PPP program.

Methods

Research ethics approval was obtained from the Trillium Health Partners.

Study Population: 85 VPs from the PPP in Mississauga were surveyed in the spring of 2013 for their knowledge and insights about the program and their abilities to make suggestions for improvement.

Study Protocol: Recruitment packages were created and sent to the VPs by the Medical Education Office at Trillium Health Partners. Each contained an information and consent letter, an anonymous survey, and a stamped self-addressed envelope for completed survey return.

Survey: The semi-structured survey requested demographic, Likert-scale, and short answer responses. Requested demographic information included: sex, age, employment status, income range, level of education, marital status, country of birth, first language spoken at home, ethnicity, and number of volunteer sessions completed. Likert-scale questions investigated the volunteer experience and motivators and barriers to volunteerism. Short answer questions encouraged VPs to respond in more detail.

Data Analysis: Demographic data were analyzed with basic descriptive statistics. Respondents ranked their answers to Likert questions as strongly disagree (SD), disagree (D), neutral (N), agree (A), strongly agree (SA) or not applicable (NA). Responses were grouped into four categories: SD+D, N, A+SA and NA. Short answer responses were analyzed using descriptive thematic analysis, in which written responses were coded line by line, grouped into categories and then larger themes.⁹

Two investigators (TS+RD) analyzed all data separately and then compared results to limit errors and bias. Furthermore, coding of all written responses was reviewed with the broader project team (JH+JNY).

Results

The survey response rate was 41% (35/85). The mean age of volunteers was 59 (range 21-87 years, median 64 years).

Table 1. Participant Demographics

Demographic data show that the majority of VPs identify as white (74%), are retired (66%), speak English at home (83%), are Canadian born (63%), and have university level education (71%). Roughly equal numbers of males and females responded. Three respondents had not yet participated as VPs and were awaiting contact by the medical school. The five individuals in the ‘Other’ category for country of birth were born in Egypt, Indonesia, Iraq, Trinidad, and Philippines. The six non-native English speakers spoke Polish, Arabic, Indonesian, Urdu, Telugu, and Tagalog.

Table 1. Participant Demographics

Sex	Respondents	
	Number	%
Male	16	46%
Female	19	54%
Number of Times Volunteered as VP		
0	3	9%
1	5	14%
2	2	6%
3	5	14%
4+	20	57%
Employment status		
Employed Full-time	1	3%
Employed part-time	2	6%
Self-employed	3	9%
Unemployed	1	3%
Full-time homemaker	3	9%
Retired	23	66%
Student	1	3%
Disability	1	3%
Annual Household Income Before Taxes		
Under \$25,000	5	14%
\$25,000 - \$49,999	2	6%
\$50,000 - \$74,999	7	20%
\$75,000 - \$99,999	3	9%
\$100,000 - \$124,999	3	9%
\$125,000 - \$149,999	1	3%
\$150,000 or more	3	9%
Prefer not answer	11	31%
Highest Level of Education Completed		
High School or less	5	14%
Vocation/trade/technical school	4	11%
University – undergraduate	14	40%
Post graduate/Professional	11	31%
Prefer not to answer	1	3%
Marital Status		
Single, never married	2	6%
Married/common law	25	71%
Widowed	3	9%
Divorced/separated	4	11%
Prefer not to answer	1	3%
Country of Birth		
Canada	22	63%
United Kingdom	5	14%
India	3	9%
Other	5	14%
First Language Spoken at Home		
English	29	83%
Non-English	6	17%
Ethnicity		
White	26	74%
Arabic	2	6%
South Asian	3	9%
Chinese	1	3%
West Indian	1	3%
Filipino	1	3%
Prefer not to answer	1	3%

Figure 1. Volunteer patient opinions about their experiences with the PPP program

Nearly all VPs agreed or strongly agreed with the following statements: I am likely to volunteer again (94%), the sign-up process was easy (91%), I am treated respectfully by students (91%), I am likely to recommend the PPP program to a friend (89%), I am treated respectfully by administrative staff (89%), I enjoyed the volunteer experience (89%), and I was treated respectfully by physicians (86%).

Figure 2. Volunteer patient opinions about their motivation for volunteering with the PPP program

The main motivators for VPs who volunteered were to improve the quality of the healthcare system (91%) and to feel good about themselves (65%). Few VPs stated they were volunteering to fulfill a religious belief or obligation (3%), to improve their resume (9%), or because they have friends (9%) or family (11%) who have volunteered.

Figure 3. Volunteer patient opinions about what prevents people from volunteering with the PPP program

The major barriers to volunteerism stated by VPs were: lack of awareness about the program (88%), not knowing how to volunteer (88%), not being able to afford time off work (85%), not being allowed time off work (82%), inconvenient timing of sessions (79%), not being able to commit long term (79%), and discomfort with student touch (77%). 69% of respondents agreed or strongly agreed that privacy concerns were a barrier to volunteering.

Similarly, short answer responses indicated that the top four barriers to participation were: awareness, timing, privacy, and communication:

1. *Awareness:* Volunteers believed that “the public in general are just not aware of the program.” One VP said: “No one I’ve told about the program knew it existed... awareness is not huge.”
2. *Timing:* VPs reported the timing of the volunteer sessions (Thursday and Friday mornings) as prohibitive. One VP stated, “The time factor is the greatest deterrent – younger people are at work and cannot take time off. Seniors already volunteering do not want to take on additional responsibility. Many think it’s a great program but do not follow up on it.”
3. *Privacy:* Many people have different comfort levels with physical touch and personal disclosure and “many people are very private about their bodies.” The program is off-putting to those who do not want to discuss their personal health or have students touch them. VPs pointed out that these privacy concerns might be exacerbated by gender differences between students and VPs.
4. *Communication:* Several volunteers felt they “weren’t well informed” about their VP role and lacked “preparation and instruction”. One VP also stated that slow program follow-up after sign up and before volunteering was a concern.

The top four suggestions for program improvement were advertising, recruiting, communication and preparation, and cultural adaptation:

1. *Advertising:* To increase program awareness, VPs suggested a widespread advertising campaign “in churches, temples, and synagogues” as well as “doctor’s offices, pharmacies, and walk-in clinics.” One VP suggested the program should partner with a local community college to develop more effective marketing. The overall sentiment was that “this worthy program needs a lot more hype.”
2. *Recruiting:* VPs believed that family physicians tutoring in the MAM program “will know best who among their patients will enjoy and be most suitable” for the PPP program. They also suggested involving medical students in recruiting, as “many of your students seem to be representative of Canada’s cultural diversity ... Could they act as ambassadors of the program through cultural newsletters, groups, and media?”
3. *Communication and Preparation:* VPs would like more coaching regarding their roles and what is expected of them. For instance, “It would be helpful to know what to expect, specifically, when you come, i.e., ‘Students will be performing a head and neck examination. Please wear a shirt with a loose collar or a t-shirt type top.’”
4. *Cultural Adaptation:* To ensure VPs from particular cultural and religious groups have their traditions respected, it was suggested the program accommodate VPs preferences for medical student gender: “Perhaps making female students and physicians available for women of certain cultural groups might increase their willingness to participate.”

Discussion

As measured by demographics, education, and employment, this study demonstrates relative lack of engagement in the PPP program by non-white and low socioeconomic status (SES) individuals (Table 1). To diversify the VP population to match the diversity of Mississauga, the PPP program will need to target recruitment efforts to minority groups, as well as to people of lower SES.

To prepare medical students to serve their local community, VPs from a wide range of ages, cultures, and SES should be recruited. Data indicated the current VP pool is primarily composed of white, educated, and retired individuals who were born in Canada and whose mother tongue is English.

Comparing demographics of our study population to the overall population in Mississauga confirms that our VP pool is not reflective of the local community. Their median age was 64, while the median age in Mississauga is 38.¹⁰ In Mississauga, just over two thirds of the population aged 25-64 has post-secondary education, compared to 85% of VPs.¹¹ Finally, 23% of VPs identified as visible minorities, while 49% of Mississauga’s population are visible minorities.¹²

Primary volunteering motivators were to improve the quality of the healthcare system and to feel good about contributing.

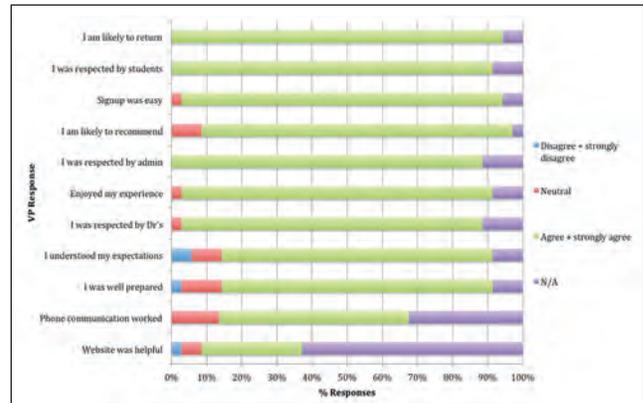


Figure 1. Volunteer patient opinions about their experiences with the PPP program.

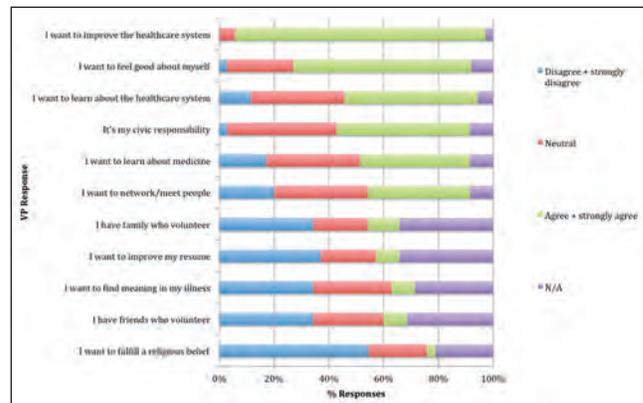


Figure 2. Volunteer patient opinions about their motivation for volunteering with the PPP program.

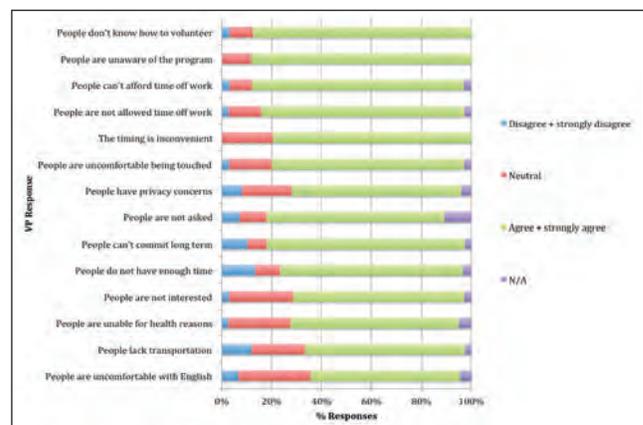


Figure 3. Volunteer patient opinions about what prevents people from volunteering with the PPP program.

Notably, only three VPs expressed being motivated by a desire to improve their resume and only one reported volunteering to fulfill a religious belief. Top participation barriers included lack of program awareness, difficult timing of volunteer sessions, privacy concerns, and lack of program communication about volunteer role expectations. The vast majority of volunteers stated they enjoyed their experiences and were likely to

return in the future. They felt respected by staff and students and would recommend the program to friends and family. Most VPs felt well prepared and knew what was expected of them, however several desired more preparation and training. These results give us confidence that the internal barriers to participation in the program are minimal.

The study was limited by a 41% response rate. Given the fact that the majority of our respondents were retired, we cannot assume the opinions of youth or working age community members are accurately represented. It may be that younger, visible minority volunteers or those with lower education levels chose not to respond due to lack of time or work commitments. VPs were asked to respond to the survey only once, however it is possible that some may have responded multiple times, thus skewing the results toward their responses. Finally, one must take into account that those responding to the questionnaire had already committed to volunteer and therefore would be more likely to view the program favorably.

Our results are generally consistent with pre-existing literature. Previous studies indicate that volunteer patients enjoy their experience, have positive attitudes toward participating in medical education, and want to play active roles in teaching.¹³⁻¹⁵ Prior studies showed that volunteers' satisfaction increased if they received written information prior to participation.¹³ Privacy and confidentiality concerns are also common.¹³ Our results may be particularly relevant to hospitals and medical schools initiating volunteer patient programs.

This study resulted in several recommendations for recruiting more diverse VPs for medical education purposes:

1. Engage in a widespread, culturally diverse advertising campaign. Consider partnering with communications or graphic arts programs to design effective marketing strategies. Advertise in multiple languages and place flyers or brochures in popular, culturally diverse places. Medical students could also be encouraged to spread the word about the program, as they belong to diverse communities and interact with community agencies during their training.
2. Consider holding clinical sessions on evenings and/or weekends. This would allow more working individuals to volunteer and potentially give students a more realistic view of community demographics.
3. Clearly communicate program expectations to VPs and provide options to participate in sessions suiting their physical comfort levels and privacy concerns. Inform them of the type of clothing to be worn to each session and whether or not changing into a gown will be requested. Maintain accurate volunteer demographic profiles so that cultural and religious preferences can be respected and gaps in VP demographics can be more readily assessed and addressed.
4. Consider holding clinical sessions with volunteers who do not speak English as their first language. Students could learn to interact with patients through an interpreter and VPs could have an opportunity to improve their English skills.

Conclusions

The MAM's new volunteer patient program consists of volunteers who are more educated and less culturally diverse than the surrounding community. Volunteer patients generally had a positive experience with the program and are a valuable source of information for program assessment and improvement. The main barriers to volunteering were lack of awareness of the program, session timing, privacy concerns, and sub-optimal communication. Solutions to overcome these barriers include better advertising, recruiting, communication, and preparation of VPs, as well as accommodating VP preference for medical student gender. Our results can be particularly beneficial to established medical schools and hospitals, and new medical school satellite campuses or hospitals that may be looking to initiate volunteer patient programs.

Conflict of Interest

There are no conflicts of interest to declare. This project was unfunded. Travis and Ravjot were medical students at the University of Toronto who conducted this study in partial fulfillment of their Year 2 Determinants of Community Health course.

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Quality Improvement Training in Medical Education: The Evidence and a Personal Experience

Marina Abdel Malak, RN, BSc. N, MD Candidate¹

¹University of Toronto

Quality in healthcare is aimed at ensuring that appropriate care and interventions are delivered to each patient, according to their needs and the available resources.¹ Quality improvement (QI) therefore refers to initiatives that promote effective, safe, timely, equitable, and efficient patient-centered care.

An excellent repository for learning about past quality improvement projects in healthcare is ShareIDEAS - Improving and Driving Excellence Across Sectors (shareideas.ca). Participants in QI projects can submit their project experiences to this site, which is available to the public. An example of a successful QI project, which is featured on the ShareIDEAS website, occurred in the Toronto Central Local Health Integrated Network (LHIN), where all nurses were instructed to specifically remind each patient to bring all his or her medications to the next appointment. This simple change resulted in more accurate medication reconciliation records, which reduced the incidence of medication errors. Another QI project in Champlain, for example, provided healthcare providers with education on how to utilize psychiatric screening tools in patient encounters. This education resulted in more patients being correctly identified as struggling with a mental health disorder, and therefore, increased the number of referrals made, which resulted in patients receiving treatment and support for their illnesses. These are only two simple examples of how QI projects can have important impacts on patient care and outcomes.

During their careers, physicians will be faced with a variety of situations that will require them to decide which interventions are the most appropriate for their patients. At times, physicians may question whether current practices and routines are truly efficient and effective, and if there are 'better ways' of doing things that can lead to improved patient outcomes.² This is the first step in QI: realizing that something might not be as effective as was once thought, and then taking steps to determine if specific changes produce better results. For example, a physician might realize that patients are not being routinely asked about their allergies. Upon investigating the problem, brainstorming causes, consulting with the healthcare team, and addressing the literature, the physician determines that one potentially useful intervention would be to incorporate this question as a reminder in the electronic medical record (EMR). The physician and healthcare team take necessary steps to modify the EMR to include the prompt, and then test the idea to determine whether

or not it results in significant change. Once the data is collected, an analysis should be undertaken to see if the change is effective, appropriate, and worth implementing into practice.³ If the change is effective, the team can continue with the proposed change and monitor it for sustainability. If the change was not successful or feasible to sustain, the team can propose another test of change, thereby beginning the process of QI again.

It has been suggested that training and educating physicians in QI should begin, at the very latest, during residency, in order to ensure that trainees are familiar with the processes before entering clinical practice.⁴ In fact, the Royal College of Physicians and Surgeons of Canada has mandated that engaging in QI contributes to the core competencies of physicians as leaders, medical experts, scholars, advocates, collaborators, communicators, and professionals – effectively summarized as the 'CANMEDS' roles.⁵ Thus, there is an impetus for residents to be educated in QI during their training.

How should QI training occur, and in what format? Medical education institutions differ in their approaches to this: some use structured lectures, others utilize online modules to deliver QI content, and still others adopt a blended curricular approach. Each approach certainly has its own advantages and disadvantages. Interestingly, there is data to support the effectiveness of all of these approaches, illustrating that ultimately, the approach chosen should be appropriate for the institution's available resources, residents, and faculty.⁶

When designing and developing or modifying the QI curriculum that is taught to residents, educational institutions will undoubtedly have to make decisions about the structure of the curricula. For example, should residents choose a problem in their current training setting and address it, or should they simply receive education on what QI is? As the QI curriculum is developed, attention to available resources is essential. Does the hospital or healthcare institution have available and interested faculty members who are able to teach QI to residents, and is there sufficient technological expertise (i.e. a technology expert) that will facilitate online learning or resource access for residents? These are just a few of the factors that institutions must consider when designing, developing, and incorporating the QI curriculum into resident training. Throughout this process, ensuring that the curriculum is relevant to residents, and enabling them to understand how they can apply QI into the future practice, is critical.⁷

Teaching **QI** to residents is not an easy process, and frustrations will occur. Barriers and challenges include a lack of time in resident and faculty schedules, ensuring the curriculum is relevant to residents, and educating faculty members in **QI** prior to expecting them to teach it, among others. There are numerous approaches to addressing these concerns, and institutions should elicit feedback from both faculty and residents in order to ensure that the **QI** education is best tailored to their unique context, needs, resources, strengths, and perspectives.⁸ For example, providing training sessions for faculty members allows them to learn how they can best support medical students in learning about **QI**. Eliciting feedback from medical students on their **QI** experiences can provide institutions with information on what is going well, as well as what can be improved in the future.

The benefit realized from the investment in **QI** education for residents is impactful. The literature describes that residents engaging in **QI** projects report an increase in confidence in their knowledge and skills, and demonstrate an appreciation for **QI** in their future clinical practice.⁹ Zenlea et al. (2014) found that 46% of medical students reported **QI** training and projects to be just as important as formal, clinical curricula. Furthermore, receiving education on and completing **QI** projects improves the delivery of healthcare services and contributes to positive patient and healthcare outcomes. Moreover, encouraging residents to identify potential areas of improvement within practice settings, outlining and testing steps that address these challenges, and evaluating the impact of the interventions promotes a culture of inquisitiveness and leadership among future physicians.¹⁰ By teaching residents about **QI** during their training and engaging them in these initiatives, medical institutions help their residents gain an appreciation for their role as physicians who are competent leaders and patient advocates, and who contribute to a culture that provides safe, effective, and patient-centered care.

This summer, I joined the **QI** Program team at the Department of Family and Community Medicine (DFCM) at University of Toronto and contributed to a project related to quality improvement education and curriculum development for residents. This opportunity exposed me to the field of quality improvement, and allowed me to appreciate the importance of **QI** in healthcare. As medical students and professionals, we often feel that our work is divided between clinical practice, research, and/or academic education. Prior to this experience with the DFCM team, I did not consider **QI** as an activity that I would engage in as a student, or as a physician. However, after working on the project I began to see things differently. For example, when discussing potential changes or improvements to the curriculum, it was important to consider not only the evidence from literature, but also the people invested in the project - the residents, the faculty who teach the **QI** curriculum and supervise project work and the supporting academic site teams who partner with residents to complete **QI** projects. Addressing all of these perspectives enabled me to understand that although

one approach to teaching **QI** might be satisfactory to a certain institution, it may not be suitable for all academic organizations. Therefore, **QI**, like other areas in medicine, is never a ‘one-size fits all’ endeavour. Rather, one must approach teaching **QI** in a manner that is flexible, adaptable, relevant, and exciting. As a student, I realized the importance of reflection and evaluation in **QI**, like in all other parts of medicine. In this manner, one can very much see the connection between **QI** to various goals of being a healthcare provider: making things better, safer, and more efficient and productive for patients and for ourselves. All physicians can engage in **QI** as part of their journey in healthcare!

These pearls are something I will carry with me as I continue throughout my journey as a medical student, as I believe that **QI** plays a major role in our work as physicians. The wonderful thing about **QI** is that I need not wait until I practice as a physician in order to engage in it – I can start now. All it takes is identifying an opportunity for improvement – a stimulus for change. Then it is simply a matter of contemplating what changes might result in improvement, testing the changed ideas, evaluating the results, and reflecting on whether or not those changes were effective and if/how they can be applied in practice more broadly and sustainably. This is what I find so interesting and exciting about **QI** – it is similar to what physicians do in everyday practice: they see patients, consider what interventions can be effective for the current issue, ‘test’ a specific treatment option, and then evaluate the outcome! Thus, **QI** really is not much different from the ‘typical clinical’ work that we often associate with being a physician. It is, ultimately a matter of assessment (‘taking a history’ with patients, or considering the issue for a **QI** initiative), diagnosing, planning, and intervening (making the changes, testing out interventions or plans), and evaluating the outcomes. Put in this light, medical students and professionals alike can appreciate the importance and relevance of **QI** in clinical practice – just as I do.

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What's the Job Market in Surgery like in Canada?

Ben Li, MD Candidate¹

¹Faculty of Medicine, University of Toronto

Introduction

There is increasing concern amongst medical students interested in surgery that they will have difficulty finding a job in the future. This article highlights the most recent data on employment challenges for newly graduated surgeons in Canada.

In 2011, the *Globe and Mail* published an article titled *Canadian surgeons face flat-lining job market*,¹ recounting anecdotes of how newly graduated orthopedic surgeons are unable to find jobs. Similarly, the *National Post* published an article in 2015 called *Untrained and unemployed: Medical schools churning out doctors who can't find residencies and full-time positions*,² describing head and neck surgeons who struggle to find work and citing 178 orthopedic surgeons in Canada who are unemployed. These articles are based on several studies looking at employment statistics of newly graduated Canadian surgeons.

A survey of 176 orthopedic surgeons in Canada who graduated between 2006 and 2011 showed that only 56% had secured employment, 35% were completing a fellowship or graduate degree, and 9% had not found a job.³ Of those who were unable to secure a job, 69% were taking on-call shifts and 31% had no work at all.³ Less than half of the graduates had full time work.³

A study of 50 cardiac surgeons in Canada who graduated between 2002 and 2008 found that 98% of graduates stated that finding employment was difficult or extremely difficult.⁴ Sixty-four percent believed that there is an excess of cardiac surgeons in Canada.⁴

These news articles and statistics suggest that there are significant employment challenges for surgeons. Given that there are real difficulties amongst new graduates, it is important to understand the perception of the job market for those still in surgical residency.

2013 Resident Doctors of Canada national survey of Canadian residents

In 2013, Resident Doctors of Canada, a national representative body of over 8,000 residents in Canada, conducted a national survey of 1,975 residents to understand the perception of employment opportunities amongst medical trainees.

Table 1, Table 2 and Table 3 compare the results of residents in family medicine, medicine, and surgery.

Table 1. Confidence of residents in finding employment in Canada after completing residency. Adapted from Resident Doctors of Canada: 2013 National Resident Survey.⁵

Specialty	Confident in finding employment	Not confident in finding employment	Unsure
Family Medicine	85%	1%	14%
Medical specialty	37%	10%	53%
Surgical specialty	16%	25%	59%

Table 2. Proportion of residents planning on undertaking a fellowship after completing residency. Adapted from Resident Doctors of Canada: 2013 National Resident Survey.⁵

Specialty	Planning to undertake a fellowship	Planning not to undertake a fellowship	Unsure
Family Medicine	4%	14%	82%
Medical specialty	46%	21%	33%
Surgical specialty	61%	15%	24%

When asked what prompted their decision to undertake a fellowship, residents responded with the following factors (able to select more than one factor):

- Future employment/career goals (84%)
- Personal interests (67%)
- More training/skills/specialization (63%)
- To help find a staff position (55%)

Table 3. If residents knew at the start of residency there were limited jobs available within their chosen specialty, would they still have chosen it? Adapted from Resident Doctors of Canada: 2013 National Resident Survey.⁵

Specialty	Would still have chosen my current specialty	Would have chosen a different specialty	Unsure
Family Medicine	29.1%	43.4%	27.5%
Medical specialty	46.3%	25.3%	28.3%
Surgical specialty	59.2%	17.4%	23.5%

Corresponding Author:
Ben Li
benx.li@mail.utoronto.ca

These data suggest that surgical residents are less confident in finding employment after graduating and are more likely to pursue a fellowship to become more employable than residents in family medicine or medical specialties. Interestingly, surgical residents are more likely to have chosen their specialty again even if they knew that they would face challenges in finding a job in the future. Though it is unclear why this is the case, it may suggest that surgical residents are less likely to be influenced by employment challenges in their decision to pursue their specialties than residents in family medicine or medical specialties.

Next, it is important to understand the factors contributing to employment challenges amongst surgeons.

2013 Royal College of Physicians and Surgeons of Canada study on unemployed specialists

In 2013, the Royal College of Physicians and Surgeons of Canada published an article titled *What's really behind Canada's unemployed specialists?*⁶ The study aimed to understand the employment challenges of specialists and the factors contributing to these challenges. The authors interviewed 50 leaders in medicine, including program directors and senior hospital administrators, and surveyed over 1,371 newly graduated specialists.

Their research revealed that 16% of new specialist physicians cannot find work and 31% pursue further training to become more employable.⁶ Employment challenges are increasing, with those reporting employment issues increasing from 13% to 17% between 2011 and 2012.⁶ These issues are most pronounced in resource-intensive disciplines such as surgery. Table 4 illustrates the proportion of newly graduated surgeons who are unable to find employment.

Table 4. Proportion of graduating surgeons unable to find a job placement. Adapted from Royal College Employment Survey, 2011 and 2012.⁶

Discipline	Unable to find a job placement
General Surgery	13/46 (28.3%)
Neurosurgery	8/21 (38.1%)
Ophthalmology	13/30 (43.3%)
Orthopedic Surgery	15/60 (25%)
Otolaryngology	5/17 (29.4%)
Urology	6/15 (40%)
Cardiac Surgery	5/5 (100%)

The study identified three factors contributing to employment issues amongst newly graduated specialists:

- 1) More physicians are competing for fewer resources. The health care needs of patients are increasing and the number of newly trained specialists continues to grow, but hospital funding growth cannot keep up. As such, expensive resources such as operating room time are cut.

- 2) Interprofessional care models reduce reliance on physicians. Other health care professionals, such as nurse practitioners and physician assistants, can fulfill the roles physicians used to fulfill. There is also an increasing reliance on residents to meet the immediate needs of patient care, but there is an insufficient number of staff positions available for these residents over the long term.
- 3) Residents report a lack of adequate career counselling and information about jobs. More than 50% of new specialists did not receive any career counselling and more than 33% of unemployed specialists reported that poor access to job postings hampered their ability to find a job.

2016 Ontario Medical Students Association report on physician workforce trends in Ontario

More recently, the Ontario Medical Students Association Education Committee published a 2016 report titled "Insights into physician workforce trends in Ontario,"⁷ which describes employment trends for each specialty in Ontario. The report synthesized information from national physician surveys, key reports from the Canadian Medical Association and the Royal College of Physicians and Surgeons of Canada, and data from the Canadian Resident Matching Service (CaRMS), as well as surveyed Program Directors and residents. Based on this information, a prediction of the job market was made for each specialty ranging from difficult/very difficult to very good/excellent. A summary of the results for surgical specialties, as well as family medicine and internal medicine for comparison, is presented in Table 5.

Table 5. Job prospects in Ontario for surgical specialties, family medicine, and internal medicine. Adapted from the Ontario Medical Students Association Education Committee 2016 report "Insights into physician workforce trends in Ontario."⁷

Specialty	Job prospects
Cardiac surgery	Difficult/very difficult
General surgery	Potentially difficult
Neurosurgery	Difficult/very difficult
Ophthalmology	Good
Orthopedic surgery	Difficult/very difficult
Otolaryngology	Difficult/very difficult
Plastic and reconstructive surgery	Good
Urology	Good
Vascular surgery	Indeterminable
Family medicine	Very good/excellent
Internal medicine	Good

Out of the 9 surgical specialties studied, the report identifies 4 that have difficult/very difficult job prospects. In comparison, family medicine and internal medicine have very good/excellent and good job prospects respectively. Given the recency of the publication of this report, these data reinforce the fact that the job market in surgery continues to be poor.

Discussion

Overall, these data suggest that there is a significant gap in medical workforce planning in Canada. The significant proportion of newly graduated surgeons who are unable to find employment (Table 4) and the low confidence of surgical residents in finding a job after completing their training (Table 1) suggests that there is a systemic problem in the Canadian surgical job market. Since the publication of the 2013 Royal College report⁶ and the results of the 2013 National Resident Survey,⁵ the job market in surgery has not noticeably improved, as demonstrated by the lackluster job prospects in surgery illustrated by the 2016 Ontario Medical Students Association report.⁷ According to the 2013 Royal College report, about 20% of specialists who do not find employment in Canada will look for work outside of the country, particularly in the United States.⁶ There is significant potential for brain drain to the United States given that the Association of American Medical College (AAMC) predicted that the United States would have a shortage of between 61,700 and 94,700 non-primary care specialists by 2025.⁸

Not only does the underemployment of qualified surgeons lead to wastage of the many hours and dollars put into training surgical residents and the potential migration of highly skilled Canadian surgeons to other countries, it reduces patients' access to timely and quality care. Wait times for medical procedures is at a 20-year high according to a study by the Fraser Institute, at 20 weeks, and ranging up to 47 weeks for neurosurgery and 38 weeks for orthopedic surgery.⁹ There are many newly trained surgeons who want to operate but cannot find a job. The current limiting factor is the lack of access to resources such as operating room time and hospital beds.⁶

To address Canada's surgery unemployment problems, medical workforce planning must reconsider how it allocates resources and trains new surgeons. There are complex factors influencing employment for surgeons in Canada, and we have only recently begun to understand the problem. Improving the job market for surgeons will require comprehensive reform to postgraduate medical education, resource allocation,

and career support. Potential solutions include reducing the number of surgical residency spots, increasing the capacity for hiring staff surgeons by reforming remuneration models, improving hospital funding planning so that operating room time is sufficient for the volume of procedures required, and increasing accessibility to career counselling services for medical students and residents.

With the recent increase in the number of reports published on employment challenges for newly graduated surgeons, we can hope that specific problems will be pinpointed and targeted solutions will be implemented to improve the job market in surgery for the next generation of medical students.

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Moving Beyond Geographically Defined Communities to Ensure Equitable Access to Vaccines

Lisa Parvin, M.S.¹

¹The School of Population and Public Health, University of British Columbia

Eradication of smallpox in 1977 gave mankind hope to win the fight against infectious diseases. Remarkable progress has been made in reducing child mortality from vaccine-preventable diseases since then. Every year, an estimated 2 million to 3 million deaths are averted from four vaccine-preventable infectious diseases: diphtheria, tetanus, pertussis, and measles.¹ These achievements, however, are not evenly distributed across all regions of the world or in all communities within a country. Vaccination coverage varies across regions and communities with respect to geographic location, ethnicity, age, sex, education, and other factors. To ensure equitable access to vaccines by all people, regardless of their socioeconomic background or geographic location, 194 countries endorsed The Global Vaccine Action Plan (GVAP) in 2012 at the World Health Assembly.² To achieve GVAP's third strategic objective: "the benefits of immunization are equitably extended to all people," countries have obligations to ensure equitable access to vaccination programs to all their citizens, particularly to those who live in marginalized and inaccessible communities.²

Several studies suggested the need for targeted and tailored interventions and strategies at the community level within a country to ensure all children are getting equitable access to life saving vaccines. A recent study in Bangladesh showed vaccination coverage among 12-23 month old children in Haor areas is 57%, which is much less than the national coverage of 71% at the time of the study.³ Lower vaccination coverage, higher drop-outs, and invalid doses among children living in these low-lying geographically hard-to-reach areas compared to the national average indicate current strategies and programs run by the government are unable to provide equitable access to vaccines.³ In a study in rural Ethiopia, travel time to health posts is found to be a barrier and associated with lower immunization coverage.⁴ This study again sheds light on the issue of modifying the current vaccination delivery strategies to reach geographically isolated and marginalized communities. A study conducted in rural southern Tanzania suggests long distances from a health facility may be a risk factor for low vaccination coverage among children living in rural areas.⁵ High socioeconomic status of the family, however, may be associated with timely vaccination, which is defined as receiving a vaccine within one month of recommended time.⁵ Low vaccination coverage among poorly accessible rural communities indicates much work is yet to be done to achieve GVAP's strategic objectives.

In order to achieve equitable access to vaccines by all people, GVAP recommends recasting the World Health Organization and The United Nations Children's Fund's "Reaching Every District" approach to "Reaching Every Community" with a goal to reach every eligible individual from different geographic locations and socioeconomic backgrounds, including those who reside outside the usual government outreach and therefore considered hard-to-reach.² Success of this recommendation would rely on how effectively national immunization programs are able to identify underserved communities and implement tailored strategies to provide equitable access to vaccines. Most often, vaccine service delivery mechanisms rely on government administrative units, which are frequently geographically-defined. In rural Bangladesh, like many other countries, Expanded Programme on Immunization (EPI) services are offered through EPI outreach sites that are placed in the smallest government administrative units with a catchment of about 1,000 populations.⁶ When it comes to identifying communities at highest risk of inequitable access to vaccines, programs need to move beyond the geographically- defined communities approach and expand the definition based on various other common characteristics such as cultural values, lifestyle choices, and nomadic nature. Disparities may exist among individuals with different cultural values and lifestyles, which may make them more vulnerable than the rest of their community members in the same village, town or city. Studies have shown vaccination coverage among children living in the slums of big cities may vary drastically from the average coverage for that city. A study conducted in two slums in Dhaka, Bangladesh found only 43% of the children were fully vaccinated, as opposed to 82.4% for the Dhaka division.⁷ Such a gap in the vaccination coverage among children living in the same urban area, and often in the same administrative zone, indicates more microscopic views are needed to identify underserved populations in addition to considering the larger geographic locations.

When research is conducted, highly vulnerable communities from similar socioeconomic background are often grouped together and similar strategies are applied for interventions.⁸ Even though these communities share many common characteristics in terms of poverty and poor access to education and health programs, they may be very distinct in their way of living and have their own cultural and social practices. One example of such a group of people are the river gypsies of Bangladesh.

According to a report generated by a local non-governmental organization, vaccination coverage among children of this particular group of people may be as low as 2%.⁹ Challenges and barriers identified as reasons for low vaccine coverage in other marginalized communities may very well be applicable to river gypsy communities, yet they may face a unique set of challenges due to their nomadic life or recent integration into the broader society. Strategies that have worked for other rural communities may or may not work for those who are largely socially excluded, lack access to education and live among their own in clusters near river banks.¹⁰ Children of migrant workers in the Tak province of Thailand are another example of a highly marginalized and vulnerable population facing barriers in accessing routine vaccination programs which are unique to their context, such as continued migration and fear of getting arrested.¹¹

Previous initiatives and approaches, such as the “Reaching Every District” approach have been successful in increasing vaccination coverage through outreach programs, district-level planning and provision of immunization programs and resources at district and sub-district levels.² Building upon their success, GVAP recommends to recognize barriers that communities outside of government outreach face in accessing routine vaccination programs, and to provide equitable access to vaccines by implementing tailored strategies depending on their local contexts.² Use of modern information technology has been recommended to generate immunization registries, to track an eligible person’s immunization status, and to send tailored messages as reminders.² Use of mobile phones was proven to be a useful tool to increase vaccination coverage among rural, hard-to-reach populations and urban slum dwellers of Bangladesh by sending reminders through short text messages or images and by tracking the immunization status of the study population.¹² Involvement of community members throughout the program development and implementation phase to understand the local contexts, community members’ needs, and to build trusted relationships, has proven to be another successful strategy to reach marginalized communities. A targeted intervention to reach nomadic tribes of Chad in response to a polio outbreak showed tailored strategies such as using a mobile vaccination team along with trained local nomadic community members to identify settlements and offering vaccines to all children, women, and animals, improved the vaccination coverage among this highly mobile and hard-to-reach population.¹³

Targets are set for both national and district level vaccination coverage to achieve the Decade of Vaccines (2011-2020) vision of “a world in which all individuals and communities enjoy lives free from vaccine-preventable diseases”.² By the end of this decade, vaccination coverage for all vaccines is targeted to be at least 90% at the national level and at least 80% at the district level.² Reaching out to marginalized populations, whose inequitable access to vaccines often is not reflected properly by the national and district level coverage, is crucial to achieve the objectives set forth by GVAP. Greater effort and attention needs to be dedicated to identifying these highly vulnerable individuals and their families, with the help of local advocacy groups and community health workers, and tailored interventions need to be developed in order to fulfill the vision of Decade of Vaccines.

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School Gardening: A Different Approach to Tackle Childhood Obesity?

Maximilian Andreas Storz, MD¹; Eric P. Heymann, MD²

¹Faculty of Medicine, The Saarland University, Homburg, Germany

²Department of Emergency Medicine, University Hospital of Bern, Bern, Switzerland

The global incidence of childhood obesity has dramatically increased within the recent decades.¹ Approximately 43 million pre-school children worldwide were estimated to be overweight and obese in 2010, while another 92 million children were considered at risk of becoming overweight.² According to the World Health Organization, the terms overweight and obesity are defined as abnormal or excessive fat accumulation which presents a risk to human health. The latter has especially been found to be strongly associated with the development of insulin resistance and often results in subsequent diabetes mellitus.^{3,4}

In order to tackle this alarming development, many campaigns and programs have focused on reducing childhood obesity and promoting healthier diets among children in the past. However, since our nutritional behaviors are influenced by a large number of psychosocial factors, this is a challenging issue and a single approach might be insufficient in doing so. A potential way of encouraging children towards a healthier diet, including more fruits and vegetables, is often overlooked: school gardening.

School gardens are gardens that are maintained by students for other students, and are located in the vicinity of a school. They are usually maintained under the supervision of a teacher or an expert in the field. The main aim is to educate children in the production of fruits and vegetables, to promote a healthy diet, and to enhance environmental awareness. Step by step, children are introduced to the subject of horticulture by working together in small groups towards a rewarding goal. A well-structured program combines hands-on work, such as planting, growing, and harvesting organic fruits and vegetables, with interactive cooking and nutrition education lessons.⁵ These lessons include a wide range of topics, ranging from the role of vitamins in our body to healthy family dining habits, or the difference between fresh produce and packaged foods. Since cooking and eating together is an essential part of ev-

ery lesson, children can directly apply their recently acquired knowledge and are able to reap the first fruits of their work.

One major idea behind such projects is to encourage children to eat fresh and non-processed foods that are low in sugar and fat. Plant-based diets that are rich in fruits and vegetables can have substantial health effects, including lowering plasma lipid levels and reducing the risk of coronary artery disease and stroke.^{6,7} Unfortunately, a large number of children currently do not meet the recommended guidelines for fruit and vegetable consumption.⁸ Furthermore, several studies suggested that eating behaviours adopted in childhood may potentially continue into adulthood, suggesting that these behaviours may lead to a further decrease in future consumption of fruits and vegetables by 41% and 25%, respectively.^{9,10} These findings certainly emphasize how crucial it is to promote a healthy diet early on, and this is where school gardening comes into play.

There is growing evidence that school gardening programs have the potential to substantially influence children in their dietary patterns and improve students' knowledge on nutrition.^{5,11,12} For instance, the gardening experience helps children by improving their ability to identify vegetables they usually do not consume on a regular basis, such as cabbage or zucchini.¹³ According to *Ratcliffe et al.*, garden-based education has the potential to increase student's willingness to taste vegetables outside the school setting.¹⁴ Another study compared the effects of a nutrition education curriculum with and without garden activities to each other. Students who participated in a garden-based nutrition intervention program consumed an increased number of servings of fruits and vegetables compared to those students who participated in the nutrition education curriculum alone.¹⁵ Additionally, garden-based education led to a significant increase in the intake of vitamin A, vitamin C, and fiber by students.¹⁵ Not surprisingly, a recent study by *Evans et al.* shows that children who enjoy such activities have the highest level of vegetable exposure, preference, and consumption.¹⁶ Another trial by *Cotter et al.* on salt intake modification by working practices in a school garden is also worth mentioning.¹⁷ Children that were involved in a program combining lectures on the potential dangers of excessive salt intake and regular garden activities, such as cultivating herbs to use as a substitute for salt in food preparation, significantly reduced their salt intake by 1.1 g per day.¹⁷ It is widely accepted that high salt intake

Corresponding Author:
Maximilian Andreas Storz
Faculty of Medicine, The Saarland University, Homburg, Germany
Saarland University Medical Center,
Kirrbergerstrasse 100, 66424-Homburg, Germany
+49 157 / 5454 3852
storzm815@gmail.com

from diet is related to the increasing prevalence of hypertension. Thus, this strategy, which is based on theoretical and practical education, achieved an important reduction in daily salt intake in at least 50% of the participants.¹⁷

Another important point is that gardening activities usually take place outside of the classroom. Stimulating children to increase their physical activity by working together on a rewarding common project is another way to tackle obesity. In a randomized controlled trial, *Gatto et al.* recently investigated the effects of a 12-week gardening intervention on obesity parameters and dietary intake among Hispanic/Latino youth in Los Angeles.¹⁸ Their intervention, better known as “LA Sprouts”, included not only gardening elements but also lessons on nutrition and cooking. Children participating in the “LA Sprouts” intervention experienced a significant reduction in waist circumference (−1.2 cm vs. 0.1 cm in the control group; $P < 0.001$) and in body mass index z-scores (−0.1 vs. −0.04 in the control group; $P = 0.01$). Additionally, a significant increase in dietary fiber intake by 3.4% ($P = 0.04$) was observed in the intervention group.¹⁸

Since school gardening usually implies diversified outdoor activities, children have the opportunity to breathe fresh air while being exposed to the sun and daylight. This enhances vitamin D production and also constitutes a welcome change compared to the usual classes which take place inside. It is noteworthy that garden-based learning does not negatively impact academic performance, as claimed by many critics. On the contrary, it has been shown to enhance improvements in science achievements and math scores.^{19,20} In addition, studies revealed that participating in garden activities supports children in developing important skills that will help them to better navigate the world, including contributing to their communication of knowledge and emotions.²¹ With regards to the potential benefits mentioned above, it is quite disappointing that only a minority of the Canadian schools offered gardening activities in 2013.²² In many cases the implementation of school gardening programs appears to be a challenging task, since there is often a lack of sufficient funding and a suitable location. Moreover, it requires dedicated volunteers with enough time to maintain the facilities.

In our opinion, a successful gardening program involves not only the children and their respective teachers, but also the parents. The key element is to inspire young children attending elementary school, and to incorporate weekly gardening activities, such as garden maintenance, into the classical scholar schedule. Through participation in gardening programs, elementary students can be taught knowledge in a more practical way, allowing them to get more hands-on experience. One example is to identify plants and herbs in the school garden while being physically active, instead of acquiring this knowledge solely from books while sitting in the classroom.

A multidisciplinary approach is necessary in order to tackle the complex issue of childhood obesity. School gardening is one approach that also has numerous other educational, mental,

and physical benefits. Unfortunately, these programs are often limited to a single session per week, or to a brief period of time such as in the “LA Sprouts” trial.¹⁸ While this recent study contributed substantially towards a better understanding of school gardening interventions, we believe that these programs should not be limited to a short time span. Although implementation of school gardening programs remains a challenging task, we suggest that only long-term studies are able to reveal the full potential of school gardening on childhood obesity.

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The Missed Student

The following poem is dedicated to mental health awareness in the medical field.

At the end of 2016, studies were released demonstrating the prevalence of depression amongst medical students, reaching up to a quarter of the student body. Few seek help.

I wrote this poem after reflecting on the mental health of my colleagues. If a quarter of medical students are depressed, then it is blindly optimistic for me to think that all of my friends are mentally well and supported. This new knowledge left me unsettled.

We need to be perceptive. I challenge all of us to be as proactive in caring for our colleagues as we are for our patients.

The Missed Student

He lives in a nightmare that people call a dream,
His sadness unnoticed, his cry a silent scream.
He feels no achievement, he falls into abyss,
Unfocused and hopeless; his spirit is amiss.
He walks through the busy halls; no one spares a smile,
Goes about his duties; it's been this way a while.

He scrambles up the strength to face that final day,
Decision made, plans final; his fears kept at bay.
He cleans out his locker, faces the painful walk,
Through the wards and out the door, down across the block.
Home alone he takes the chance to leave one remark;
A letter to his parents; his story in the dark.

... ..

I stare down at my black dress, cut short at my knees,
Standing on the sacred floor with guilt and unease.
I cannot bear to raise my head and see his mother cry,
And so I listen to her voice; she says her last goodbye.
I think of all I did not say, the signs that I missed,
I focused on my studies; I failed to assist.

- KM (A Canadian Medical Student)

A Divine Diagnosis: The Christian Church's Discovery of Gardner-Diamond Syndrome

Katherine McDonald, BScH¹; Asfandyar Mufti, BMSc¹; Robert Jackson, MD, FRCPC²

¹Department of Medicine, University of Ottawa

²Division of Dermatology, University of Ottawa

Abstract

The Roman Catholic community was the first to observe and describe what later became known as Gardner-Diamond syndrome (GDS), otherwise known as psychogenic purpura. They attributed the dermatological manifestations of GDS to the 'Holy Stigmata' or the 'Five Holy Wounds,' physical and sensory signs linked to Jesus Christ's crucifixion. Between 1927-1989, medical curiosity resulted in the discovery of a link between these stigmata and a recognizable hematologic condition, which later became known as GDS. GDS is an autoimmune hematological disease associated with emotional and physical stress that involves painful ecchymosis. This stress is often related to psychiatric conditions such as depression, anxiety, and obsessive-compulsive disorder. GDS, the medical condition, must not be confused with mimicking presentations, such as variants of fictional disorder in which so-called 'fraudulent stigmatists' self-inflict similarly-presenting wounds. As such, clinicians must be able to distinguish patients with true GDS from religious individuals who have self-mutilated to mimic the 'Five Holy Wounds'. Reaching this diagnosis of true GDS might require a multidisciplinary approach between psychiatry, hematology and dermatology.

Each stigma has a specific biblical origin. The involvement of the hands and feet are associated with the nails that secured Jesus Christ to the cross. The involvement of the unilateral abdomen is related to the lancet that pierced Him. Finally, the involvement of the scalp is related to His crown of thorns.¹

Stigmata were first referenced centuries ago, by the Church. In the Holy Bible (Galatians 6:17), Saint Paul refers to stigmata when he states, "...for I bear on my body the marks of Jesus."² The Christian faith dictates that when these markings appear on an individual's body, it is a holy tribute to the affected individual, marking their divinity and deeper connection to Jesus Christ.

Holy Stigmata were first documented as appearing on St. Francis of Assisi (1181-1226) but have also appeared on other notable Roman Catholics, including St. Catherine of Sienna (1347-1380) and St. Padre Pio (1887-1968).¹

Unfortunately, the divine status conferred to affected individuals by the Church has sometimes also encouraged self-infliction of wounds among religious followers. These self-inflicted wounds are not legitimate cases of GDS, but rather, are examples of factitious disorder, wherein individuals feign Holy Stigmata as an attempt to gain recognition from the Church.³ Fraudulent stigmatists include historical individuals such as Magdalena de la Cruz (1487-1560), as well as devout modern day religious followers who replicate the Holy Stigmata as a symbol of Jesus Christ's courage within themselves.⁴ The differentiation between GDS and imitating wounds with a religious connotation is critical, as the former is a diagnosable medical condition and the latter is a cultural action. The latter is not medical unless it is intended as self-harm.

In 1927, the medical community investigated the Holy Stigmata for the first time. German psychiatrist Rudolf Schindler documented sixteen patients with the purpuritic lesions of the holy stigmata and discovered that they could be healed in due time by hypnosis.^{5,6} The sixteen patients gradually recovered from the purpura rather than experiencing the typical worsening of skin lesions due to their distress. Since the goal of the hypnosis was to reduce psychological stress, it was hypothesized that the purpuritic lesions were a result of stress, emotional trauma, or psychiatric illness. This idea garnered further support when in the following year two more cases of GDS (known as hysterical bleeding or purpura at the time)

The History of Gardner-Diamond Syndrome

While history often demonstrates a volatile relationship between religion and medicine, their coexistence has sometimes resulted in positive outcomes for society. For instance, the Roman Catholic community was the first to observe and describe the Holy Stigmata, which the medical community later reinterpreted as the rare but fascinating disease, Gardner-Diamond syndrome (GDS).

In the Christian tradition, the term stigmata (singular stigma) refers to the bodily wounds (physical stigmata) or sensations of pain (invisible stigmata) that correspond with the crucifixion marks on Jesus Christ's body.¹ These are the traditional 'Five Holy Wounds.'

emerged, both associated with what was then described as a 'hysterical personality' and delusions.⁵⁻⁸ Similar to the previous example, these two cases involved patients in extreme distress with a possible underlying psychiatric disorder.

The tangibility of medical evidence further advanced when in 1955, hematologists Dr. Frank Gardner and Dr. Louis Diamond identified four cases of Caucasian women presenting similarly to those with Holy Stigmata.⁹ It was discovered that these women developed sudden erythema and edema followed by painful ecchymosis secondary to auto-sensitization to a component of their own blood.^{7,9} This observation prompted the term 'painful bruising syndrome' as well as the official medical term, GDS.

The long list of synonymous medical terminology did not end with the terms GDS, painful bruising syndrome, hysterical bleeding, and auto-erythrocyte sensitization syndrome. In 1989, GDS gained the attention of notable hematologist Oscar Ratnoff, the founder of the coagulation cascade. He coined the term, 'psychogenic purpura' to more accurately describe the psychiatrically related auto-erythrocyte sensitization syndrome.³

The skin lesions in GDS are not fixed to the locations of the Stigmata of Crucifixion, but they can sometimes demonstrate a resemblance due to the typical ecchymotic pattern on the face, hands and feet. After a period of pruritus and burning sensation, edematous lesions present in the extremities and advance to ecchymosis within twenty-four hours.⁵ A minimum of one week is required for the lesions to heal, but they often persist and new bruises develop. The patients may have associated symptoms, including but not limited to fever, arthralgia, myalgia, headache, dizziness, gastrointestinal symptoms, hematuria, subconjunctival hemorrhage, vaginismus, and menorrhagia.⁵

GDS is also linked to some medically recognizable hematologic conditions, such as thrombocytosis.⁵ Further research has demonstrated that the auto-sensitization is specific to phosphatidylserine, a component of the erythrocyte cell membrane, and that the auto-sensitization seems to increase during times of stress on the body, in line with Schindler's original stress-related hypothesis.³

The religious explanation of psychogenic purpura was publicly accepted for centuries, but it did not subdue the curiosity of the medical community and physicians. Although arguments for 'genuine' Holy Stigmata still exist, the Christian theory behind the stigmata has failed to withstand rigorous analysis within the medical realm.^{1,5} Devout Catholics may continue to support the religious theory because there is no adequate medical explanation for the repeated involvement of the five holy body regions.

The history of this rare cutaneous condition highlights the importance of the Church's keen observation of the Holy Stigmata as well as the scientific community's recognition of the medical merit behind the religious claim. Members of the Church recognized a cutaneous ecchymotic pattern and provided a religious explanation. Physicians saw the validity

in this pattern recognition and felt it was worth medically investigating. Ultimately, it was the Roman Catholics who first identified the signs of GDS. Despite proposing an incorrect mechanism of pathogenesis, the Church accurately observed and documented a dermatological manifestation of a systemic disease centuries before the medical community.

The Current Clinical Application of Knowledge on Gardner-Diamond Syndrome

GDS is a rare condition with an interesting etiology and history. If encountered, this condition would more likely present to family medicine, emergency medicine, dermatology, hematology, or psychiatry. The syndrome is most often seen in Caucasian women, particularly among individuals with a history of psychiatric diagnoses such as depression, anxiety or obsessive compulsive disorder (OCD).¹⁰ The etiology of GDS remains unclear, but it has been suggested that severe stress or emotional trauma, combined with a hematologic abnormality, is the inciting cause. It is uncertain whether GDS patients require a concurrent psychiatric diagnosis, or if a psychiatric disorder merely predisposes the patients to more profound distress.

Clinicians should be able to differentiate this auto-erythrocyte sensitization syndrome from self-inflicted wounds in order to determine appropriate management. This can be done based on the patient's history. For instance, GDS is usually preceded by a prodrome of pain and warmth at the sites of ecchymosis as well as by headaches, nausea and occasionally, by vomiting.¹⁰ A minor trauma or surgery that results in both bleeding and psychological distress can sometimes trigger GDS in a predisposed individual.¹⁰

Although commonly coinciding with the location of the 'Five Holy Wounds,' GDS-associated bruising may be located anywhere on the body. Therefore, when considering the differential diagnosis, the inciting factors (e.g. stress/psychiatric disorder, erythema and burning sensation prior to bruising) and the patient profile (e.g. Caucasian female) might be more suggestive of GDS than the exact location of the ecchymosis. However, in the majority of individuals with GDS, bruising typically starts in the periphery (hands and feet).⁵ Ecchymosis is often extensive, severely painful and debilitating to the patient, and lasts for an indefinite period of time. Unfortunately, there are no laboratory investigations that can definitively diagnose GDS; it is a diagnosis of exclusion.¹⁰

The differential for GDS primarily includes other bleeding disorders. If GDS is suspected, laboratory investigations should include prothrombin time (PT), activated partial thromboplastin time (aPTT), and a complete blood count (CBC) with platelet count, all of which should be within the normal ranges.¹¹ Additional coagulopathy testing may also be ordered depending on the individual case and the clinical suspicion. If necessary, a skin biopsy may be performed. In GDS, the skin biopsy will show extravasated red blood cells and no evidence of vasculitis.^{7,9}

The management of GDS highlights the strong connection between the psyche, the immune system and the skin. This is not a new discovery, as the literature already demonstrates that 30% of patients with a skin disease have a concurrent psychiatric diagnosis.^{12,13} Although the etiology of the disease remains uncertain, it has been proposed that in an individual who is predisposed to auto-erythrocyte sensitization, emotional or physical stress might trigger and/or worsen GDS, particularly when an underlying psychiatric diagnosis is present.^{7,10} Support for this theory has been demonstrated in clinical treatment of GDS. For example, psychotherapy has been shown to improve GDS-related ecchymosis, most likely due to a reduction in patient stress.⁵ In addition, selective serotonin reuptake inhibitors (SSRI) and anxiolytics have been shown to improve the GDS patient's mood and to reduce the healing time.^{10,14}

Clinicians and trainees should be educated in the emerging fields of psychodermatology and psychoimmunology in order to succeed in the diagnosis and management of rare and challenging conditions such as GDS. Self-mutilation must always be considered in the differential diagnosis. A detailed history, focused attention on the patient, and blood work with additional coagulation tests are paramount for the diagnosis of this perplexing medical condition.

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