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UNIVERSITY OF OTTAWA
JOURNAL OF MEDICINE

JOURNAL MÉDICAL DE
L'UNIVERSITÉ D'OTTAWA

SURGERY & TRANSPLANTATION

CASE REPORT

Anatomical Variation of
the Brachial Plexus

INTERVIEW

A Discussion on the
Current and Future
Direction of Renal
Transplantation

RESEARCH

Changing Trends in
Stroke Treatment

COMMENTARY

3D Printing for 21st
Century Medical
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UOJM

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ABOUT US

UOJM is an international, peer-reviewed journal led and published by the students of the Faculty of Medicine. We welcome submissions in a variety of areas in biomedical research and feature original research, reviews, news and commentaries, case reports and opinion pieces. Our articles are written in both English and French, and represent the only student-run bilingual medical journal in Canada.

Le **JMUO** est un journal revu, édité et publié par les étudiants de la Faculté de médecine. Nous encourageons les soumissions d'une variété de différents domaines en recherche biomédicale et publions des articles de recherche originale, des articles de revue, des nouvelles et commentaires, des rapports de cas et des pièces d'opinion. Nos articles sont écrits en français et en anglais et représentent le seul journal médical bilingue géré par les étudiants au Canada.

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FROM THE EDITORS

UOJM: Preface

In its 8th installment, the University of Ottawa Journal of Medicine is proud to showcase the research and perspectives of graduate and medical students from Canada and abroad. The UOJM has continued to expand its readership and contributor base as Canada's only bilingual, academic medical journal. Our continued presence at the Ontario Medical Students' Weekend fosters early collaborations with medical trainees, and our ongoing promotion through newsletters, journal release events, and student-led writing offers many opportunities for students to engage with the multiple facets of the UOJM.

UOJM 8.1: Surgery and Transplantation demonstrates the incredible evolution that has occurred in the field of surgery and transplantation in recent years. Innovative surgical and medical imaging, implementation of robotics and artificial intelligence, and a better understanding of the immunological aspects of transplant recognition and rejection have played important roles in enhancing patient outcomes and access to treatment. However, scientific and clinical challenges remain and warrant discussion by scientists, medical professionals, stakeholders, and policymakers. Issue 8.1 is therefore intended to explore the advances and challenges in the field of surgery and transplantation, the development of relevant techniques and technology, and the translational impact on patient care, Canadian healthcare policy, and clinical collaboration.

Looking forward, we are excited to announce our **Fall 2018** issue on **Genetics**. In the short history since the genetic code was first cracked, scientific discovery has driven remarkable advances in our understanding of developmental biology, genetic disease and therapy, genetic engineering, stem cell biology, epigenetics, and more. Beyond the building blocks of DNA itself, genetic science has improved our ability to tackle the broader domains of human health, including immunology, cancer, neuroscience and chronic illnesses. The advent of gene editing technologies and personalized genomics has encouraged timely discussions between scientists, clinicians, and stakeholders in public health policy and bioethics. Thus, Issue 8.2 will explore advances in basic and clinical genetic science, as well as the inherent barriers to progress in a dynamic and rapidly-growing field.

The submission deadline of our **Fall 2018** issue is **September 1st, 2018**. High quality writing will be recognized with an honorarium award. Submissions can be made online, and details regarding article formatting and the submission process can be found on our website at www.uojm.ca.

We hope you enjoy the UOJM's Surgery and Transplantation issue!

Co-Editors-in-Chief
Teslin Sandstrom
Danny Jomaa

FROM THE EDITORS

UOJM: Préface

Dans sa huitième édition, le Journal de Médecine de l'Université d'Ottawa est fier de présenter la recherche et les points de vue des étudiants diplômés et des étudiants en médecine du Canada et de l'étranger. L'UOJM a continué d'élargir son lectorat et sa base de contributeurs entant que seule revue médicale universitaire bilingue au Canada. Notre présence continue à la fin de "l'Ontario Medical Students Weekend" favorise les collaborations précoces avec les stagiaires en médecine, et notre promotion continue par le biais de bulletins d'information, de publications de revues et d'écrits dirigés par des étudiants offre de nombreuses occasions de participer aux multiples facettes de l'UOJM.

UOJM 8.1: Chirurgie et Transplantation démontre l'incroyable évolution qui s'est produite dans le domaine de la chirurgie et de la transplantation au cours des dernières années. L'imagerie chirurgicale et médicale innovante, la mise en œuvre de la robotique et de l'intelligence artificielle, et la compréhension améliorée des aspects immunologiques de la reconnaissance et du rejet des greffes ont joué un rôle important dans l'amélioration des résultats et l'accès au traitement. Cependant, des défis scientifiques et cliniques demeurent et méritent d'être débattus par les scientifiques, les professionnels de la santé, les intervenants et les décideurs. Le numéro 8.1 vise donc à explorer les progrès et les défis dans le domaine de la chirurgie et de la transplantation, le développement de techniques et de technologies pertinentes et l'impact de la traduction sur les soins aux patients, la politique canadienne de soins de santé et la collaboration clinique.

Nous sommes impatients d'annoncer notre numéro **d'automne 2018** sur la **Génétique**. Dans la courte histoire depuis que le code génétique a été fissuré, la découverte scientifique a conduit à des avancées remarquables dans notre compréhension de la biologie du développement, la maladie génétique et la thérapie, le génie génétique, la biologie des cellules souches, l'épigénétique, et plus encore. Au-delà des blocs de construction de l'ADN lui-même, la science des gènes a amélioré notre capacité à aborder les domaines plus vastes de la santé humaine, y compris l'immunologie, le cancer, les neurosciences, les maladies chroniques et bien d'autres.

L'avènement des technologies d'édition de gènes et de la génomique personnalisée a encouragé des discussions opportunes entre les scientifiques, les cliniciens et les intervenants en matière de politiques de santé publique et de bioéthique. Ainsi, le numéro 8.2 vise à explorer les progrès de la science génétique fondamentale et clinique, ainsi que les obstacles inhérents au progrès dans un domaine dynamique et en croissance rapide. La date limite de soumission de notre numéro **d'automne 2018** est le **1er Septembre 2018**.

L'écriture de haute qualité sera récompensée par un prix d'honneur. Les soumissions peuvent être faites en ligne, et les détails concernant le formatage de l'article et le processus de soumission peuvent être trouvés sur notre site Web à www.uojm.ca.

Nous espérons que vous apprécierez le numéro de chirurgie et de transplantation de l'UOJM!

Rédacteurs en chef
Teslin Sandstrom
Danny Jomaa

Transplantation and Surgery: A Discussion on the Current and Future Direction of Renal Transplantation



Dr. Warren



Dr. Skinner

Nikhile Mookerji¹, Gurpreet Malhi¹

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ABSTRACT

Dr. Jeff Warren, MD, FRCPC, is an associate professor at the University of Ottawa within the Department of Surgery, Division of Urology. He has been a staff Urologist since 2009 and obtained his fellowship in multi-organ transplants, including kidneys and pancreases, from the University of Western Ontario. He received his MD from the University of Ottawa in 2002 and also completed his residency at the University of Ottawa in 2007. He is currently the head of surgical foundations for all surgical residency programs at the University of Ottawa. His clinical interests are in kidney transplantation surgery, minimally invasive surgery, and medical education.

Dr. Tom Skinner, MD, FRCPC, is a transplant fellow at the University of Ottawa within the Department of Surgery, Division of Urology. He received his MD from Dalhousie University in 2012 and completed his Urology residency at Queen's University in 2017. He has a BSc. from the University of British Columbia and a MSc. from McGill University. His clinical interests are in minimally invasive surgery, renal transplantation, surgical education, and healthcare economics. During this interview, Dr. Skinner and Dr. Warren discuss the current state of transplant surgery, the biggest challenges to transplanting patients, and the future of the specialty. They also discuss robotic surgery and the Spanish model for organ donation.

RÉSUMÉ

Dr Jeff Warren, MD, FRCPC, est professeur agrégé à l'Université d'Ottawa au Département de chirurgie, Division d'urologie. Il est urologue personnel depuis 2009 et a obtenu son fellowship en greffe de plusieurs organes, y compris les reins et le pancréas, à l'Université Western Ontario. Il a obtenu son doctorat en médecine de l'Université d'Ottawa en 2002 et a complété sa résidence à l'Université d'Ottawa en 2007. Il est actuellement responsable des fondations chirurgicales pour tous les programmes de résidence en chirurgie de l'Université d'Ottawa. Ses intérêts cliniques portent sur la chirurgie de transplantation rénale, la chirurgie mini-invasive et l'éducation médicale.

Dr Tom Skinner, MD, FRCPC, est boursier en transplantation à l'Université d'Ottawa au Département de chirurgie, Division d'urologie. Il a obtenu son diplôme de médecine de l'Université Dalhousie en 2012 et a complété sa résidence en urologie à l'Université Queen's en 2017. Il détient un baccalauréat en sciences de l'Université de la Colombie-Britannique et une maîtrise de l'Université McGill. Ses intérêts cliniques portent sur la chirurgie mini-invasive, la transplantation rénale, l'éducation chirurgicale et l'économie de la santé. Au cours de cette entrevue, Dr Skinner et Dr Warren discutent de l'état actuel de la chirurgie de transplantation, des plus grands défis pour la transplantation des patients et de l'avenir de la spécialité. Ils discutent également de la chirurgie robotique et du modèle espagnol pour le don d'organes.

Tell us a little about your background in Urology, and what got you interested in transplant surgery?

Dr. Skinner: I did my medical training at Dalhousie University in Halifax, after which I did my Urology residency at Queen's University in Kingston. I got interested in Urology by the end

of my second year of medical school and did some electives in Kingston and ended up matching there. In my second year of residency, I came here to Ottawa and did a transplant rotation with Dr. Warren. That's where I became interested in transplantation. I had some exposure to transplantation prior to that as an elective student at Dalhousie and it was on my radar, but I

Keywords: Transplantation; Urology; Surgery; Robotic Surgery

didn't know much about transplantation until I came here to Ottawa. At that time they didn't have a transplant fellowship program but they created one just before I finished residency, so I applied and have been here since July.

Dr. Warren: My history is pretty similar. I did my undergraduate degree in life sciences and immunology at Queen's University and did medical school at the University of Ottawa. I also did my residency at the University of Ottawa. I had a bit of a background in immunology, and I really enjoyed my nephrology rotation when I was a junior resident. A lot of these things where people end up with ultimate career paths, I think, are more fortuitous than anything. The timing was such that I had an interest and aptitude in transplants and there was a transplant position open in Ottawa when I was a senior. So I went down to Western University for two years and did a fellowship in transplant surgery where I was doing transplants of kidneys, pancreases and a bit of liver as well. I came back to Ottawa in 2009 and have been on staff since. I have a varied urology practice, but my predominant interest and academic focus is on kidney transplants.

What has been the biggest change you noticed since you first started with respect to transplant surgery?

Dr. Warren: I would say in the last ten years, since I've finished up my training and come back to Ottawa, what has changed in Ontario is the sheer number of transplants that we're doing. We're getting more people off dialysis that are candidates for transplants than ever before. With the aging population and obesity crisis, the demographic of patients that we're transplanting has changed. They all tend to be a bit older and more obese, and we are stretching the envelope with acceptability on both of those fronts. Also, something called donation after cardio-circulatory death (or DCD) and domino live chain programs have also improved donor numbers throughout Canada and the United States, and certainly in Ontario, where we are the leaders across the country. So there actually has been a lot of change in the last 10-12 years since I've been involved. Predominantly all those changes are geared towards increasing the number of suitable kidneys that can be transplanted in order to meet the growing demand.

Can you tell us about the different types of donors? What method of donation has the highest success rate?

Dr. Skinner: There are basically three main types of donors. Elective donors are most often a relative or loved one of someone who needs a kidney that come forward. We occasionally have altruistic donors that just hear about kidney donation in the media and decide they want to give a kidney up. These individuals are screened heavily, and if they are deemed to be safely able to proceed with a kidney donation and live with a solitary kidney, they can choose to donate their kidney. Our screening process is extensive for them.

The next tier of donation would be cadaveric donors, and those are broken up into two different categories. Until 2006, they were all NDD, or neurological determination of death. If someone has had a stroke or head injury and they are deemed to have reached the criteria for brain death, usually determined by a neurologist or intensivist, then they can become a candidate to donate their organs. These are considered the highest quality of cadaveric organs, as the heart continues to pump up until the organs are harvested in the operating room.

In 2006, we started doing DCD donation in Canada, which is donation after circulatory death. Those are patients that still typically have some sort of traumatic or head injury, but they don't meet the criteria for brain death and are also unable to go home and have a meaningful life off of life support. They are the second tier of cadaveric donors. Generally, for DCD donation, they typically withdraw life support in the ICU while the surgical team is waiting in an operating room, and the donor is brought in once their vital signs are absent.

What are your thoughts about the Spanish model of transplantation where there is presumed consent unless an individual opts out? Do you see our society going in that direction?

Dr. Warren: That's a very good thought, and very interesting and timely. Spain, Belgium and the Netherlands are actually the three countries that have adopted an opt-out strategy for organ donation. And certainly I don't think there's any argument that it increases the number of viable donors, just based on the informed consent process. I think it's very difficult from a legal and cultural perspective to implement similar laws in a country like Canada that is very multicultural. Part of the reason is that there are lots of different faiths throughout the world and there are examples where it is not deemed appropriate for patients to donate their organs after death because they may be needed in the next life. There are a few Asian cultures, the Japanese

for example, where the vast majority do not prescribe to organ donation after death. Also, donation laws and how they are handled in Canada are based on a province-to-province basis. At the national level, the Canadian Society of Transplantation has looked at this for the past 10-15 years and it really is a hot topic every year. We often get people from Spain, the Netherlands, and Belgium to come talk about their experiences where you hear some pretty compelling stories. To introduce federal legislation, I think, would be very challenging.

In Spain, they also attempt to preserve organs roadside by paramedics. Do you think that can be implemented in trauma cases?

Dr. Warren: Yes, we have been talking about that. This is a different issue. In countries where they practice this at the scene, the goal is to resuscitate the patient. The paramedics do the resuscitative efforts, and then after the paramedic team thinks its futile, they call the physician at their hospital to tell the story and ask whether or not they get permission to declare death and to cannulate the organs. Once again, the world experience is in Spain with this practice, and part of the reason is because of the informed consent laws there. They are able to do that with minimal ethical implications. It has had a positive impact on the number of organs that are transplanted, not just kidney, but also livers and lungs.

There is talk about doing this in Canada with something called the Maastricht criteria (1), which is where the criteria for donation after circulatory death came from. These would involve what are called uncontrolled DCDs. There is concern about the viability of the organs, but there are certainly some good outcomes in case series from Spain and other countries that have similar practices. That is something that may be a possibility in Canada because you're not taking the organs, you're just preserving the body. It doesn't mean you're going to use those organs for donation, but it gives you time to contact the families and find out what the patient's wishes were. I think from an ethical perspective and from a legal perspective, that would be the next step. It has not been practiced yet and part of the reason is that most transplant surgeons and physicians are worried about the quality of the organs. Some case series report unwitnessed cardiac arrest, in which case you have the question of whether the organs have been nonviable or ischemic for too long. In countries like Spain, that are very aggressive with their organ donation, it's usually with a witnessed cardiac arrest outside of a hospital. In that situation,

at least you have a timeline for how much ischemia has been there.

Is warm ischemia time one of the most important markers of kidney viability from the surgical point of view?

Dr. Skinner: Yes. With cadaveric donors, that is the difficult hurdle we have to overcome. It plays a role in organ transplantation because there's always going to be warm ischemia time during the implantation phase when you're sewing the kidney in. We usually talk about it more in the context of the donation side. In deceased donors it's important because it's an independent marker of both delayed graft function (DGF) and long-term kidney success rates. But as a group, you can group them into high and low warm ischemia times. NDD donors, for example, have extremely low warm ischemia times and that's why they tend to be of superior quality.

However, with DCD donors, the battle you are fighting is from the time that their vital signs are absent, they have to be transported to the operating room, placed on the operating table, and you still have to cut down and find the vessels, cannulate them, and flush. There is always a 5-10 minute delay that's unavoidable and that is the primary reason why those organs are of inferior quality. DCD's have much higher delayed graft function rates and renal failure rates.

Back in 1989, it had been reported that approximately 20% of kidneys transplanted were not functional past their first year (2). The number has now decreased to as little as 5% and is often related to rejection of the donor organ. Could you explain how future therapies will attempt to combat this issue?

Dr. Warren: That's a good question. The one-year endpoint has a lot to do with the kidneys that we lose for immunological reasons and acute rejection. This is difficult to get around because it encompasses not just rejection from a graft perspective but various native kidney diseases as well. The classic example are people with a primary glomerulopathy, like focal segmental glomerulosclerosis (FSGS) in young people. They tend to be anywhere between 3-10% of the transplants that we do in Canada. A lot of those unfortunate young recipients are going to lose their newly transplanted kidneys because of recurrence of disease. This is very difficult to control and an argument can be made that some of these people shouldn't be transplanted in the first place because the prognosis is so poor.

The main reason that the one-year rates have improved from 20% graft loss down to about 5% is because of the improvement and aggressiveness of immunosuppression, with newer calcineurin inhibitors that work better and especially with the advent of newer anti-proliferatives. The classic example is mycophenolate (which is also known as CellCept), and these have really diminished the risk of acute rejection. The loss of kidneys from acute rejection in the first year has decreased because of better pharmacology. The surgery itself has not changed in the last 30-40 years. I do think we are a bit more efficient in minimizing both the warm ischemia time and the cold ischemia time. Whether or not the recent use of Lifeport perfusion pumps is going to extrapolate long term and lead to better kidney functioning at one year I think remains to be seen. But I really don't think you're going to get much more improvement over 5% graft loss unless we completely revamped the whole idea of transplantation, such as growing kidneys that are specific for recipients and therefore don't require immunosuppression.

How far do you think we are from that?

Dr. Warren: Well, I'm 41 now and plan to practice until I'm about 60 or thereabouts. Whether or not it happens in my career, I think, is difficult to tell. It is kind of like any new technology, things tend to explode. They go from 0 to 60 pretty quickly. For example, I didn't have a cellphone when I was a resident, and that wasn't too long ago. I got a cell phone my second last year of residency, which sounds like a long time ago but it was 2005. There is the possibility for artificial kidneys but there are certainly immunological challenges to overcome. Dr. Tony Atala, who's an expert in regenerative medicine and happens to be a urologist, is already growing organs in scaffolds. It's a matter of populating those organs with cells that are viable, and then making them HLA compatible or completely inert with the recipient.

There's the possibility that this may replace the entire role of surgery and transplantation, where you can actually just inject cells that will do a renal-like function somewhere else in the body. Now, the problem with any organ that you're going to replace that has an excretive function, is that you still have to get rid of the waste somehow. The kidneys and liver are good examples of this. In cardiac transplants however, it's a possibility where you might be growing hearts in petri dishes. There's already a physician down in Texas that has been growing hearts that have no antigen on them and the question is whether or

not they are going to be feasible. I think that we will actually do this with hearts before we do it with kidneys or livers. But in the next 10-15 years, probably not.

What is robot-assisted surgery? Who is doing the surgery? Is there artificial intelligence involved?

Dr. Skinner: Robotic surgery is an extension of laparoscopy. Laparoscopy is a form of surgery where you inflate the body cavity that you're working in with an inert gas like carbon dioxide and you work in that space with long instruments through small ports so that your incisions are much smaller. Laparoscopy has become the standard of care in most surgeries. General surgery, gynecological surgery and urology are doing at least some of their surgeries laparoscopically. Robotic surgery is just an extension of that where there are laparoscopic ports inserted into a cavity filled with an inert gas, but the surgeon is not directly connected to these instruments. So they are sitting at a console and are directly manipulating the robot's arms. There is no artificial intelligence where the robot is doing parts of the procedure on its own, but it can assist the surgeon by reducing tremor, or by moving a very small instrument in a confined space with much more degrees of freedom than the human hand can do in the same space. But it is still always under the control of a surgeon at the console.

What is the biggest challenge you see within kidney transplantation in the future?

Dr. Skinner: The biggest hurdle for transplantation is getting everyone transplanted. There's more people with end stage renal disease than there are kidneys available for them. Increasing donors by any means (live donors, deceased donors, and extended criteria donors) to get people transplanted, or improving other forms of renal replacement therapy will help. But we know that mortality rates on dialysis are very high, and quality of life (on dialysis) is very low. Kidney transplant is superior in essentially all realms, including financially, so, we need to find ways to transplant more people, and I think that's the biggest thing to overcome.

Dr. Warren: I think that the holy grail for transplantation has always been tolerance. Being able to transplant an organ from two people that are not genetically identical without having the morbidity, side effects, complications, and the long-term sequelae of the immunosuppressive medications. So while

there are lifesaving medications, they're not perfect. There's a lot of side effects, risk of long term cardiovascular toxicity, other end organ damage, infections and malignancy. So tolerance is an immunological challenge of transplantation, and if you think about what we talked about a few questions ago about being able to grow kidneys in a petri dish, so to speak, you may be able to bypass all of the problems of tolerance because you can make the tissue genetically inert. It's like putting in a titanium clip, but it actually functions like an organ and by definition then will be tolerant because there is no antigen. So I think that is the holy grail or the ultimate goal of the transplantation. Whether or not that's a reality in the next 20-30 years remains to be seen.

Is Xenotransplantation, the use of organs from different species, a possibility? What are some barriers?

Dr. Warren: We are moving away from that direction. There has not been much interest in that for the past 10-12 years. 20-30 years ago there was an interest because a supply of organs from different species would not be a problem; however, if you look at experimental models, xenotransplantation due to immunological mechanisms between species is not a good idea. It leads to very acute rejection and intolerance within the host. The only exception to this is heart valves which can be taken from bovine or porcine sources. These are tissues that are inert and not very antigenic, but if you are trying to transplant a visceral organ like a liver, kidney, or heart it will not work. Human-to-human transplants are still not perfect, but between species is not viable.

What do you enjoy most about surgery and what advice would you give to students considering transplantation surgery?

Dr. Skinner: What drew me to surgery was in part the people. Obviously, there is a technical aspect to surgery that I really enjoy but there is also a great deal of comradery within the field which definitely played a role in my decision to pursue it. In Urology, there is a large variety of procedures and interventions that you can do with a good balance between surgery and medicine. We also have long term follow up for some patients, which allows you to get to know them over time. Transplantation is one of the more technical procedures within the field, and one of the procedures that is immediately gratifying. When you take a kidney off clamp and see it change color and start producing urine, it's a very satisfying moment. Urologists happen to do interventions that have

significant impacts on quality of life, which is very rewarding. Just seeing people go through dialysis with end stage renal disease and observing the improvement in quality of life made by a renal transplant is amazing.

My advice for medical students would be to explore different specialities and see how you fit with the people who work in that specialty. Your preceptors will become your future colleagues, which can be difficult to appreciate early on but is important to consider. You should try and see what the more common interventions in any speciality are and ask yourself if you could do that for the rest of your life. Again, not easy to do early on but something to consider. My advice for medical students when on the wards and on electives would be to have a positive attitude, show interest, and be professional. If you are considering Urology or surgery in general, research helps but isn't mandatory. It can be difficult with all the stressors of medical school but I would encourage you to continue to maintain your hobbies and interests outside of medicine. Finally, just remember there is no cookie cutter path for a career in surgery, everyone takes their own route, as will you!

Dr. Warren: I would echo all of Tom's comments about that. One thing that I think is unique about transplant surgery in particular is it's one of the few exceptions in surgery where you get to put something into a patient. Almost everything we do in surgery is taking something bad out of a patient, except this is the instance where you get to put something good in.

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3D Printing for 21st Century Medical Learners: Opportunities for Innovative Research and Collaboration

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ABSTRACT

With the commercialization of accessible 3D printers, using 3D printing for creation of personalized medical interventions has become a rapidly expanding area of research. In keeping with these developments, the Faculty of Medicine at the University of Ottawa has purchased 3D printers (Makerbot Replicator 2X and Ultimaker 2 Extended +) and launched a collaboration with Makerspace and the Health Sciences Library to investigate local opportunities to incorporate 3D printing into education, simulations and research. This article aims to summarize some of the recent developments in 3D printing and introduce readers to how one could use 3D printing for personalized medicine.

RÉSUMÉ

Avec la venue de la commercialisation d'imprimantes 3D accessibles, l'emploi de l'impression 3D pour la création d'interventions médicales personnalisées est un domaine de recherche en développement rapide. Afin de rester à jour avec ces développements, la Faculté de Médecine de l'Université d'Ottawa s'est procuré des imprimantes 3D (Makerbot Replicator 2X et Ultimaker 2 Extended +) et a entamé une collaboration avec Makerspace et la Bibliothèque des Sciences de la Santé, pour examiner des opportunités locales visant à incorporer l'impression 3D à l'éducation, aux simulations et à la recherche. Cet article vise à résumer certains des développements récents en impression 3D et à présenter aux lecteurs la manière dont celle-ci peut être utilisée pour la médecine personnalisée.

One of the latest trends to inspire creative minds is 3D printing. While printing in more than two dimensions has been possible since the 1980s, the recent reduction in cost and increase in accuracy and accessibility has made 3D printing much more appealing for the average consumer. The resulting boom in user base has made 3D designs available online for tools, toys, jewelry and even guns, which has sparked quite a bit of controversy (1). However, 3D printing is not just an innovation for hobbyists, it also opens doors for experts in other fields who may have ideas that they wish to turn into tangible reality – a particularly useful opportunity for prototyping and the development of personalized medicine with end-products that can be tailored to an individual's needs. In keeping with this, the Faculty of Medicine at the University of Ottawa has launched a collaboration with the Engineering Makerspace and the Health Sciences Library to bring 3D printing to medicine. So, as a student with access to desktop printers, what can you make? What should you expect?

TYPES OF 3D PRINTERS

Automated production of physical objects from 3-dimensional computer-aided design (3D CAD) models, often called rapid prototyping, is possible through several approaches (2). The term "3D printing" in particular refers to an additive technique that builds products layer-by-layer using a series of cross-sectional images. It is very much like a traditional ink printer with a material that can be built up vertically. How one would 3D print an object would depend on the 3D printer one has available, the most common methods being stereolithography (SLA) and fused deposition modeling (FDM) (3). In SLA printing, the liquid polymer is turned solid layer-by-layer along the paths of a laser beam. In selective laser sintering (SLS), a similar process using lasers is conducted on powdered polymer rather than liquid (3). In FDM printers, a thermoplastic polymer is extruded from the printer head as a paste that solidifies and forms the base for the next layer (3). The two printers purchased by the Faculty of Medicine are both small desktop FDM models (Makerbot Replicator 2X and Ultimaker 2 Extended +) compatible with a range of different thermoplastic filaments with varying physical properties.

Keywords: 3D printing



Figure 1. A knee joint printed with clear 3D filaments t-glass on a Makerbot Replicator 2X at the University of Ottawa. The knee joint model was extracted from computed tomography (CT) data.

APPLICATIONS OF 3D PRINTING

With the basics of 3D printing explained, it is not hard to see that just like regular printing, it could be applied to virtually any field. 3D printers are useful across the field of medicine, particularly in personalized medicine because of the challenge that individualized anatomy poses to medical treatment. While devices like casts and bandages can be fitted to a wide range of body types and sizes, customized products such as prosthetics, implants and even surgical tools must be tailored to a patient's anatomy, risk factors and prognosis (4,5). Additionally, pre- and perioperative planning for complex surgical operations can be made much easier with physical models, particularly if it requires the joint effort of several surgeons (6-11). For rehabilitation medicine, 3D printed prosthetics and exoskeletons have drastically improved access (5). As an example, a local Ottawa child was able to receive 3D printed prosthetics that could be modified and adjusted as he grows (12). Furthermore, 3D printing is a great way of modelling anatomical structures in medical training and education to help learners visualize conceptual components in a physical manner, such as with 3D printed projections of the orbit or the hand (13-15). The current cutting edge research in personalized 3D printing is the creation of personalized medications – printing customized combination pills at precise doses. Unfortunately, there are no commer-

cially available printers that can perform such a task.

It is important to have realistic expectations when it comes to 3D printing, since reality is often years behind what is presented in the media. A common issue revolves around material. The desktop printers are only compatible with a limited number of thermoplastics, with only one or two used at a time and could block the extruding nozzle quite easily. Sometimes, mechanical challenges when printing with more complex materials such as flexible or transparent polymers can be improved by optimization and careful adjustment of printer components and settings. In other instances, it may be necessary to work in prototypes and use a higher-end printer to produce the final model. Another issue is time – think of how long your regular inkjet printer takes to print one page, then consider that several hundreds of these “pages” are required to form a full object. Therefore, the bigger, more detailed the model, the longer it takes.

PROCESS OF CREATING CUSTOMIZABLE MODELS

The first step to 3D printing is researching the idea to see whether it is feasible with the available printers. The NIH 3D Print Exchange is a starting point for locating existing 3D printing research, as it is the largest database for scientific 3D models (16). Extracting 3D models that correlate with real patient anatomy is possible through medical imaging data and 3D scanning (17,18) (Figure 1). Medical imaging includes plain X-ray films, computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound. Of these, it is possible to obtain CT, MRI and ultrasound in 3D formats, so long as the source scan is sufficiently thinly sliced. In hospitals and clinics, these data are stored in Digital Imaging and Communications in Medicine (DICOM) files, which are a series of scanned images that can be converted into 3D files with software (17). Just like interpreting regular imaging data, CT scans are best for bones while MRIs and ultrasounds are better for soft tissue. If you need visualization of blood vessels, the best approach will be an angiogram, which uses CTs or MRIs with contrast dye to highlight the vessels. However, image series that have thick slices can create significant distortion in the model when extracted. 3D scanning, on the other hand, is able to map external features at points in space, but lacks the ability to render internal anatomy.

To create new models or to alter existing models requires 3D CAD software programs, of which there are many available - the most common being Google Sketchup and Blender. In these

computer programs, the models are represented by a group of points in space that can be exported as .stl files, which are formed by interconnected triangles and make up the standard supported file type for most 3D printers.

3D PRINTING AT THE HEALTH SCIENCES LIBRARY

Since early 2015, the Faculty of Engineering's Makerspace and the Health Sciences Library have been offering 3D printing workshops at the University's downtown campus and at its Roger Guindon Pavillon (RGN) which houses the faculties of medicine and health sciences. The workshops held at RGN have been very popular, indicating a high level of interest among medical students and researchers in the applications of 3D printing to medicine. Prior to this initiative, 3D printers were available to students at the Faculty of Engineering building, located at the downtown campus; but with the Faculty of Medicine's purchase of 3D printers, medical students now have greater access to 3D printing technology within proximity to their professors and classes. As part of the Health Sciences Library's pilot project to offer 3D printing-on-demand, researchers in affiliated hospitals have requested models for proteins being studied and medical students have used the NIH 3D Print Exchange model database to locate anatomical models for printing. Although the traditional notion of libraries is largely associated with silent study and shelves upon shelves of books, contemporary library spaces and services are increasingly oriented to providing digital research tools and materials, group collaboration spaces, and support for independent learners. As a place where ideas and individuals intersect, could 3D printing in the Health Sciences Library act as a catalyst for the development of a community of students, researchers and healthcare practitioners with a shared interest in MakerHealth technologies?

CONCLUSION

In the field of personalized medicine, 3D printing holds tremendous opportunities for innovative research and collaboration. Whether designing protein structures to demonstrate drug interactions, extracting anatomical models for surgical preparation, or creating customized prostheses, the average person can make a difference with desktop 3D printers. As with other technological translations into clinical practice, buy-in from medical professionals is a critical factor to the adoption of 3D printing for future progress. So why not try your hands at it today?

For further information on 3D printing, please visit the University of Ottawa Health Sciences website at: biblio.uOttawa.ca/en/health-sciences-library/3d-printing

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Soft Skill Development in Ophthalmology and its Importance to Aspiring Canadian Medical Students

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ABSTRACT

Soft skills are social and emotional intelligences that facilitate harmonious interpersonal interactions. Soft skills enable physicians to understand and build rapport with patients. Soft skills are increasingly considered crucial physician qualities within surgical specialties, including ophthalmology. Although avenues exist for general soft skill development, medical students may find challenges directing their development to ophthalmic settings due to medical curricula's limited ophthalmology exposure. This perspective commentary discusses resources to aid ophthalmic soft skill development. Lectures provide foundational knowledge. Electives and volunteering provide opportunities to practice soft skills. Electives and mentorship direct soft skills towards desired disciplines. Studying and participating in research that utilizes patient-centred outcomes improves current and future care.

RÉSUMÉ

Les compétences relationnelles sont des intelligences sociales et émotionnelles qui facilitent les interactions interpersonnelles harmonieuses. Ces compétences permettent aux médecins de comprendre et d'établir des rapports avec les patients. Elles sont de plus en plus considérées comme des qualités médicales essentielles dans les spécialités chirurgicales, y compris en ophtalmologie. Bien qu'il existe des avenues pour le développement général des compétences, les étudiants en médecine peuvent trouver des difficultés à orienter leur développement vers des contextes ophtalmologiques en raison de l'exposition limitée aux programmes d'études en ophtalmologie. Ce commentaire de perspective discute des ressources pour aider au développement de compétences relationnelles ophtalmiques. Les conférences fournissent des connaissances fondamentales. Les cours facultatifs et le bénévolat offrent des occasions de pratiquer des qualités personnelles. Les cours au choix et le mentorat orientent les compétences non techniques vers les disciplines souhaitées. Étudier et participer à des recherches qui utilisent des résultats centrés sur le patient améliore les soins actuels et futurs.

Soft skills, also known as non-technical skills, facilitate harmonious interactions between people. These skills include communication, professionalism, adaptability, and interpersonal skills like empathy and conflict resolution (1,2). Soft skills enable us to build trusting relationships with our patients and understand their personal experiences and needs. This understanding can be used to communicate our medical expertise and direct research initiatives to improve future care. Soft skills are included within CanMEDS roles' core competencies (3). As Canadian postgraduate medical education transitions to a competency-based design, it is anticipated that there will be an increased focus on core competency skill-set assessment (4,5). Thus, soft skill development will become a greater focus for trainees.

Soft skills are increasingly being considered crucial qualities in surgical specialties, as they improve patient management

and teamwork in both clinic and operating room settings (6,7). Ophthalmology utilizes diverse treatment modalities, including surgical, laser, and medical interventions. In ophthalmology, quality of life improvement is most often the objective. While the most feared result of eye disease is sight loss, patients' quality of life is also impacted by psychosocial, emotional, and systemic consequences of the disease and their treatment (8–13). Because quality of life is defined by personal experience, an intimate understanding of patients' perspectives is needed to optimize care (14,15). Consequently, soft skills are highly-desired traits in both comprehensive and subspecialty ophthalmologists (16).

Medical students acquire soft skills longitudinally through collections of personal experiences (**Figure 1**). Although general soft skills are translatable across specialties, a deeper understanding of specialty-specific situations where soft skills are

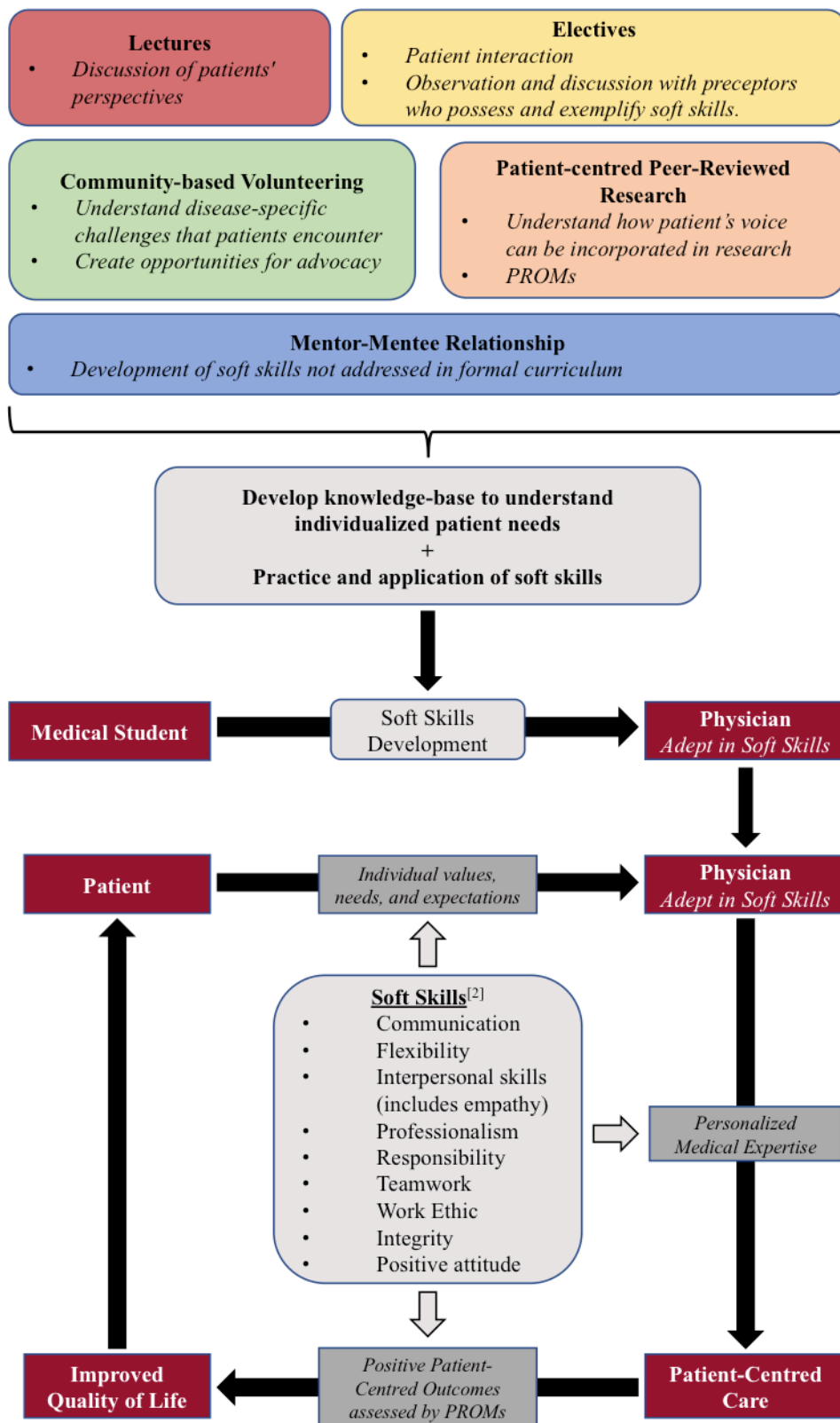


Figure 1. Schematic representation of resources that aid soft skill development in medical students, and how these soft skills can then be applied in routine clinical care. Abbreviations: PROMs, patient-reported outcome measures.

particularly important enables students to play more significant roles on healthcare teams (6), partake in research with patient-centred outcomes, and develop strong soft skills foundations before entering residency. Due to the limited ophthalmology exposure in undergraduate medical curricula, medical students may find particular challenges in directing their soft skills development in an ophthalmic setting.

In this commentary, the focus will be on the learning experiences from a medical student's perspective. Through anecdotal discussion and literature review, the aim will be to convey the importance of soft skills, discuss how medical students can actively improve soft skill development, and direct this development to ophthalmology.

What soft skill development resources are available for students?

Soft skill development can be attained through several facets within medical education, including lectures, electives, research, and community-based volunteering.

LECTURES

Canadian undergraduate medical education programs have made recent changes to help students understand individualized perspectives of patients and their communities (17). These aspects of curricula improve soft skill development foundations by familiarizing students with specific populations' needs and available patient resources (17). Specifically, the University of Ottawa's medical program has Society, Individual, and Medicine (SIM) classes where patients, physicians, and allied health professionals discuss social determinants of health, diseases' impacts on quality of life, and specific healthcare needs of vulnerable patient populations (18–20). Students also have access to a supplemental SIM website that builds around the foundational knowledge developed in class (18).

During SIM, there is discussion of the importance of exploring patients' concerns beyond their presenting complaints, as patients often have several related, co-existing problems just beneath the surface that will affect care of the current illness (21). For physicians to engage in patient-centred care, time must be taken to understand patients' lives as a whole rather than a compilation of current symptoms and signs (21). By understanding these concepts learned in SIM, students develop a foundational approach to build empathy for their patients, thereby aiding in the establishment of thera-

peutic alliances.

ELECTIVES AND OBSERVERSHIPS

Electives and observerships provide students with opportunities to practice soft skills by participating in patient care and learning from preceptors who already possess these skills. During electives, students can form mentor-mentee relationships with physicians they particularly respect, identify with, and admire. Mentors aid in soft and clinical skills development that are not addressed in formal undergraduate curricula (22). Mentors achieve this by acting as coaches to help students set career goals, improve resilience, provide feedback, and develop important insight for being successful physicians (23).

For example, ICU electives provide students opportunities to learn from physicians who are often particularly adept at soft skills. During these electives, students may apply lessons from SIM, such as the intricacies of autonomy, medical beneficence, and substitute decision making (24). This knowledge helps students initiate soft skill-related discussions with their ICU mentors, who can then help students develop their approach to soft skill-critical scenarios, such as the resolution of ethical conflict to deliver optimal patient-centred care. End-of-life care exemplifies complexities that coincide with patient-centred care. Here, physicians must elucidate patients' values and goals of care while patients often have minimal capacity to communicate new information or appreciate the consequences of various actions. In addition, physicians must effectively communicate with patients' families. Although knowing this information is essential, its utility depends on the physician's soft skills.

Patient-centred care often involves balancing patients' autonomy and beneficence when conflict exists between these two ethical principles (25). In paternalistic care, physicians are the dominant authority and decision maker in patient treatment (26,27). Although most of medicine is shifting away from traditional paternalistic care (28), patient-centred care is not necessarily the complete antithesis to that of paternalism (26). Patient-centred care is not simply fulfilling a patient's every request. Rather, a physician's responsibility is to understand their patient's values and provide guidance that best meets their goals. Otherwise, we are abandoning them to their autonomy.

Execution of successful patient-centred guidance requires effective listening, understanding values, and establishing trusting relationships. To fulfill these requirements, physicians must

create non-judgmental environments and orchestrate discussion with empathy, respect, and authenticity. Without soft skills, a physician cannot possibly provide medical expertise that the patient needs and therefore cannot provide the high-quality patient-centred care that they deserve. With these soft skills, we build trust with our patients – bridging the gap between our medical knowledge and the patient’s care. This connection allows us to approach medicine in a patient-centred fashion.

TRANSLATION OF SOFT SKILLS TO A DISEASE-SPECIFIC FOCUS

Glaucoma, a leading cause of irreversible blindness worldwide (29), is characterized by progressive optic neuropathy, initially manifesting as peripheral vision loss (30). As such, patients may not notice reductions in their visual field until significant permanent vision loss has already occurred. In the current glaucoma treatment paradigm, intraocular pressure-reducing topical medications are considered first-line therapy (30). Because glaucoma is a chronic disease with currently no known cure, medical therapy must also be chronic and life-long. Consequently, medication adherence is crucial for successful management. Similar to the previously described ICU example, glaucoma medication non-adherence may present conflicts between a patient’s autonomy and beneficence.

Schwartz and Quigley’s (2008) literature review found that adherence to glaucoma medications was generally below 50% after one year of therapy (31). The question arises as to the possible role soft skills play in reducing non-compliance. Many commonly reported barriers to glaucoma medication adherence – poor self-efficacy (32,33), patients’ skepticism that glaucoma causes vision loss (33–35), skepticism regarding the effectiveness of glaucoma medications (32–37), poor glaucoma knowledge (33–38), mistrust in physician (33,36–38) – are directly affected by the patient-physician relationship. Other commonly reported barriers – forgetfulness (33,35–37,39), administration difficulties (32,33,35,37,39), cost (33,34,37,39), adverse effects of medication (33,34,37,39), and perceived stress, depression, or anxiety (9,13,40) – should be amenable to elucidation by physicians with a thorough patient history.

Physicians’ soft skills create opportunities to facilitate open, candid, and non-judgmental dialogue with patients, allowing physicians to engage in discussions with their patients regarding their beliefs on their disease and its treatment (33). Physicians can address these beliefs to improve self-efficacy through motivational counselling and individualized education, and

provide personalized techniques to help patients with their forgetfulness (33,41). By addressing psychosocial issues such as mental health or financial concerns, we can identify patients that require referral to appropriate members of our healthcare team (13,42). If compliance remains challenging due to numerous adherence barriers, then physicians can consider alternative therapies that reduce the patient’s active involvement such as – in the case of glaucoma management – laser-based therapies.

By integrating knowledge and soft skills acquired from lectures and electives, students can direct their development towards an ophthalmic focus. For example, lessons learned during SIM classes and ICU electives regarding the importance of exploring patients’ concerns through effective communication and empathy can motivate a student to inquire further about patients’ glaucoma medication adherence. By understanding patients’ needs, we can provide the medical expertise that we have spent so many years acquiring for the benefit of our patients. Rather than abandoning patients to their autonomy, we can work cohesively with them as a team to provide optimal patient-care.

RESEARCH

In ophthalmology, traditional clinical outcome measures (COMs) – like visual acuity and intraocular pressure – do not always correlate with patient-reported outcome measures (PROMs) – such as functionality during sight-dependent daily activities like driving or reading (43). Both clinical research and routine clinical practice are increasingly using PROMs, as they capture patients’ experiences better than COMs (43). Eye care providers must understand how patients value sight and their expectations of care. These may be patient-specific, which would cause a general, empirical approach to be suboptimal. Validated PROM questionnaires allow us to better understand ophthalmic outcomes from patients’ perspectives (43). By familiarizing themselves with this research, students develop a sense of where their soft skills are particularly needed within ophthalmology.

For example; in cataract surgery, patients’ expectations of outcomes are high (44). Although patient satisfaction is generally concomitantly high, this is not always the case (45,46). Using the Catquest-9SF PROM questionnaire, Mollazadegan and Lundström (2015) found that although PROMs were generally good, poor PROMs were associated with higher preoperative

visual function (47). Moreover, 7.4% of patients demonstrated improved visual acuity but poor PROMs (47). This discrepancy was associated with difficulties performing near-vision tasks after surgery (47). Nuclear cataracts, which at their onset temporarily improve near-vision, may negatively impact patients' perceived outcomes if not correctly informed (47). Thus, pre-operative identification and discussion of pre-existing factors may improve surgical outcomes as assessed by PROMs.

As members of the ophthalmic care team, medical students may be approached by patients or otherwise become involved in pre-operative cataract surgery care. By understanding how a patient's COMs and PROMs may differ, students recognize the importance of inquiring about their patient's specific limitations from their cataract. By understanding how patients typically value outcomes in cataract surgery, students become aware of pre-existing factors that should be addressed. This awareness directs soft skill development to this specific ophthalmologic situation. The student is better equipped to explore patients' expectations and underlying concerns. Students can then engage their preceptors in discussions on how to improve quality of care by providing the specific information their patient needs.

In addition, students' appreciation of the importance of PROMs may help them participate in progressive research with robust, patient-centred methodologies. Participation in patient-centred ophthalmic research may be achieved by contacting potential supervisors and engaging in discussion of patient-centred outcomes within projects. This active dialogue alerts the researcher of their student's focus, which may expand the student's role on the team, allow students to direct their own initiatives, and help students meet their academic and professional goals.

VOLUNTEERING

Volunteering with organizations that provide services to citizens with visual impairments is another great approach for building soft skills. The Vision Mate program at the Canadian National Institute for the Blind (CNIB) pairs students with clients who request assistance to complete specific tasks (48). In the Vision Mate program, students witness the abundant accessibility issues that people with visual disabilities experience, and the challenges of performing daily activities like navigating websites, transportation, or career-related tasks. Students who witness these accessibility problems gain understanding

of specific obstacles to which they can advocate. Volunteers will understand how those with visual impairments adapt their learning style or techniques when performing certain tasks. This understanding helps students become mindful and accommodating of people with visual impairments by adapting their own teaching or performance techniques. Students will grow to admire their client's determination in achieving their objectives despite experiencing numerous additional obstacles that most others do not encounter. As a team, students will find satisfaction working through adversity with their client. Students will become aware of valuable resources that provide assistance to those with low vision. As medical students progress through their professional careers, the knowledge, adaptability, empathy, and sense of responsibility acquired from community-based volunteering can be applied to their future practice or advocacy initiatives.

CONCLUSIONS

Soft skill training and development have been historically absent in medical training. Their need and value have only recently become of greater interest. Growing evidence suggests that soft skills are equally as important and foundational as knowledge and technical skills. Research supports that soft skill development should start early in physicians' careers as it is neither intuitive nor inherent in all students selected to become physicians. Medical students have many opportunities to actively direct their soft skill development (**Figure 1**). Lectures, electives, and volunteering provide the foundation to develop and practice soft skills. Electives and mentorship direct these skills towards desired disciplines. Studying and participating in research with patient-centred outcomes enables students to take initiative in improving current and future care. We encourage all students to realize the positive influence and role they can have by actively integrating soft skills into their education, which in turn can translate into a very rewarding career in medicine.

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Save a Child's Heart: A Unique Global Health Model

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ABSTRACT

Save a Child's Heart (SACH) is a UN-sponsored Israeli non-profit organization that provides free, life-saving cardiac treatment to children from developing countries who would otherwise be unable to receive sufficient medical care in their home country. SACH utilizes a unique model of care involving several areas of focus including a tertiary care centre in Israel, international screening missions, training local healthcare professionals (HCPs), establishing local care facilities in partner countries, and engaging local and international volunteers. Through these efforts, SACH has been successful in providing cardiac care to 4599 children, training 116 HCPs, and establishing four independent surgical centres internationally. This model has proven its efficacy and can be applied to other tertiary surgical endeavors.

RÉSUMÉ

Sauver le coeur d'un enfant (SACH) est un organisme Israélien à but non lucratif parrainé par l'ONU qui offre des soins cardiaques gratuits et vitaux aux enfants des pays en développement qui seraient autrement incapables de recevoir des soins médicaux suffisants dans leur pays d'origine. SACH utilise un modèle unique de soins impliquant plusieurs domaines, dont un centre de soins tertiaires en Israël, des missions de dépistage internationales, la formation de professionnels de santé locaux, la mise en place de centres de soins locaux dans les pays partenaires et l'engagement de volontaires locaux et internationaux. Grâce à ces efforts, SACH a réussi à fournir des soins cardiaques à 4599 enfants, à former 116 HCPs et à établir quatre centres chirurgicaux indépendants à l'échelle internationale. Ce modèle a prouvé son efficacité et peut être appliqué à d'autres efforts chirurgicaux tertiaires.

Global health initiatives are essential to tackling global inequity. This article will explore the ways in which SACH, a unique global health initiative, has emphasized sustainability and can thus be used as a global health model. SACH is a UN-sponsored Israeli non-profit organization that provides free, life-saving cardiac treatment to children from developing countries who would be otherwise unable to receive sufficient medical care in their home country (1). The majority of children who present to SACH carry the diagnosis of Rheumatic Heart Disease (RHD) or Congenital Heart Disease (CHD), both of which bear a poor prognosis without treatment (1). Notably, more than 15 million people are diagnosed with RHD worldwide. The prevalence of RHD is highest in Sub-Saharan Africa (1 to 14 per 1000) and the 180-day mortality rate is observed to be as high as 17.8% (2). The incidence of CHD has been estimated at ~1% of live births (2). It is known to be the most common congenital malformation and is the leading cause of mortality as a result of congenital defects. A systematic review identified variations in mortality rates of CHD

worldwide which differed based on the availability of surgical and medical care (3). Such variations ranged from 3–7% to 20% in developed and developing countries, respectively (3). The 20% mortality rate in developing countries was also thought to be an under-reported value. This marked variation in mortality from CHD has been attributed to advances in developed countries in prenatal diagnosis, access to tertiary care centres, and medical and surgical treatment options for CHD. The lack of sustainable strategies for screening and prevention programs, financial resources, trained healthcare providers, and access to tertiary care centres for medical or surgical treatment in developing countries have also been contributing factors. The burden of CHD in developing countries and the need for improvement in care was demonstrated by the establishment of the World Society for Pediatric and Congenital Heart Surgery (WSPCHS) in 2006. The vision of WSPCHS is as follows: "that every child born anywhere in the world with a congenital heart defect should have access to appropriate medical and surgical care" (4).

Keywords: Global health, Non-profit organization, Cardiac, Volunteers, Sustainability

Individual patients receive short-term solutions from many global health initiatives, whereas long-term sustainable solutions are neglected. Attempts to overcome barriers to cardiac surgery in developing countries have included the transfer of children to countries abroad to receive care, as well as medical missions of surgical teams. Despite the short-term successes of such attempts, many global health initiatives do not achieve long-term solutions (2). Innovative, unique solutions are needed in developing countries as the current sporadic provision of cardiac care has had minimal impact; the optimal strategy in terms of sustainability involves local training and education (5). This is further supported by the demonstrated discrepancies between developed and developing countries in terms of disease burden and health workforce: Africa makes up over 24% of global disease but only 3% of global health workforce, in comparison to the Americas which make up 37% of the global health workforce, but only 10% of global disease (6).

SACH follows a unique global health model that demonstrates sustainability through its emphasis on long-term solutions. This is achieved by training healthcare professionals (HCPs) from developing countries as well as undergraduate medical students, and by establishing independent surgical centres in its partner countries (7). These initiatives help fill in the missing gaps for long-term solutions in addition to highlighting the importance of trainees in the process. This model is based on the following four pillars: 1) use of a tertiary care centre in Israel; 2) international screening missions to developing countries in collaboration with other non-governmental organizations (NGOs); 3) training local HCPs at the Israeli tertiary centre and establishing local care facilities in partner countries; 4) local and international volunteers that provide service in Israel, learn humanitarian work, and act as local ambassadors in their home countries (1). The efforts and impact of the sustainability of SACH's global health model can be quantified in a number of ways, including an evaluation of the number of HCPs trained, medical missions, independent surgical centres, and volunteers. SACH's emphasis on sustainability has resulted in 116 HCPs from 17 different countries being trained between 1996 and 2016 (7). Each HCP was trained in one of 8 different fields (**Figure 1**). The most common fields of training have been anesthesiology (n=32), nursing (n=26), surgery (n=21), cardiology (n=17), and intensive care (n=13) (7). Fourteen of the countries from which trained HCPs came from are part of the 53 countries in which SACH has provided cardiac care. SACH has also sent 73 medical missions to 13 countries as of 2017 (**Figure 2**). SACH has estab-

lished independent surgical centres in four of these countries: Romania, Moldova, Tanzania, and China. Currently, the organization is working to establish centres in Ethiopia and Ramallah (West Bank) (7). Furthermore, SACH has attracted 789 volunteers and medical interns between 2012 and 2017 (7), over half of which have been from Canada and the United States, while the remainder have been from 22 other countries (**Figure 3**).

Ultimately, these efforts have resulted in SACH providing medical care for 4599 children with heart conditions who were treated between 1996 and 2017 (7). Of note, 2159 (47%) of these children are Palestinians from the West Bank and Gaza. The remaining 2440 (53%) are from the 53 other countries served by SACH (**Figure 4**). A visualization of SACH's international impact is presented through a map in **Figure 5** which highlights the home countries of SACH patients, HCPs, and independent surgical centres.

The takeaway from SACH's mission is "we can and we should." This statement is the title of the first article concerning SACH written by the founder of SACH, Dr. Ami Cohen, and his colleagues (8).

"We Can." SACH has a comprehensive and unique model, as demonstrated above, and has the ability to create long-term improvement in cardiac care in low- and middle-income countries. SACH does this by training local health care professionals and undergraduate medical students, as well as establishing independent surgical centres in partner countries. Despite the importance of transferring patients to receive healthcare abroad and the need for healthcare teams to visit developing countries, these are ultimately not long-term solutions to global health issues. SACH has demonstrated through its unique four pillar model that establishing a long-term solution for global health issues is attainable.

"We Should." Every patient has the right to be treated regardless of their country of origin, race, sex, religion, socioeconomic background, and political beliefs. SACH continues to work toward making a positive and long-lasting impact on children in developing countries. This includes treating Palestinian children from the West Bank and Gaza who make up close to 50% of SACH children.

The SACH model of care is not only applicable to cardiac surgery and cardiac medical interventions; it is a model that has

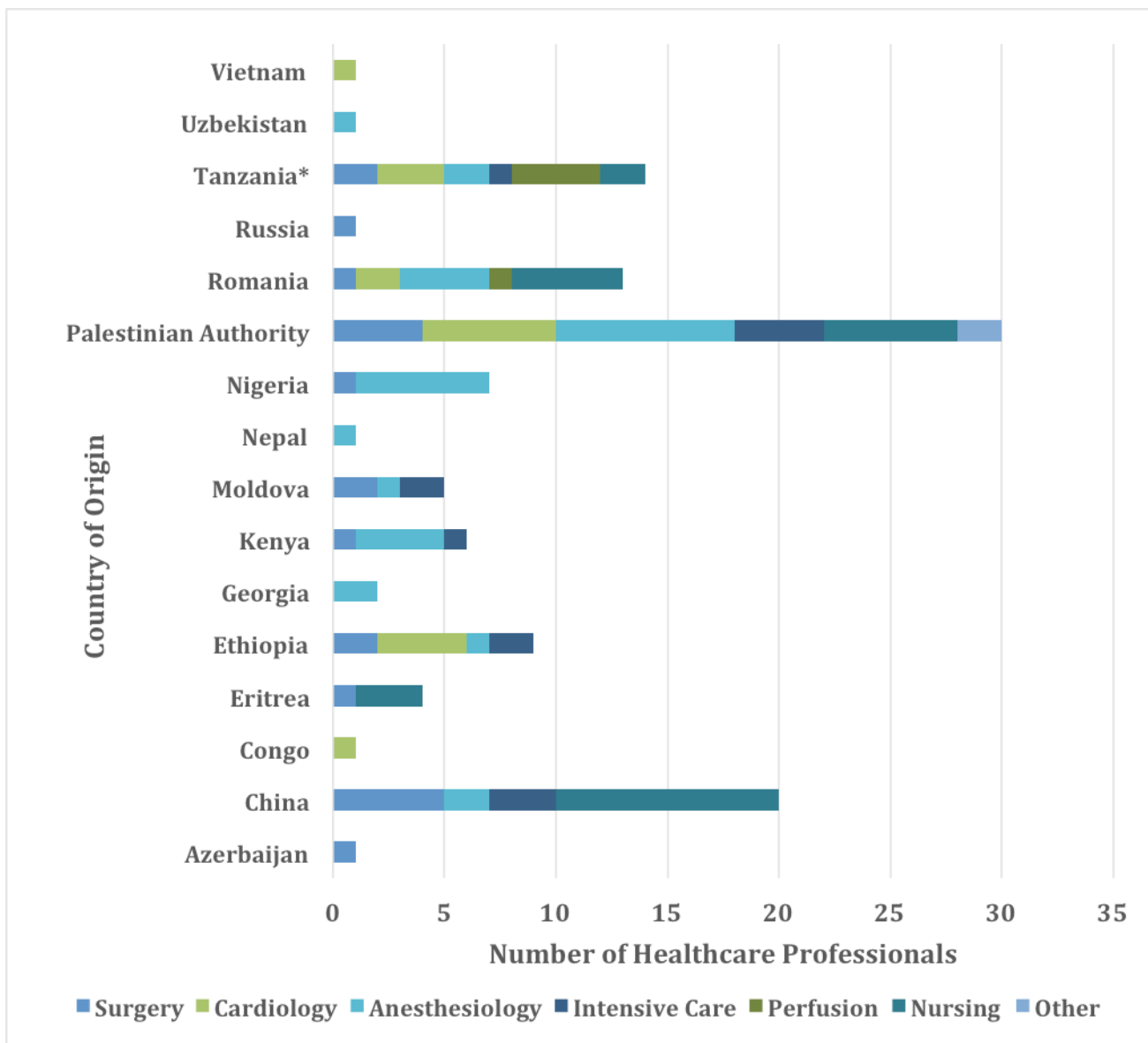


Figure 1. Number of healthcare professionals that have been trained by SACH stratified by medical discipline/specialty (1996–2016) (n=116). HCPs are grouped by country of origin. The 2 HCPs from the ‘Other’ category from the Palestinian Authority include 1 in Radiology and 1 in Fetal Ultrasound. *Healthcare professionals from Tanzania includes those from Zanzibar (7).

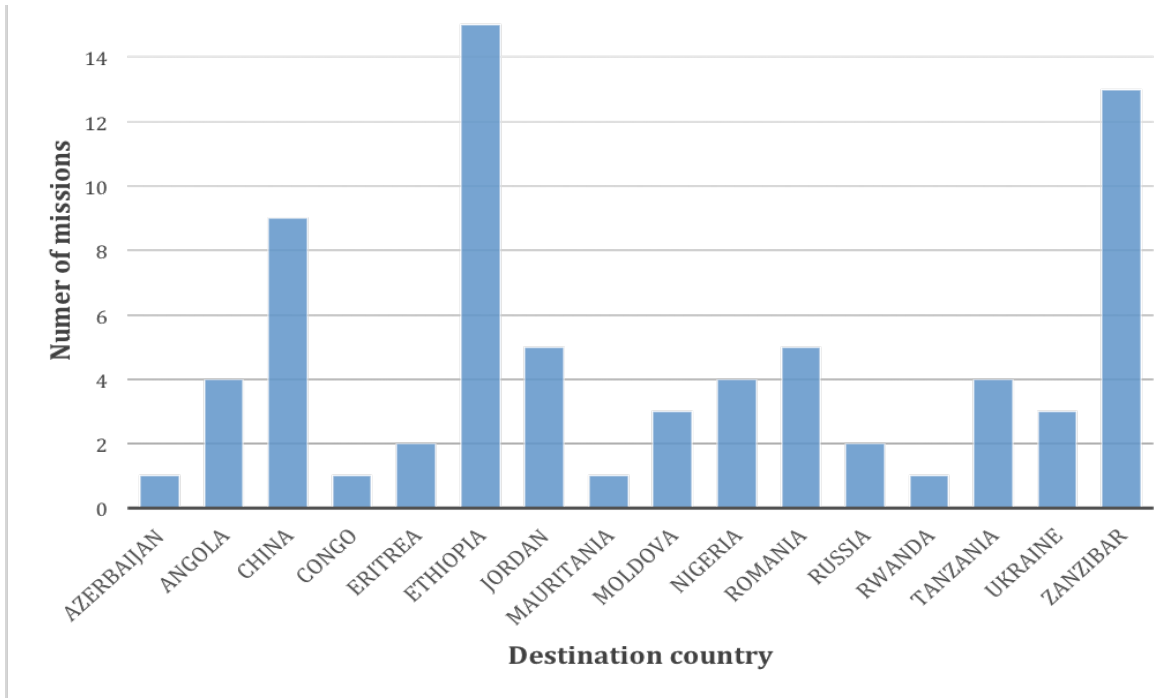


Figure 2. Destination countries and the associated number of missions that SACH has undertaken between 1996–2016 (n= 73).

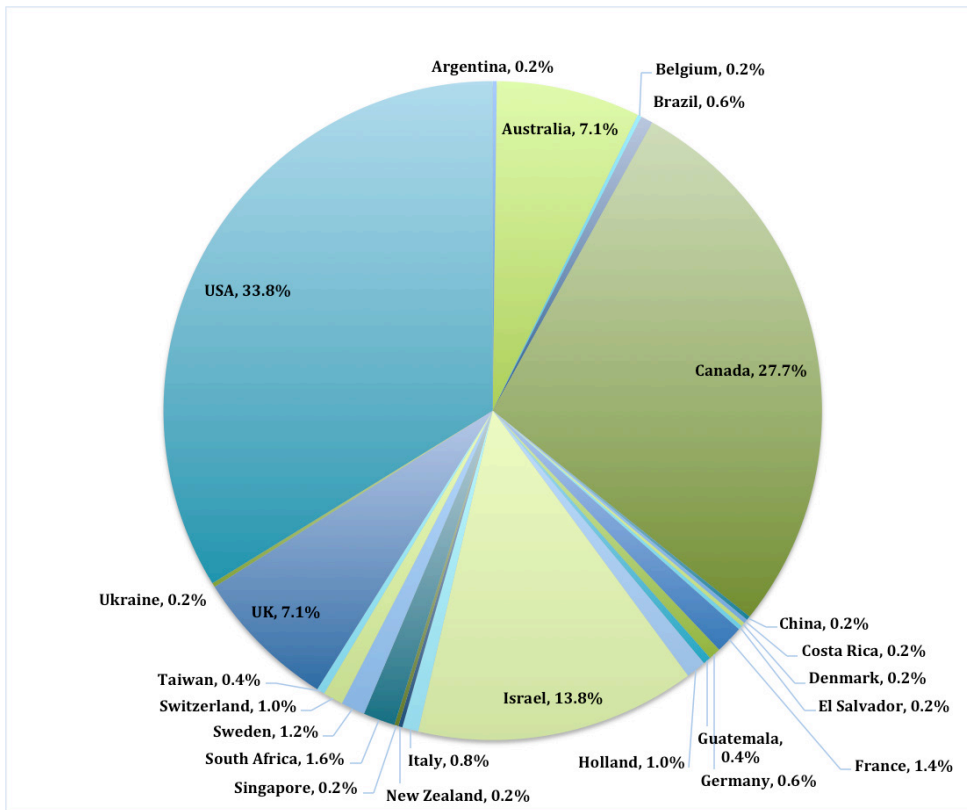


Figure 3. International volunteers with SACH (2012–2017). Proportion of individuals that have volunteered with SACH based on country (n=789).



COMMENTARY

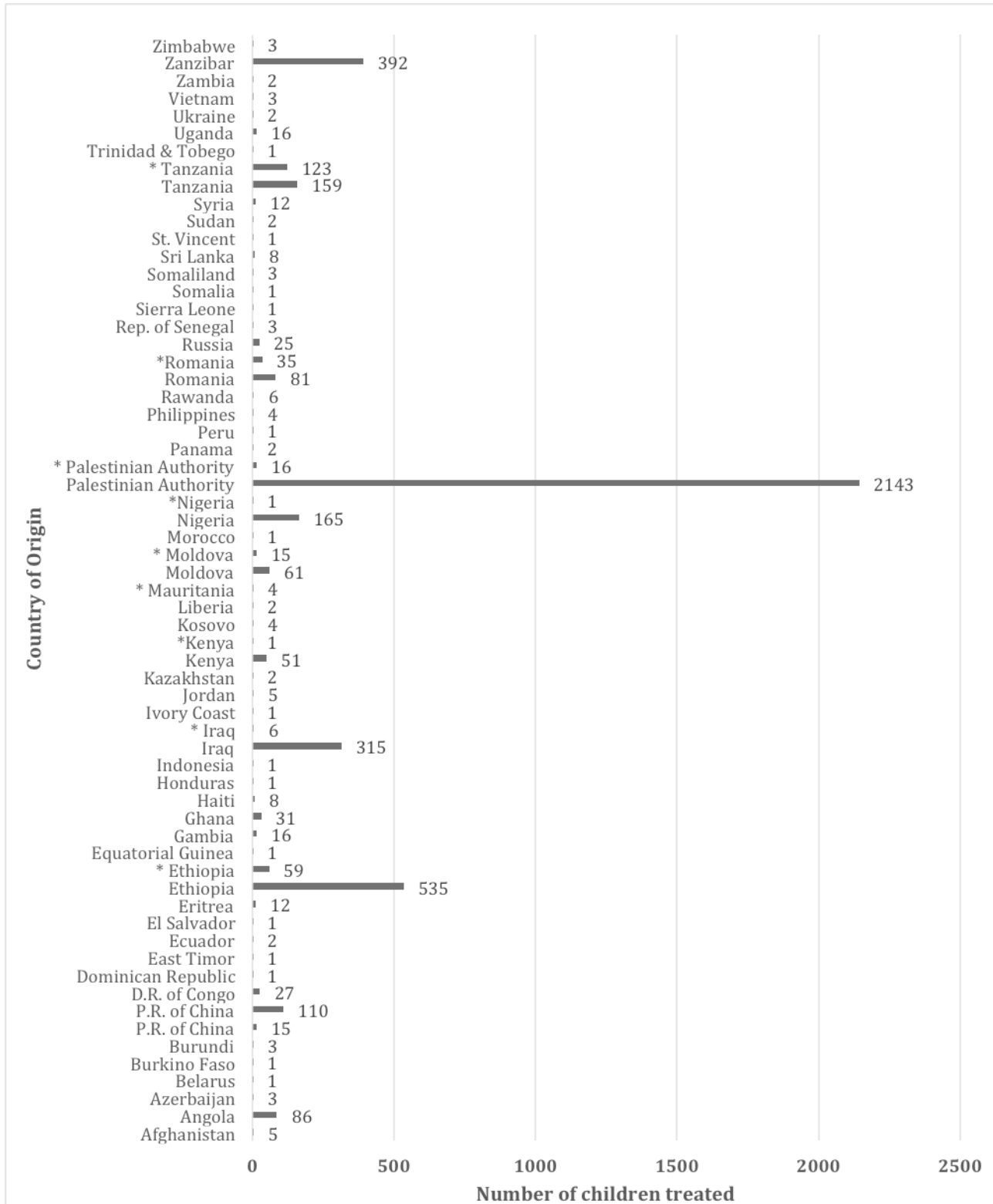


Figure 4. Children treated by SACH (1996–2017). Number and origin of children treated by SACH (n=4599). * Implies that children were treated in home country.

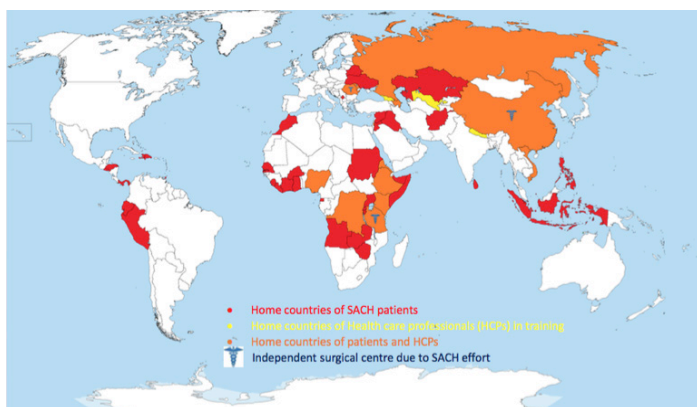


Figure 5. Visualization of SACH's international impact.

proven its efficacy and can be applied to other tertiary surgical endeavors. For instance, surgical interventions can be applied to craniofacial reconstruction, neurosurgery, complex spine surgeries, and other conditions that have a high level of burden in developing countries (1). Such endeavors can adopt the unique SACH global health model: a tertiary care site with locally-trained doctors who are skilled enough to simultaneously deliver local care and training (1). Perhaps this will allow us to one day see the world's heart beat as one.

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Approaches for the Identification and Management of Non-Compliance in Patients with Chronic Illness

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ABSTRACT

Patients with chronic illnesses often require complicated care, characterized by frequent follow-ups, exacerbations, and alterations in treatment. Understandably, patient non-compliance is not an uncommon occurrence, and may significantly diminish the quality of health care received. This paper explores the current approaches to chronic illness management, including strategies to identify and reduce non-compliance, as well as the physician's responsibilities in chronic illness management as guided by the CanMEDS roles. It also introduces a novel approach to the identification and management of non-compliance in patients with chronic illness: the Patient-System Interaction Model (PSIM).

RÉSUMÉ

Les patients atteints de maladies chroniques nécessitent souvent des soins complexes, caractérisés par des suivis fréquents, des exacerbations et des altérations du traitement. Naturellement, la non-conformité des patients n'est pas un phénomène rare et peut réduire considérablement la qualité des soins de santé reçus. Ce document explore les approches actuelles de la gestion des maladies chroniques, y compris les stratégies visant à identifier et à réduire la non-conformité, ainsi que les responsabilités du médecin dans la gestion des maladies chroniques guidées par les rôles CanMEDS. Il introduit également une nouvelle approche pour l'identification et la gestion de la non-conformité chez les patients atteints de maladie chronique: le modèle d'interaction patient-système (PSIM).

Non-compliance is an archetypal issue in the field of medicine. Non-compliance is particularly salient in the setting of chronic disease management, where patients may require frequent monitoring or counselling, intensification of treatment during acute exacerbations, complicated coordination of care, and the development of adequate self-management strategies in order to prevent future morbidity and mortality (1). Optimal chronic disease management is, understandably, often difficult to achieve. However, appropriate exploration of patient non-compliance under a chronic care framework, in addition to the patient's personal interactions with the healthcare system, may potentially combat this issue. Importantly, the CanMEDS roles should serve to guide the physician's efforts.

The chronic care model of disease management was first introduced by Wagner in 1998 in order to address deficiencies in chronic disease management (1,2). The model integrates community-based and health system-based approaches to improving care; an example of the former being the development of self-management strategies, and an example of the latter being enhanced decision supports. Specifically, the development of self-management strategies engenders an informed and active

patient, whereas optimal healthcare system management produces a proactive, cohesive healthcare team. Interactions between the patient—who is an active participant in their own care—and a knowledgeable healthcare team result in improved patient outcomes (such as adherence to prescribed medication) (2).

The physician's approach to the non-compliant patient should begin with an informal assessment of competence and proceed to subsequent exploration of the patient's current feelings and attitudes toward their condition and treatment plan. Specifically, self-management support systems should be assessed both individually by the physician and collaboratively by the healthcare team (including nurses, dietitians, and pharmacologists, among others). Additionally, an analysis of the healthcare delivery system is essential. This analysis should ensure appropriate allocation of tasks to providers, adequacy of planned interactions with the healthcare team, adequacy of follow-up and decision support, and utilization of community resources (2).

PATIENT-SYSTEM INTERACTION MODEL (PSIM)

Patients with chronic disease may demonstrate ineffective self-management despite integration of the principles described

Keywords: Chronic management; non-compliance; PSIM

in the chronic care framework. To improve this framework, it is imperative that the physician recognize and integrate the patient’s interaction with the healthcare system into the exploration of non-compliance in order to address ineffective self-management. The Patient-System Interaction Model (PSIM) of non-compliance introduces this concept and applies it to the management of chronic illness. In PSIM, an initial diagnosis leads to treatment (e.g. surgical or pharmacological). There is then a natural worsening of the chronic illness over time independent of treatment (the condition will continue to deteriorate irrespective of treatment). However, if not effectively managed by the healthcare team, this may lead to a loss of hope and distance from the medical team (for example, missed follow-up appointments). Loss of hope subsequently generates further distance from the medical team and poorer management of the chronic condition. Poorer management then results in an increase in morbidity and mortality and further worsening of the condition. Finally, morbidity and mortality are increased by distancing from the medical team (for example, lack of dose alteration, follow-up care) (please refer to **Figure 1**). Importantly, each of the antecedents leading to non-compliance in PSIM may be managed in order to reduce morbidity and mortality. For example, it is imperative that the physician ensure from the outset that the patient understands the natural progression of their illness in order to prevent loss of hope and subsequent poor self-management when the condition worsens. Additionally, it is essential that the physician ensure adequate follow-up in order to prevent distancing from the medical team, loss of hope, and subsequent morbidity and mortality. Lastly, reassurance and encouragement may be provided with closer follow-up, improving connections with the medical team, a sense of hope, and preventing poorer self-management and morbidity and mortality.

CASE EXAMPLE

These approaches may be applied to the following case: Jane, a 55-year-old bank executive, has come to your clinic in regards to her elevated glycated hemoglobin (HbA1c) (which has risen to 7.8%). She says she “feels fine, and actually better” without her prescribed metformin, and “doesn’t see the need for it”. Superficially, the resolution seems obvious—an explanation of the importance of optimal glucose control with either a tapering of the metformin dose or perhaps a switch to an alternative medication; however, this approach is likely to fail. The physician should first explore Jane’s feelings and attitudes about her condition and treatment plan (identifying loss of hope), ensur-

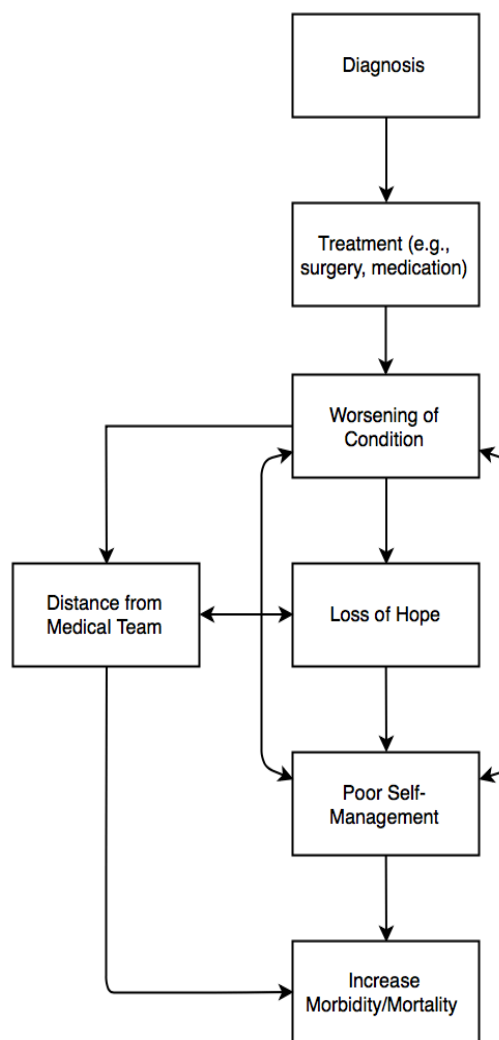


Figure 1. PSIM demonstrating causes of patient non-compliance when interacting with the medical system.

Note: Initial diagnosis leads to treatment (e.g. surgical or pharmacological). There is a natural worsening of the chronic disease over time independent of treatment (i.e. it will continue to deteriorate irrespective of treatment), however if not effectively managed by the healthcare team, this may lead to a loss of hope, and distance from the medical team (e.g. missed follow-up appointments). Loss of hope subsequently engenders further distance from the medical team, and poorer management of the chronic condition. Poorer management then results in an increase in morbidity and mortality, and further worsening of the condition. Finally, morbidity and mortality are increased by distancing from the medical team (e.g. lack of dose alteration, follow-up care). Each of the antecedents to non-compliance may be addressed in order to decrease morbidity/mortality (e.g. explanation of natural progression of disease, encouragement/reassurance, and adequate follow-up).

ing to describe the natural progression of her diabetes. For example, in our case, Jane mentions that her mother died of colon cancer; thus, her gastrointestinal symptoms on metformin have been concerning to her. Additionally, she has been disappointed with her increasing blood glucose levels despite dieting. Assessment and encouragement of Jane's self-management skills should then occur (for example, you discover that Jane has been monitoring her blood glucose infrequently and was unaware of the appropriate timing for monitoring). Lastly, the physician should assess and subsequently tailor the health-care delivery system to Jane; in our case, Jane had missed her last scheduled six-month HbA1c follow-up and was feeling depressed about her condition. Taking this all into account, an appropriate resolution for Jane may include: 1) individual support by her physician (determining where deficiencies exist, encouraging/reassuring to prevent loss of hope, adjusting medications if necessary, and providing education regarding long-term complications); 2) integration of care with a group of providers in order to develop coping strategies, create lifestyle and medication adherence goals, and access to community resources (such as group exercise classes, cooking classes, and peer-support groups); and 3) ensuring adequate follow-up (through group sessions with multiple providers) in order to prevent distancing from the medical team, loss of hope, and future morbidity and mortality (2).

APPLICATION OF THE CANMEDS ROLES

An analysis of Jane's case also demonstrates the relevance and importance of the application of the CanMEDS roles in the chronic care and PSIM frameworks. For example, as a professional, the physician is responsible for ensuring that standards of care are met and the well-being of the patient is maintained (principle of beneficence) (3,4). However, the physician is also responsible for ensuring patient-centered care and, where possible, that outcomes are resolved in the patient's favour (principle of autonomy) (3). Moreover, the physician must be capable of integrating both the roles of leader (taking responsibility for the delivery of patient care) and collaborator (working effectively with other members of the healthcare team to ensure adequate care). The physician must also be an effective communicator in order to identify and express where deficiencies in care exist (3,4).

CONCLUSION

Patient non-compliance is often a challenging issue, particularly in the setting of chronic disease management. These patients

require complicated care, commonly characterized by frequent follow-ups, exacerbations, and alterations in treatment. However, if physicians effectively explore patients' feelings and attitudes through the framework of the chronic care model (with the CanMEDS roles serving as a guide) while identifying and addressing the principles described in the PSIM framework, they will likely be more successful in reducing patient morbidity and mortality (1).

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Changing Trends in Hyperacute Stroke Treatment and Early Clinical Outcomes Reflecting Recent Improvement in Endovascular Thrombectomy Techniques

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ABSTRACT

Objective: Ischemic stroke is a major disease causing death and permanent neurological disability with the mainstay treatment being to re-establish blood flow as quickly as possible. Recent changes in the efficiency of endovascular devices performing thrombectomies have led to it now being considered the gold standard. Nevertheless, successful endovascular thrombectomy (EVT) requires access to many resources and expertise which may impact its effectiveness. The objective of the current study is to describe the application and utility of EVT in the clinical treatment of ischemic stroke at a single tertiary care hospital.

Methods: This is a descriptive retrospective cohort study from a stroke database. A total of 548 patients diagnosed with an ischemic stroke affecting large cerebral arteries between January 2010 and June 2016 were included. National Institute of Health Stroke Scale (NIHSS) score was used to evaluate stroke severity upon admission. Modified Ranking Scale was used to determine the functional status of patients upon discharge. Successful reperfusion defined as a TIC1 score of 2B or 3, age, thrombolytic use and time-to-treatment were all considered for analysis.

Results: Thrombectomies became more frequent ($p < 0.001$) with shorter time-to-treatment in recent years ($p = 0.001$). A successful thrombectomy has significantly improved functional status at discharge ($p < 0.001$), even when thrombolytics were not given ($p = 0.003$) or when patients were over 80 years old ($p = 0.021$).

Conclusion: The current work provides evidence that this single hospital has increased its frequency of application of EVT for ischemic stroke, leading to a better functional outcome at discharge independent of prior thrombolysis or age.

RÉSUMÉ

Objectif: L'accident vasculaire cérébral ischémique est une maladie majeure causant la mort et une invalidité neurologique permanente. Le traitement principal consiste à rétablir la circulation sanguine le plus rapidement possible. Des changements récents dans l'efficacité des dispositifs endovasculaires effectuant des thrombectomies ont conduit à ce qu'il soit maintenant considéré comme norme de référence. Néanmoins, le succès de la thrombectomie endovasculaire (TEV) nécessite l'accès à de nombreuses ressources et compétences qui peuvent avoir un impact sur son efficacité. L'objectif de la présente étude est de décrire l'application et l'utilité de la TEV dans le traitement clinique de l'AVC ischémique dans un seul hôpital de soins tertiaires.

Méthodes: Ceci est une étude de cohorte rétrospective descriptive réalisée à partir d'une base de données sur les AVC. Un total de 548 patients ayant reçu un diagnostic d'accident vasculaire cérébral ischémique touchant de grandes artères cérébrales entre janvier 2010 et juin 2016 ont été inclus. Le score du National Institute of Health Stroke Scale (NIHSS) a été utilisé pour évaluer la gravité des AVC à l'admission. Une échelle de classement modifiée a été utilisée pour déterminer l'état fonctionnel des patients à la sortie. Le succès de la reperfusion définie comme un score TIC1 de 2B ou 3, l'âge, l'utilisation thrombolytique et le délai de traitement ont tous été pris en compte pour l'analyse.

Résultats: Les thrombectomies sont devenues plus fréquentes ($p < 0,001$) avec un délai de traitement plus court ces dernières années ($p = 0,001$). Une thrombectomie réussie a significativement amélioré l'état fonctionnel à la sortie ($p < 0,001$), même lorsque les thrombolytiques n'étaient pas administrés ($p = 0,003$) ou lorsque les patients avaient plus de 80 ans ($p = 0,021$).

Conclusion: Le travail actuel fournit la preuve que cet hôpital seul a augmenté sa fréquence d'application de la TEV pour l'accident vasculaire cérébral ischémique, conduisant à un meilleur résultat fonctionnel à la sortie indépendamment d'une thrombolyse antérieure ou de l'âge.

Keywords: Stroke; Thrombectomy; Ischemic; Hyperacute

Stroke is a major disease with increasing prevalence, currently affecting over an estimated 400 000 Canadians, causing death and permanent neurological disability, leading to heavy economic burden from hospitalizations, long-term disability and productivity loss (1).

Blood flow must be re-established as quickly as possible during an ischemic stroke to minimize brain cell death. The use of intravenous clot busting drugs, known as thrombolytics, are approved for the treatment of hyperacute ischemic strokes. The use of thrombolytics alone is traditionally viewed as a risky medical procedure since it may cause or exacerbate an intracerebral hemorrhage or systemic bleeding with potentially deadly side effects; therefore, it is only recommended to offer this treatment if it can be given within 4.5 hour of stroke onset (2,3). These potentially lethal side effects of thrombolytics lead the Canadian Association of Emergency Physicians to adopt a more conservative 3 hour time limit for thrombolytic use (4).

The use of endovascular devices to remove cerebral blood clots has been a promising method to quickly and effectively restore blood flow following an ischemic stroke with less side effects and more efficiency than thrombolytics. Limitations in advanced neuroimaging, poor recanalization using first generation devices and prolonged time-to-treatment have led to prior negative randomized controlled studies (5). Recent improvements in the thrombectomy techniques and imaging triage have led to a string of successful clinical trials (6) resulting in endovascular thrombectomies (EVT) being considered the gold standard of care (7) and causing the revision of hyper-acute stroke guidelines by the American Stroke Association and Heart & Stroke Foundation of Canada (2,8). Endovascular thrombectomies have been found to be safe when combined with intravenous thrombolytics and in patients on oral anticoagulants (9,10) and has a larger therapeutic window of 6 hours that could become larger pending more research (2).

Nevertheless, a successful endovascular thrombectomy requires access to many resources which may not be available in all medical centers. These resources include access to advanced neuroimaging, intensive care unit (ICU), angiography suite time interventional neuroradiology and preferably a dedicated stroke team. Additionally, the use of endovascular treatment is limited to large-vessel occlusions and is estimated to apply in only 7% to 13% of ischemic strokes depending on the permissive criteria (11).

Although there is promising research demonstrating the utility of endovascular thrombectomies, there is a lack of evidence to demonstrate how this has influenced the clinical practice of hyperacute stroke treatment. The objective of the current study is to describe the application and utility of EVT in the clinical treatment of ischemic stroke of large cerebral vessels at a single tertiary care academic hospital.

METHODS

Study design and participants

We conducted a single center retrospective cohort study from a stroke database consisting of consecutive patients who underwent CT perfusion (CTP) scanning in a 320-multislice Toshiba CT scanner at the Civic Campus of The Ottawa Hospital (TOH) following a stroke code. Our dataset represents a random subset of the stroke patients in the Ottawa Valley region chosen as part of a larger study on CTP in stroke. Suspected acute stroke patients within our catchment area are all redirected to the Civic Campus of TOH where advanced hyperacute stroke care is provided by a dedicated stroke team. The current study collected clinical data of these stroke patients by performing a chart review from electronic patient record (vOacis) to document their follow-up course and prognosis. Data was collected starting from January 2010 until June 2016.

Patients diagnosed with an ischemic stroke and documented thrombus in the anterior cerebral artery (ACA), middle cerebral artery (MCA), posterior cerebral artery (PCA), vertebral and/or basilar artery were included. There were no exclusion criteria based on age, morbidity, time-to-treatment or concurrent treatment with intravenous thrombolytics. All data was collected using online, de-identified patient records: the electronic medical record (vOacis) and radiological database (PACS). Approval for this study was obtained from the local REB (OHSN-REB 2009474-01H). Data were collected regarding each patient's presentation, clinical course, diagnostic imaging and thrombectomy results and follow-up.

Institutional acute stroke workflow

For patients presenting with suspected stroke, an Emergency Department physician initiates a stroke code. The dedicated stroke team consists of a neurologists, diagnostic and interventional neuroradiologists, neurological ICU team with support from emergency department physicians, nurses and stroke coordinators. Patients first undergo a neurological exam, NIHSS score calculation, blood glucose levels and an acute stroke CT scan protocol.

Our acute stroke imaging starts with a non-contrast CT followed by combined whole brain perfusion and cranial CT angiogram (CTA) acquisition. This is followed by CTA of the neck with a separate bolus of contrast injection. The NIHSS score, the CT scan and the patient health records are then analyzed in order to assess inclusion and exclusion criteria for thrombolytics, with an aim of this assessment occurring within 60 minutes of the stroke code being called, and/or providing a thrombectomy if occlusion is suspected from a CT angiogram (12). Usually the patients will have intravenous thrombolytics as they are being prepared for thrombectomy.

Stroke assessment

We identified patients with suspected acute stroke less than 6 hours from symptom onset who had CT scans as per our stroke protocol and confirmed thrombus in one of the large intracranial arteries. NIHSS scores of less than 5 were considered mild, 6-13 moderate, and scores over 13 were considered a severe stroke (13). The Modified Ranking Scale (mRS) was used to determine the degree of disability of the stroke patients upon discharge. A score of 0-2 was considered functionally independent while a score of 3-5 was considered functionally dependent, and a score of 6 indicating death (14). Details of treatment received with thrombolytics or endovascular thrombectomies were recorded. A thrombectomy was considered successful if a Thrombolysis In Cerebral Infarction (TICI) score of Grade 2B or 3 was achieved (15). time-to-treatment for thrombectomies was considered as the time interval between time of stroke onset until groin puncture rounded to the half hour.

Statistical analysis

Univariate and descriptive statistics were calculated for all study variables. Pearson's correlation was used to determine the relationship between different measures. Differences in continuous measures were assessed using 2-sample t-tests, and categorical measures were assessed using Chi-square test. One-Way ANCOVAs were used to assess differences in continuous variables while controlling for a covariate of stroke severity identified during the correlation analysis. We evaluated the association between thrombectomies and mRS scores using logistic regression analysis while controlling for confounding factors of age, time-to-treatment, thrombolytic treatment and NIHSS stroke severity. This analysis was compared between 7 different years (2010 – 2016). Post hoc analysis was performed with Bonferroni correction to control for multiple comparisons. All p values were two-tailed, and a value of less than 0.05 was

considered statistically significant. All analyses were performed using SPSS software version 17.0 for Windows® (Chicago, IL, USA).

RESULTS

Year-to-year variability

A total of 1361 patients have undergone the stroke code and CTP scanning at TOH between January 2010 and June 2016. From these patients, 560 were found to have an acute thrombus involving the ACA, MCA, PCA or basilar artery and were included in the analysis. Table 1 summarizes all our results from year-to-year. The number of stroke cases treated in our dataset have increased gradually over the years, except for a spike in strokes in 2011. The average age of all patients was 73 years and 53% of the participants were females with no significant fluctuations from year-to-year, $p > 0.05$. NIHSS scores were only noted in 525 of our participants, with severe stroke being the most common type of stroke at 37.5%, followed by moderate stroke at 33.7% and mild strokes at 28.8%. There is some significant year-to-year variability in stroke severity ($F = 2.178$, $p = 0.044$), and post hoc analysis revealed that 2014 had less severe strokes than 2010, 2013, 2015 and 2016, $p < 0.05$. There was a total of 29 strokes involving the ACA, 484 involving the MCA, 51 involving the PCA and 31 involving the basilar artery, representing 5.2%, 86.4%, 9.1% and 5.5% of all strokes, respectively. These proportions did not significantly differ between years.

A total of 320 (57.1%) patients received thrombolytics to treat their strokes. Treating with thrombolytics varied significantly between years $F = 2.40$, $p = 0.027$. Post hoc analysis demonstrated that 2014 had significantly less use of thrombolytics compared to 2010, 2015 and 2016, $p < 0.05$. Thrombolytics were also more common in 2015 than in 2011. The use of thrombolytics in 2016 was more frequent than 2013 and 2011. The overall mRS, mortality and corresponding functional status of the patients at discharge did not change significantly between years.

As shown in **Figure 1**, thrombectomies became more frequent in recent years; $F = 9.295$, $p < 0.001$. Post hoc analysis revealed that both 2013 and 2014 had significantly more thrombectomies than 2010, $p < 0.05$, while 2015 and 2016 having significantly more thrombectomies than all other years (2010-2014), $p < 0.05$. Thrombectomy time-to-treatment has significantly improved over the years, $F = 3.374$, $p = 0.001$. time-to-treatment in 2014 and 2016 were each significantly faster than 2011 and 2012, while 2015 had the fastest time-to-treatment times, being significantly faster than 2011, 2012 and 2013 ($p < 0.05$).

Table 1. Summary of demographic and stroke data of all patients.

	2010	2011	2012	Year			
				2013	2014	2015	2016
Number	62	106	89	70	78	102	53
Gender	♂ 32	♂ 48	♂ 43	♂ 38	♂ 38	♂ 38	♂ 26
	♀ 30	♀ 58	♀ 46	♀ 32	♀ 40	♀ 64	♀ 27
Age	70.3 ±	72.8 ±	72.2 ±	77.6 ±	70.4 ±	74.5 ±	74.2 ±
	15.6	16.5	13.3	11.8	16.5	15.4	15.5
NIHSS							
Mild	14 (22.5%)	31 (29.2%)	28 (31.5%)	14 (20.0%)	33 (42.3%)	22 (21.6%)	9 (17.0%)
Moderate	18 (29.0%)	32 (30.2%)	24 (27.0%)	23 (32.9%)	20 (25.6%)	36 (35.3%)	24 (45.3%)
Severe	22 (35.5%)	35 (33.0%)	30 (33.7%)	31 (44.3%)	21 (26.9%)	39 (38.2%)	19 (35.8%)
Unreported	8 (12.9%)	8 (7.6%)	7 (7.8%)	2 (2.8%)	4 (5.1%)	5 (4.9%)	1 (1.9%)
mRS							
Functional	24	55	35	30	38	44	26
Dependent	23	36	42	27	28	41	21
Death	15	15	12	13	12	17	6
ACA	5	4	3	2	5	9	1
MCA	50	95	70	63	68	90	48
PCA	8	9	12	5	9	5	3
Basilar	5	6	9	2	1	6	2
tPA	40	53	49	37	37	66	38
Thrombectomy	2	9	8	11	14	32	21
Unsuccessful	0	2	0	1	1	5	2
Time-to-treat	3.0 ± 2.8	5.8 ± 6.5	5.4 ± 2.6	4.1 ± 1.2	3.6 ± 2.3	2.6 ± 0.9	3.7 ± 2.4

Continuous data were reported with the mean and standard deviation (SD). Categorical data were summarised as frequency (n) and percentage (%).

Predictors of post-stroke functional outcome

Pearson's correlation found that better functional status is related to lower age $r=0.300$, $p<0.001$, milder stroke severity $r=0.409$, $p<0.001$, thrombectomies $r=-0.11$, $p=0.009$, successful thrombectomies $r=-0.165$, $p<0.001$ and reduced time-to-treatment $r=0.207$, $p=0.042$. Functional status was not related to the use of thrombolytics ($p>0.05$) and was not used in the following linear regression analysis. A linear regression was calculated to predict mRS scores based on age, stroke severity and thrombectomy. A significant regression equation was found; $F=81.105$, $p<0.001$, with an R^2 of 0.318. It was found that age ($\beta=0.245$, $p<0.001$), thrombectomy ($\beta=-0.210$, $p<0.001$) and stroke severity ($\beta=0.475$, $p<0.001$) were each significant predictors of mRS scores.

When including only recent patients after 2015 and only successful thrombectomies, the significant regression; $F=39.871$, $p<0.001$; had an improved R^2 of 0.452. With the stroke severity being the strongest significant predictor of mRS scores ($\beta=0.53$, $p<0.001$), followed by successful thrombectomy ($\beta=-0.424$, $p<0.001$) then the age of the patient ($\beta=0.21$, $p=0.002$).

Efficacy of thrombectomies on functional status

A successful thrombectomy has significantly improved functional status at discharge $t=3.94$, $p<0.001$, as shown in **Figure 2**. Specifically, thrombectomies were found to be a successful treatment for eligible patients with MCA strokes $t=4.079$, $p<0.001$, but the 4 patients with basilar strokes who received a thrombectomy were not shown to have an improved func-

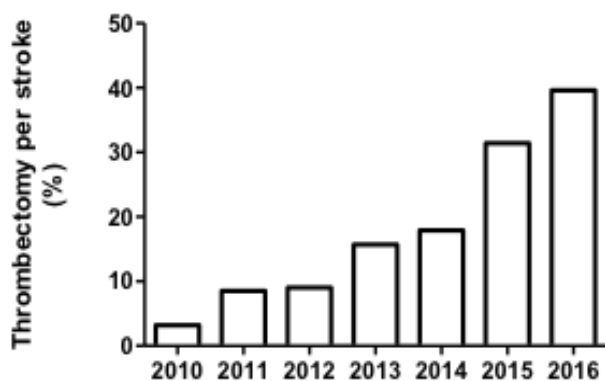


Figure 1. The percentage of patients with ischemic strokes who received thrombectomies according to the year the patient was admitted.

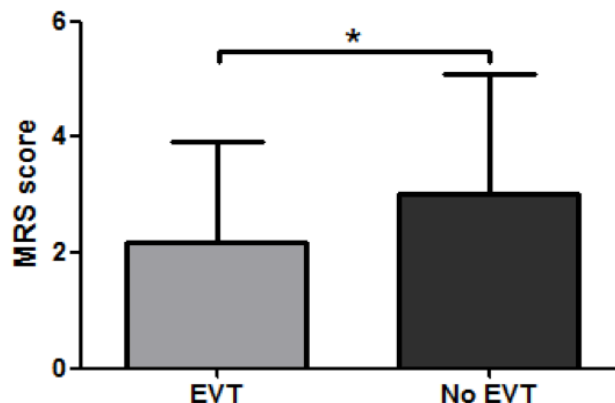


Figure 2. mRS score depending on a successful endovascular thrombectomy (EVT) and without the treatment (No EVT). * represents $p < 0.01$.

tional status compared to the other basilar strokes patients; $t=0.167$, $p=0.869$.

The 11 cases of thrombectomies with a time-to-treatment of 6 hours and over were found to not significantly affect functional status, $t=0.922$, $p=0.357$, but it almost reached significance when controlling for stroke severity, $F=3.827$, $p=0.051$.

When controlling for stroke severity, thrombectomies were shown to be an effective treatment for ischemic strokes in a subset of patients who did not receive thrombolytics; $F=9.181$, $p=0.003$.

Efficacy of thrombolytics on functional status

The application of thrombolytics was not found to significantly improve functional status at discharge; $t=-1.243$, $p=0.214$, even when controlling for stroke severity; $F=3.581$, $p=0.059$. However, thrombolytics were found to significantly improve functional status when excluding mild strokes; $t=2.348$, $p=0.019$.

Efficacy of hyperacute ischemic stroke treatment in older patients

In addition to be related to functional outcome, age was found to be correlated to stroke severity $r=0.124$, $p=0.004$. In patients over 80 years of age, thrombectomies were only found to significantly improve functional outcome when controlling for the covariate of stroke severity; $F=5.393$, $p=0.021$. The

application of thrombolytics in this age group was found to be associated with significantly worse functional outcomes; $t=-2.639$, $p=0.009$; however, this propensity disappeared when controlling stroke severity; $F=1.127$, $p=0.290$.

DISCUSSION

We have provided preliminary evidence that the recent advancements in the use of thrombectomy as a treatment of hyperacute ischemic stroke has significantly influenced clinical practice in our center. Our main finding of the current descriptive study is that EVT at the Civic Campus of TOH have greatly increased in use in recent years, and its application is associated with a better clinical outcome score at discharge.

Year-to-year variability

Age, mortality and cerebral artery involved did not change with year. The descriptive nature of the current study has led to a lack of uniformity in our patients between years, such as the increase in participants in 2011, a reduction in stroke severity and the concomitant thrombolytic use in 2014. These changes could be due to random fluctuation in the patients treated at TOH. Our prevalence of thrombolytics are similar to other reports, where there can be a large proportion of patients who do not receive thrombolytics for various inclusion or exclusion criteria (16). The increase use of thrombolytics in 2015 and 2016 could partially be caused by the increased consultations to TOH for thrombectomies in eligible participants around the Ottawa Valley and better organized acute stroke care in the catchment area.

Prevalence of thrombectomies

There has been a dramatic increase in the percentage of hyperacute stroke patients treated with thrombectomies in recent years, from 3.2% of strokes in 2010 to 39.6% of cases in 2016 as depicted in Figure 1. The percentage of treated cases is far above the predicted 13% of all ischemic strokes predicted (11). Despite this high prevalence, there is no change in proportion of cerebral artery involved or chances of performing a successful thrombectomy. This could be partially explained by the fact that thrombectomies can only be performed in large cerebral arteries and we only included patients with ischemic strokes where large cerebral arteries were involved. Additionally, there is evidence for increased use and reduced time-to-treatment of thrombectomies in 2014; however, this becomes much more apparent in 2015 coinciding with the successful clinical trials and new strokes treatment guidelines (6,8).

Predictor of functional outcome

Consistent with previous reports, we have found that the strongest predictor of functional outcomes following stroke is the age of the patient and stroke severity (17). We also found that thrombectomies and time-to-treatment of the thrombectomy were significantly related to functional outcome; however, the application of thrombolytics was not related to functional outcome. A linear regression demonstrated that around 32% of all variability in functional outcome following ischemic stroke can be predicted using stroke severity, age and the utilisation of a thrombectomy. When we repeated this linear regression for ischemic strokes in 2015 and 2016, its predictive power increased to explain 45.2% of all variability, and the utilisation of a successful thrombectomy was a better predictor than age.

Functional outcomes following a thrombectomy

A successful thrombectomy was found to be an effective treatment to improve functional outcome following an ischemic stroke even in the absence of thrombolytics and tended towards being efficient even after the suggested 6-hour time limit (2). This is in accordance with the recent meta-analysis concluding that EVT will benefit most patients with an eligible acute ischemic stroke even if they are over the age of 80 years of age or not eligible for thrombolytics (18). Specifically, this meta-analysis found that the number needed to treat with EVT was 2.6 to reduce the mRS score by at least 1 (18). Despite this recent overwhelming evidence favoring EVT, these findings have not been noted in studies prior to 2015 (19,20).

Specifically, we found an overall effect that thrombectomy led to

a lower mRS score at discharge. Although thrombectomies were found to be therapeutically effective in 2012 and 2014, it became much more apparent in 2015 and 2016 as seen in **Table 2**. This is likely due to the increased efficiency in providing thrombectomies to ischemic stroke patients as shown by a reduced time-to-treatment, which has important implications on functional outcomes (21).

Although the thrombectomy was found to be an effective treatment for select patients with ischemic strokes involving the MCA, it was not found to be effective in improving the functional outcome with basilar artery occlusion. The limited number of cases involving the basilar artery thrombus may not be representative sample for this population since a recent meta-analysis has found that endovascular re-perfusion techniques improve functional outcome after basilar artery occlusion (22).

The subset of adults over 80 years of age have also been found to benefit from mechanical thrombectomy as a treatment for ischemic stroke, suggesting that there might be no upper age limit for the utility of thrombectomies. This is in accordance with recent research suggesting that patients older than 70 years of age benefit the most from successful reperfusion following mechanical thrombectomy(23).

Limitations

There are clear limitations to the current study such as the descriptive nature of this study, which prevents any conclusive interpretations of the true efficacies of the observed treatment. There is no short- or long-term follow-up of our stroke patients. We only used a subset of patients who had advanced stroke CT scanning, possibly creating the potential for selection bias. Our stroke database possesses limited health information that could influence stroke treatment or functional outcome such as atrial fibrillation, diabetes, anti-coagulant treatment or history of previous strokes (24). We also did not include any sub-analysis of the different endovascular devices used for the thrombectomy procedures where the newer devices have been found to have improved rapidity and degree of revascularization (25).

CONCLUSION

The current descriptive paper provides evidence that the Civic Campus of TOH has increased its frequency of application of EVT for the treatment of new hyperacute stroke.

Table 2. Functional status evaluated using mRS scores at discharge in patients who received different ischemic stroke treatments.

Treatment group	Year						
	2010	2011	2012	2013	2014	2015	2016
No treatments	2.2 ± 2.4 (22)	2.5 ± 1.6 (52)	2.7 ± 2.1 (38)	2.9 ± 2.2 (33)	2.8 ± 2.1 (37)	3.5 ± 2.2 (32)	3.0 ± 1.8 (11)
Thrombolytics	3.9 ± 2.0 (40)	3.2 ± 2.0 (53)	3.1 ± 2.0 (49)	2.8 ± 2.3 (37)	2.6 ± 2.3 (37)	2.8 ± 1.9* (66)	2.5 ± 2.0 (21)
Thrombectomy	6.0 ± 0.0 (2)	3.3 ± 1.8 (9)	2.6 ± 2.1 (8)	2.8 ± 2.0 (11)	2.0 ± 1.8 (14)	2.5 ± 1.9** (32)	1.8 ± 1.5** (38)
All patients	3.3 ± 2.3 (62)	2.9 ± 1.8 (106)	3.0 ± 2.0 (89)	2.9 ± 2.2 (70)	2.7 ± 2.2 (78)	3.0 ± 2.0 (102)	2.6 ± 1.9 (53)

Data was reported as mean ± standard deviation (SD) with frequency reported underneath (n). ANCOVAs were conducted controlling for stroke severity to evaluate the effect of specified treatment on mRS scores. * indicates $p < 0.05$; ** indicates $p < 0.001$.

These thrombectomies have led to a better functional outcome at discharge for those who were eligible for this treatment despite the absence of prior thrombolysis or advanced age.

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The Development and Impact of Clinical Skills Handbooks in Undergraduate Medical Education

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ABSTRACT

Introduction: Traditional teaching of clinical skills in medical school commonly entails didactic teaching followed by practice sessions with Standardized Patients (SPs) for particular skills, such as the cardiovascular exam. To address the need for briefer and more concise reference guides from standard textbooks and to consolidate skills expectations, the University of Ottawa developed clinical skills handbooks for students. The purpose of this study was to evaluate students' use of these handbooks in the pre-clinical and clinical years.

Methods: We distributed a survey to second, third, and fourth year medical students at the University of Ottawa from November 2016 to January 2017. The survey assessed how frequently students used the booklets and their opinions on the usefulness of the booklets as a learning tool.

Results: There were 121 respondents of 492 students eligible for the survey. Of the respondents, 96.7% claimed to have used the booklets, and 75% claimed it was their primary resource for physical exam skills education. The majority of pre-clinical students used the booklets when learning a physical exam—65% almost always, and 97% at least sometimes. The majority of clinical students (also referred to as clerkship students) used the booklets when reviewing a physical exam—25% almost always, and 64% at least sometimes. Most students used the booklets when studying for OSCEs—65% almost always, and 94% at least sometimes.

Conclusions: Students at the University of Ottawa found the clinical skills handbooks to be a valuable resource during their medical training and for the majority, it was their most commonly used reference. These findings support the need for further development and use of these resources.

RÉSUMÉ

Introduction: L'enseignement traditionnel des compétences cliniques à l'école de médecine implique généralement un enseignement didactique suivi de séances pratiques avec des patients standardisés (SP) pour des compétences particulières, telles que l'examen cardiovasculaire. Pour répondre au besoin de guides de référence plus concis à partir des manuels standards et pour consolider les attentes en matière de compétences, l'Université d'Ottawa a élaboré des manuels de compétences cliniques pour les étudiants. Le but de cette étude était d'évaluer l'utilisation de ces manuels par les étudiants dans les années pré-cliniques et cliniques.

Méthodes: Nous avons distribué un sondage aux étudiants de deuxième, troisième et quatrième année en médecine à l'Université d'Ottawa de novembre 2016 à janvier 2017. Le sondage a évalué la fréquence d'utilisation des livrets et leurs opinions sur l'utilité des livrets comme outil d'apprentissage.

Résultats: Il y avait 121 répondants de 492 étudiants admissibles à l'enquête. Parmi les répondants, 96,7% ont déclaré avoir utilisé les brochures, et 75% ont affirmé que c'était leur ressource principale pour l'éducation aux compétences d'examen physique. La majorité des étudiants pré-cliniques utilisaient les livrets lorsqu'ils apprenaient un examen physique - 65% presque toujours, et 97% au moins parfois. La majorité des étudiants en clinique (également appelés étudiants stagiaires) ont utilisé les brochures pour la préparation pour l'examen - 25% presque toujours, et 64% au moins parfois. La plupart des étudiants ont utilisé les brochures lorsqu'ils étudiaient pour les OSCE - 65% presque toujours, et 94% au moins parfois.

Conclusions: Les étudiants de l'Université d'Ottawa ont trouvé que les guides sur les compétences cliniques étaient une ressource précieuse durant leur formation médicale et que, pour la majorité d'entre eux, c'était leur référence la plus couramment utilisée. Ces résultats appuient la nécessité de poursuivre le développement et l'utilisation de ces ressources.



The acquisition of clinical skills is a core component of medical education and a basic element of physician skills that is important throughout a physician's career (1). A common teaching method for clinical skills involves the use of Standardized Patients (SPs) – individuals who have been trained to simulate real patient interactions, allowing students to practice clinical skills in a standardized method and under the supervision of a tutor. This approach is recommended by the American Association of Medical Colleges over didactic methods (1). This method is useful as it allows students to receive feedback from both the SPs and a trained clinician, allows for translation of skills from knowledge to application, and can be used for testing purposes (2-5). However, because these sessions tend to be limited to a specific component of the physical exam and may only focus on a particular anatomical system for a few sessions, the value of this approach as a long-term consolidation of physical examination skills is unclear.

Typically, the approach to teaching physical exam skills is to focus on the “core” aspects of the physical exam in order for the learner to develop a strong foundation (6,7). Less common or applicable components of the exam are also taught, but emphasized to only be applied if clinical context is appropriate (7,8). For example, auscultation of the lung fields in a respiratory exam would be taught as a “core” exam skill, whereas eliciting egophony would be context-dependent. This approach is asserted to have better teaching value and long-term consolidation of skills as it is easier to learn, remember, and is more clinically useful since the focus is on the acquisition of basic skills (7).

Despite the fact that physical examination skills are one of the cornerstones of medical education, the literature is limited in describing central resources students may access to review physical exam skills during their clinical years in medical school and/or in residency training. Textbooks such as “Bates Guide to Physical Exam and History-taking” are used as a popular resource for reviewing specific items and for reviewing detailed examination approaches. However, lengthy texts are felt to be cumbersome and overly-inclusive for students (7). To address the need for a more simplified approach, the University of Ottawa Faculty of Medicine developed clinical skills handbooks to facilitate learning at the pre-clinical level, and to serve as a long-term simplified and practical reference guide for clinical years. To date, there is no published literature that describe the utility of clinical skills handbooks as a teaching tool for the

physical examination in undergraduate medical education, despite the curriculum at the University of Ottawa Undergraduate Medicine employing this tool for years. The purpose of this study was to evaluate University of Ottawa medical students' perceived utility of the clinical skills handbooks after 2-3 years of use.

METHODS

Handbooks

University of Ottawa Undergraduate Medicine students were surveyed on their opinion of the usefulness of the Clinical Skills Examination handbooks (also referred to as “booklets”). These booklets were developed by students and residents in collaboration with content experts in the Faculty of Medicine as a resource to help medical students learn physical examination skills. They included a history-taking booklet and four physical examination handbooks on: Musculoskeletal Examination; Cardiovascular, Respiratory, and Abdominal Examinations; Head and Neck Examinations; and Neurological Examination. Students had free online access to the handbooks as supplemental material to lectures introducing the physical exams, textbooks, and small group skills teachings sessions for the various components of the physical exam. The handbooks were also emailed to students by the faculty 1-5 weeks in advance of the skills sessions. The handbooks outline the components of a general physical exam or history and the relevant interpretation of findings (e.g. significance of an S3 on cardiac auscultation). There are also adjacent boxes with clinical pearls (e.g. differential diagnosis for a Relative Afferent Pupillary Defect), and diagrams to illustrate anatomy and landmarks (e.g. outlining the landmarks of Traube's space or the Right Middle Lung Lobe). The handbooks also contain sections outlining common focused physical exams such as an approach to volume status assessment.

Survey

An electronic survey was created by the authors (see Appendix A). It included questions about demographics of the students surveyed; setting in which the students used the handbooks as a reference; the impact the booklets made on students' learning of the physical exam and of the general clinical skills curriculum; the usefulness of additional features of the handbooks (diagrams, clinical pearls); as well as students' use of other resources (Bates Guide to Physical Examination and History-taking, Toronto Notes, and YouTube Videos). There were three comment sections — one for students to describe other resources

they use for the learning of clinical skills, one for suggestions on improvement of the booklets, and a general comment section. As part of the surveys, Likert scales were used to assess students' self-perceived frequency and usefulness of booklet use (e.g. "Almost Always", "Often", "Sometimes", "Rarely", "Never" for frequency) rather than attempting to numerically quantify these metrics, as it was felt that there was a wide-spectrum of frequency and thoroughness of booklet use. The Likert scales provided the advantage of allowing students to judge their frequency and thoroughness of booklet use into an interpretable response that was comparable to their peers and more readily interpreted by the larger academic community.

The survey was circulated by email to second, third, and fourth-year students via the class presidents. The first-year class was excluded as they had only been taught history-taking and the musculoskeletal exam at the time of the survey. The survey was a Google Form that was completed anonymously. Surveys were gathered from November 29, 2016 through January 27, 2017 for a total of 60 days.

Analysis

Data from the survey was compiled into two subgroups: second year students only (pre-clinical respondents), and third and fourth-year students only (clinical clerkship respondents). These subgroups were only used to compare responses to two specific questions: medical students' perceived utility of the handbooks when learning an examination (pre-clinical group), and perceived utility when reviewing an examination for clinical purposes (clinical group). Results from all other questions were relevant to all respondents and were analyzed without subgroups. No special analyses were performed beyond tabulation of responses.

RESULTS

There were 492 students across the three classes of students who were asked to complete the survey. Student response rate was 24.5% (121/492). Of the respondents, 26.4% were from the 2nd year class (pre-clinical subgroup n=32); 56.2% were from the 3rd year class and 17.4% were from the 4th year class (clinical subgroup n=89). Of the respondents, 54.5% were male and 45.5% female.

As shown in **Figure 1**, the majority of medical students surveyed used the booklets when practicing their physical exams (41% almost always, 87% at least sometimes), and when

studying for Objective Structured Clinical Examinations (OSCEs) (65% almost always, 94% at least sometimes). In the pre-clinical sub-group, a majority used the booklets when learning a physical exam (65% almost always, 97% at least sometimes). In the clinical subgroup (i.e. clinical clerks), there was a smaller number that used the booklets when reviewing an exam for clinical purposes (25% almost always, 64% at least sometimes). 117 (96.7%) students who completed the survey claimed to have used the handbooks at some point during their training.

Figure 2 demonstrates the impact the booklets had on the students' learning of clinical skills. The majority used the booklets as their primary resource for clinical skills (75% agree or strongly agree, 11% disagree or strongly disagree), felt the booklets improved their clinical skills (88% agree or strongly agree, 3% disagree or strongly disagree), and felt they needed the booklets to achieve success in the clinical skills portion of the curriculum (75% agree or strongly agree, 10% disagree or strongly disagree).

The most popular booklet used by the students was the Cardiovascular, Respiratory, and Abdominal Exam booklet with 95.9% (116/121) having used it, as shown in **Figure 3**. Use of other booklets were as follows: The Musculoskeletal Exam booklet – 95% (115/121); Neurological Exam booklet – 71.9% (87/121), History-taking booklet – 66.9% (81/121), and Head and Neck Exam booklet – 62% (75/121). There were 4 respondents who indicated having not used any booklets.

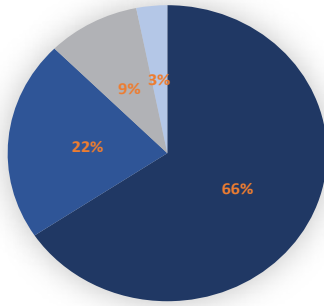
Figure 4 shows the respondents' subjective frequency of use of three other commonly used alternative education resources for physical examination skills. Listed in order of most frequently used, respondents reported: YouTube videos (14.9% almost always, 81.8% at least sometimes); Bates' Guide to Physical Examination and History-taking (2.5% almost always, 47% at least sometimes) followed by Toronto Notes (3.3% almost always, 37.2% at least sometimes).

The most common suggestions from respondents regarding improving the handbooks were to improve the diagrams and incorporate videos or video links detailing certain physical examination techniques further.

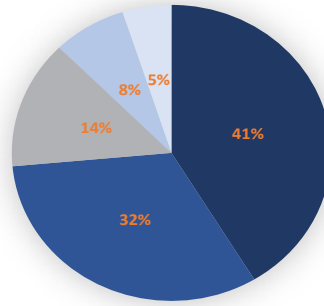
DISCUSSION

This study demonstrated that nearly every medical student (96.7%) who responded to the survey used the booklets at

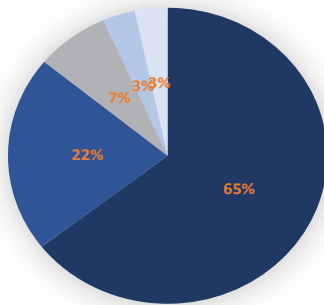
Pre-clinical subgroup: How often do you use the Physical Exam booklets when learning a physical exam?



How often do you use the Physical Exam booklets when practicing a physical exam?



How often do you use the Physical Exam booklets when studying for OSCEs?



Clinical subgroup: How often do you use the Physical Exam booklets when reviewing an exam for clinical purposes?

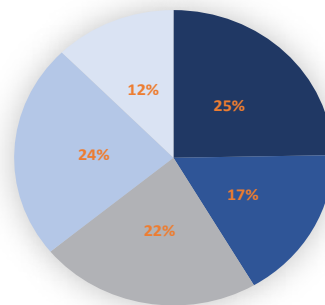
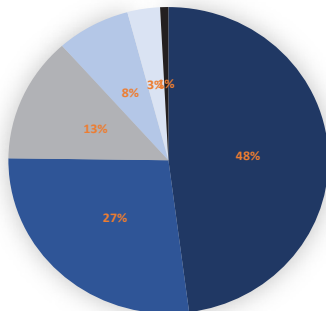
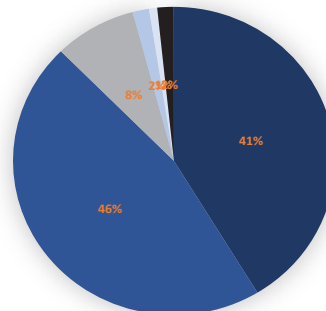


Figure 1. Responses to questions regarding setting and use of the Physical Examination handbooks.

The booklets are my primary resource for clinical skills



The booklets have improved my physical exam skills



I need the booklets to achieve success in the clinical skills portion of the curriculum

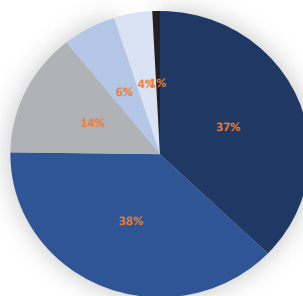


Figure 2. Responses to questions regarding subjective impact of Physical Examination handbooks for students.

some point during their training. Of the four students who did not, three added in the comment section that a language barrier was the reason. The University of Ottawa has the only bilingual Undergraduate Medicine program in Canada with both a French and English stream in each matriculating class. Since this survey has been completed the booklets have all been translated into French, which was a previous limitation.

The initial purpose for the development of the clinical skills booklets was to assist pre-clerkship students in their learning of physical exam skills either when they were practicing in a group, preparing for an OSCE, or learning on their own. This survey supports that the booklets serve this purpose, as a majority of students used the booklets when learning physical exam skills (65% almost always, 97% at least sometimes).

The second purpose of the booklets was to serve as a reference during clinical (clerkship) years. While not as commonly used for this purpose compared to as a learning resource for the introduction to a physical exam, a majority of participants in their clinical rotations still commonly used the handbooks for reference. Among the clinical subgroup, 25% almost always used the booklets, and 64% at least sometimes. This supports that the booklets also have a role as a reference during clinical training.

The results also support the concept that the booklets are an important component in the training of clinical skills for medical students. 65% of respondents reported almost always using the handbooks for OSCEs preparation, 75% used the handbooks as their primary resource for physical exam skill education, 88% stated that that handbooks have improved their clinical skills, and 80% stated that the handbooks have helped them succeed in the clinical skills curriculum. These results demonstrate that there is strong consensus among students that the handbooks are a valuable resource in medical school.

The results highlighted that the combined Cardiac, Respiratory, and Abdominal exam booklet and the Musculoskeletal exam booklet are the most frequently used booklets with greater than 95% of respondents using them. To explain this trend, the authors hypothesize that early in the curriculum, medical students are more likely to follow faculty-designated resources, as they have not yet explored other options or discovered their own personalized resources and tools for studying. With experience, students may discover strategies and resources that

are more suited to their own learning and depend less on these handbooks. The aforementioned two booklets cover nearly all of the first year clinical skills curriculum and are therefore most popular, in contrast to the Head and Neck and Neurological examinations which are only introduced in the second-year curriculum and are less frequently used. Nevertheless, the data suggests that all the booklets are used by most students, as demonstrated in **Figure 3**.

Our results demonstrate that YouTube videos are the most popular alternative resource for students to use, with 82% using them at least sometimes, in contrast to 46% and 37% for Bates' Guide to Physical Examination and History-taking and Toronto Notes, respectively (**Figure 4**). Two of the most common suggestions for improving the handbooks involved incorporating videos in some capacity, and improving the diagrams. This suggests that visual aids are valued by students, in comparison to other text-based tools.

Our survey received a moderate response rate at 24.6%. There was a bias toward the 3rd year class, representing 56.2% of respondents, compared to 26.4% and 17.4% from the 2nd and 4th year classes, respectively. A reason for this bias may be due to the fact that the authors of the study are from the 3rd year class and this might have influenced more students from their class to respond. Despite the different response rates, the method of circulating the survey was uniform. The sampling discrepancy affected the result for the number of students reporting having used the Head and Neck Examination booklet, as this booklet was not created until the 4th year students were into their first clinical year. This may also explain why it was the least popular booklet (**Figure 3**).

Limitations of this study are predominantly related to the inherent nature of survey research and response biases. Students were familiar with the authors of the study which may have prompted selection bias, as well as the general favorability towards the booklets. While problematic, these biases were somewhat mitigated as the survey was described to students as a faculty initiative to gather feedback, rather than a research tool for publication by the authors who were classmates. This study also had difficulty defining and quantifying broad terms such as "usefulness" of booklets, as attempts to objectively define and quantify this term was deemed unreliable for study purposes. For example, the authors understood that two different students may use the booklets at differing frequency, but this may simply



RESEARCH

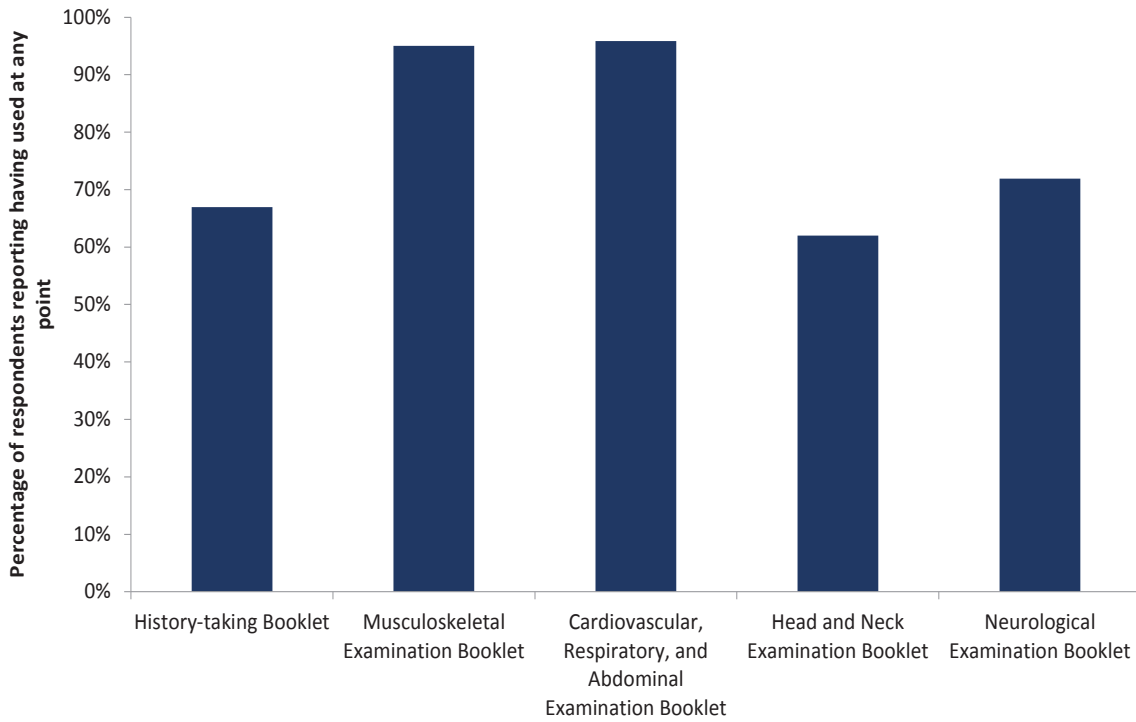


Figure 3. Percentage of respondents reporting having used each of the clinical skills handbooks.

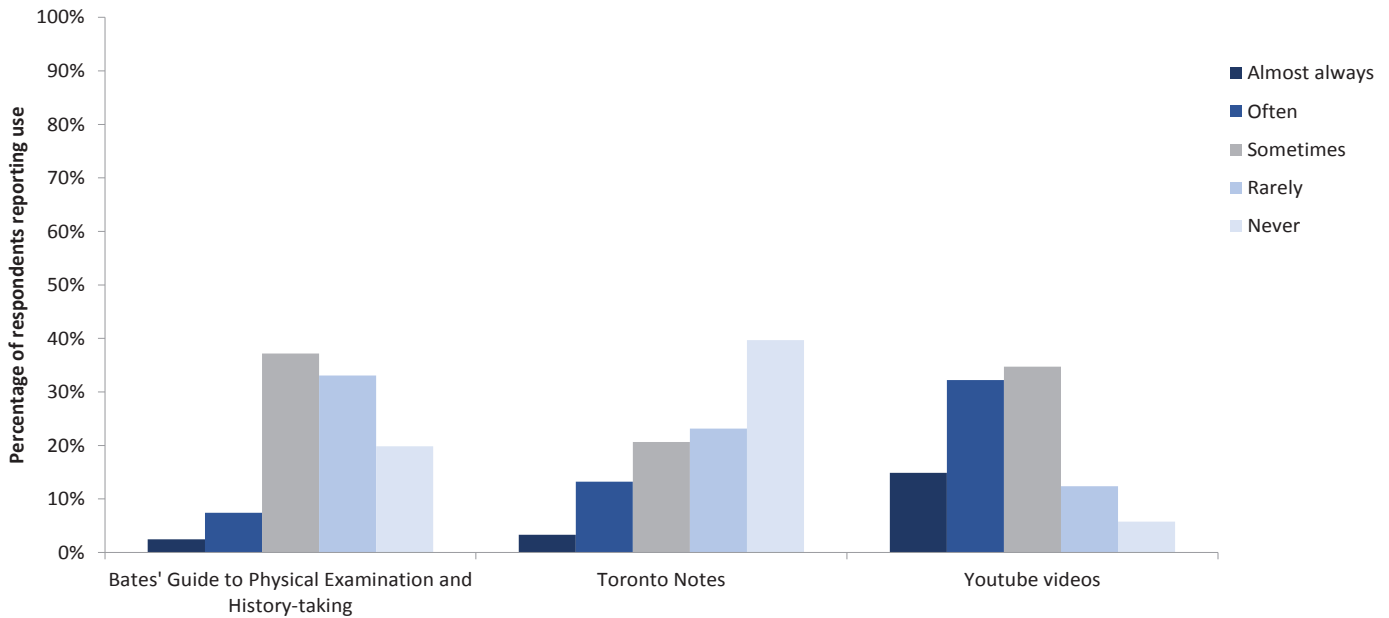


Figure 4. The respondent cohort's subjective frequency of use of each of the three common alternative resources posed in the survey: Bates' Guide to Physical Examination and History-taking, Toronto Notes, and Youtube videos.

be explained by one student studying more than the other, and subsequently using the handbooks more frequently out of work ethic rather than perceived usefulness of the booklet. As such, questions about respondents' subjective opinions on usefulness, comparisons with other tools, and respondents' self-attributed success related to use of the booklets were employed to better define the helpfulness of the booklets. Despite these limitations, the paucity of scholarly literature in describing this form of tool in medical education mandates that this study be a starting point for future evaluation and employment of such tools.

CONCLUSION

The University of Ottawa Undergraduate Medicine content experts, in collaboration with medical students and residents, developed clinical skills booklets to facilitate the learning of physical examination skills at the pre-clinical level and to be used as a resource and reference during clinical years. While there are described methods of physical exam education in pre-clinical training, there is limited evidence for strategies in clinical years. This survey of second, third, and fourth-year medical students demonstrated that the handbooks are an important tool and resource of medical undergraduate education in regards to clinical skills development. The majority of students surveyed use the handbooks on a regular basis and found the handbooks to be a popular and valuable resource for students across pre-clinical and clinical years of medical training. These findings suggest the need for further development of these forms of resources as learning tools to enhance the teaching of clinical skills. Future research may be oriented at identifying which components of the booklets are most useful for students and how the students perceive the usefulness of these booklets compared to other educational resources. Further investigations into their efficacy could influence the decision of medical educators at other centers to adopt these teaching tools as a reference.

ACKNOWLEDGEMENTS

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Evaluation of a Community-based Concussion Prevention and Advocacy Program at the University of Ottawa

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ABSTRACT

Background: Injury prevention and advocacy often receives little attention in medical education despite constituting a leading cause of morbidity and premature deaths. Brain Waves is a national concussion prevention program where medical student volunteers (MSVs) deliver a one-hour interactive presentation at the classroom level. This paper reviews the data from the past eleven years of curriculum delivery, highlighting the successes and challenges towards initiating an injury prevention advocacy program at the medical school level.

Methods: Our database included demographics collected from 2007 to 2017 as well as online survey ratings and written feedback from participating teachers and MSVs for the 2016 and 2017 school years.

Results: The Ottawa's Brain Waves program has been successful in the recruitment of 636 MSVs and delivering the curriculum to 9848 elementary school students over the past 11 years. Survey responses from MSVs (N=36) rated their experience positively on a 5-item Likert scale for the following dimensions for the injury prevention curriculum: Training satisfaction (4.72 ± 0.46), Competence (4.80 ± 0.41) and Timing (4.51 ± 0.67). Teacher responses (N=10) showed that 90% rated the program as "Good" or "Excellent". Written feedback from MSVs and teachers highlighted the importance of time management, focused-lesson plans and activity-based engagement.

Conclusions: Through involvement in the Ottawa Brain Waves program, MSVs actively contributed to mitigating risks of accidental brain injuries, adapted to the needs of the classroom and heightened their curiosity in community-based advocacy.

RÉSUMÉ

Arrière plan: La prévention et défense des blessures reçoivent souvent peu d'attention dans l'éducation médicale, en dépit du fait qu'ils constituent une cause majeure de morbidité et de décès prématurés. Brain Waves est un programme national de prévention des commotions cérébrales où les étudiants bénévoles en médecine (MSV) offrent une présentation interactive d'une heure au niveau de la salle de classe. Cet article passe en revue les données des onze dernières années de mise en œuvre du programme, en mettant en évidence les succès et les défis liés à l'initiation d'un programme de sensibilisation à la prévention des blessures au niveau de la faculté de médecine.

Méthodes: Notre base de données comprenait des données démographiques recueillies de 2007 à 2017 ainsi que des évaluations de sondages en ligne et des commentaires écrits des enseignants participants et des MSV pour les années scolaires 2016 et 2017.

Résultats: Le programme Brain Waves d'Ottawa a réussi à recruter 636 MSV et à dispenser le programme à 9848 élèves des écoles élémentaires au cours des 11 dernières années. Les réponses au sondage de MSV (N = 36) ont évalué leur expérience de manière positive sur une échelle de Likert de 5 articles pour les dimensions suivantes du programme de prévention des blessures: Satisfac-tion à l'entraînement (4.72 ± 0.46), Compétence (4.80 ± 0.41) et sens du rythme (4.51 ± 0.67). Les réponses des enseignants (N = 10) ont montré que 90% d'entre eux ont jugé le programme «bon» ou «excellent». Les commentaires écrits des MSV et des enseignants ont souligné l'importance de la gestion du temps, du plan de cours ciblé et de l'engagement basé sur les activités.

Conclusions: Grâce à leur participation au programme Brain Waves d'Ottawa, les MSV ont contribué activement à atténuer les risques de lésions cérébrales accidentelles, adaptées aux besoins de la salle de classe et ont accru leur curiosité en matière de défense communautaire.

Accidental injury constitutes a prime reason for death and disability in youths, ranking fourth among all causes of mortality before the age of 70 (1,2). Brain injury, particularly concussions, is a significant public health concern affecting nearly 23,000 Canadian youths annually (3). The majority of hospitalized brain injuries, albeit preventable, present tremendous stress to the affected individual, their families and the health care system. Interventions through community advocacy groups such as Parachute Canada (formally known as ThinkFirst), an organization that promotes school education on the permanence of brain and spinal cord damage, helmet safety and harm reduction, play a critical role in mitigating injury. Such community-based programs have been shown to increase the adherence of helmet use among children in kindergarten to Grade 6 and effectively reduce the rate of bicycle related injuries in this age group (4).

The importance of injury prevention and advocacy cannot be understated and too often overlooked within the medical curriculum. The health advocate role is a core component of medical education and remains one of the seven competencies of the CanMEDS framework (5). The Royal College of Physicians and Surgeons of Canada's official definition of the health advocate role entails the "responsible use of physicians' expertise and influence to advance the health and well-being of individual patients, communities and populations" (5). The key competencies outlined in this framework advise that clinicians should be able to respond to issues of patients on an individual basis, respond to health needs of the community, identify the determinants of health for the population served, and promote the health of individual patients, communities and populations (6). Physicians, through their role as advocates, play a vital part in the promotion of health and prevention of disease in the general population. Encouraging medical students to implement and advocate for injury prevention can better help them incorporate these concepts in their future practice and thereby reduce injury related morbidity and mortality (7).

The health advocate role is frequently described by researchers as more difficult to incorporate and teach in medicine at both the undergraduate and postgraduate levels (8,9). One study by Leveque et al. explored attitudes of physicians in France on prevention awareness from private practice pediatricians to clinic pediatricians and general practitioners (10). Their survey responses revealed that physicians in general felt that they could contribute to injury prevention; nevertheless, many felt

they lacked awareness of injury-related mortality rates in the pediatric population. The lack of awareness in fact spans earlier in a doctor's educational training. In a national survey administered to urology residents, Leveridge et al. found that only 18% of respondents had engaged in health promotion or disease prevention initiatives prior to their residency (11). Likewise, in a survey of 76 internal medicine residents, most candidates agreed on the importance of the health advocate role (12). Most of the engagement in advocacy, however, was restricted to the candidates' high school and undergraduate studies (12). Seventy-six percent of residents reported no ongoing engagement in advocacy due to barriers such as insufficient time and stress while 36% were undecided on whether they would engage in advocacy during their continued training as residents, fellows and staff (12).

One effective approach for engaging future physicians to incorporate injury prevention advocacy is via integration at an early stage (i.e. the medical school level). Despite the efforts to integrate physician advocacy in the medical curriculum, medical students do not receive adequate exposure and opportunities for community engagement. The purpose of this paper is to explore the feasibility of implementing a concussion-based advocacy program, Brain Waves (developed by ThinkFirst/Parachute Canada), at the undergraduate medical level. We synthesized lessons, both successes and avenues for improvement, based on the past 11 years of program implementation at the University of Ottawa Faculty of Medicine.

METHODS

Brain Waves Curriculum

Medical students at the University of Ottawa partnered with Brain Waves, formerly called Brain Day or Brain Week, a national head injury prevention program offered to elementary school children in grades 4 through 6. The goal of this free didactic program is the prevention of brain and spinal cord injury through education aimed at promoting healthy behaviours among children and youth. Injury prevention presentations are delivered by University of Ottawa medical student volunteers (MSVs) in their first and second years of study during a week in April of each academic year.

Prior to the delivery of the Brain Waves injury prevention presentation, MSVs received in-class training by program site coordinators during a formal 1-hour training session. This session exposes potential volunteers to the content of the presentation,

suggested activities for implementation and importance of helmet safety and concussion awareness.

The injury prevention presentation curriculum delivered by MSVs consisted of a PowerPoint presentation introducing the brain, the senses and basic neuroanatomy at an age-appropriate level. The five senses were explored through interactive games and audio-visual activities. Most importantly, the MSVs demonstrated proper helmet fitting tips using the 2-V-1 rule. That is, 2 fingers between base of helmet and eyebrows, strap forming a V under the ears and 1 finger between strap and chin. The presenters also coached the children on the importance of injury prevention using proper protective equipment. Activity booklets that consolidated the lessons were distributed to the students at the beginning of the session as a guide to follow along with the presentation. Models of the brain were shown in the form of a Jell-O brain to aid in the understanding of the underlying anatomy and physiology. The Jell-O brain further reiterated how vulnerable the human brain is to injury and the importance of protection. At the end of the session, the students were given an opportunity to ask questions and encouraged to follow safe helmet wearing practices.

Teacher and MSV Recruitment

Teachers and classrooms were recruited from a database registry of elementary schools in the Ottawa-Carleton District School Board (OCDSB) and Ottawa Catholic School Board (OCSB). An initial letter of recruitment for participation in the Brain Waves program was sent to principals in schools across the OCDSB and OCSB, and follow-up arrangements were made with interested teachers. MSVs were recruited from the University of Ottawa, Faculty of Medicine through social media advertisement, interest group promotion and word of mouth. Two MSVs were matched to each participating classroom by local program coordinators and received a one-hour training session prior to outreach. MSVs received volunteer hours towards student interest groups (Pediatric/Neurology) for participation in the program, which may be documented on the Medical Student Performance Record (MSPR). Details regarding the program timeline are presented in **Figure 1**.

Program Assessment

Information regarding participant demographics was collected prospectively for 11 years of program delivery. The database consisted of information pertaining to MSVs including the number of University of Ottawa students recruited, their respective

year in medicine and their program stream (French/English). Collected classroom demographics included institution name, language preference for presentation (French/English), level of education and classroom size. Following the administration of the Brain Waves program, a brief online survey was distributed to participating MSVs and teachers. MSV surveys consisted of a 5-item Likert scale (with 1 being strongly disagree and 5 being strongly agree) evaluating training adequacy (training was adequate for a successful presentation delivery), timing (an hour was sufficient to get through the material) and competence (MSV felt confident in injury prevention and presentation delivery). Teachers rated the program in the following domains: presentation content (the information was age appropriate), presentation clarity (the content was easy to understand), presenter knowledge (presenters were knowledgeable in injury prevention), presenter engagement (enthusiasm of MSVs) and presentation timing (the length of presentation was appropriate for the students). Written feedback and avenues for improvement were also obtained.

RESULTS

Program Trend

The Ottawa program was initiated in 2007 with 177 students and outreached to 6 classrooms. Twelve medical students delivered the program in one official language, English. In 2009, the program expanded to include presentations in French, reaching 856 students in 33 classes (26 English and 7 French) facilitated by 55 MSVs. The peak of the program was in 2012 where 1615 students received the injury prevention presentation in 64 classrooms (46 English, 18 French) delivered by 119 MSVs. In the most recent cycle in 2017, the program reached 456 students in 17 classes (12 English, 5 French) facilitated by 22 MSVs (**Figures 2 and 3**).

Involvement in the Brain Waves program was possible at Canadian sites throughout two years: 2012 and 2013. In 2012, a total of 17418 students participated in the Brain program with 586 MSV presenters while in 2013, 18431 students were reached with 1193 classroom presenters. Ottawa, despite representing approximately 2.5% of the Canadian population, outreached to 9% and 8% of the national presentations for the 2012 and 2013 cycles, respectively.

Medical Student Volunteer Feedback

Electronic surveys were distributed in 2016 and 2017 to all participating MSVs for feedback regarding their experience

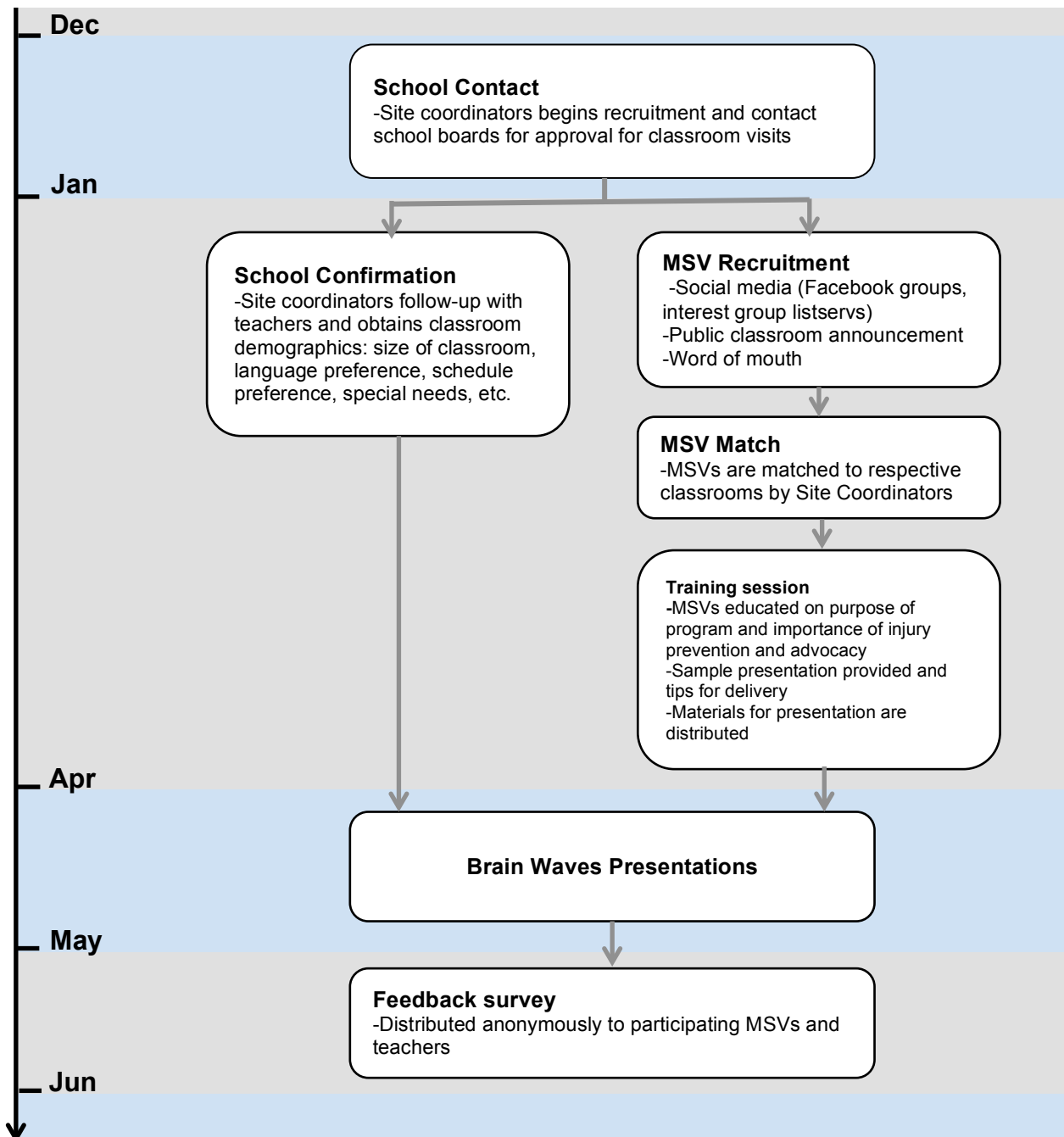


Figure 1. Sample timeline for the preparation and delivery of the Ottawa Brain Waves Program. Site coordinators are medical students working in a team to coordinate the classroom outreach, training session, MSV recruitment and matching. MSVs are medical students who deliver the Brain Waves Injury Prevention program to the elementary school classrooms.

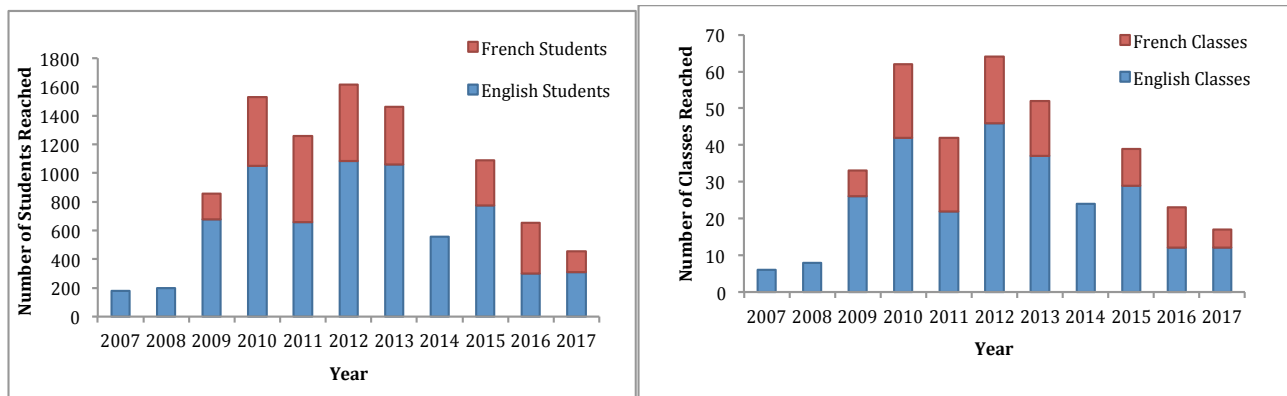


Figure 2. Demographics data for total number of elementary school students (left) and classrooms (right) out-reached between 2007 and 2017. A total of 9848 received the injury prevention presentation with the peak attendance year being 2012 with 1615 students (64 classes).

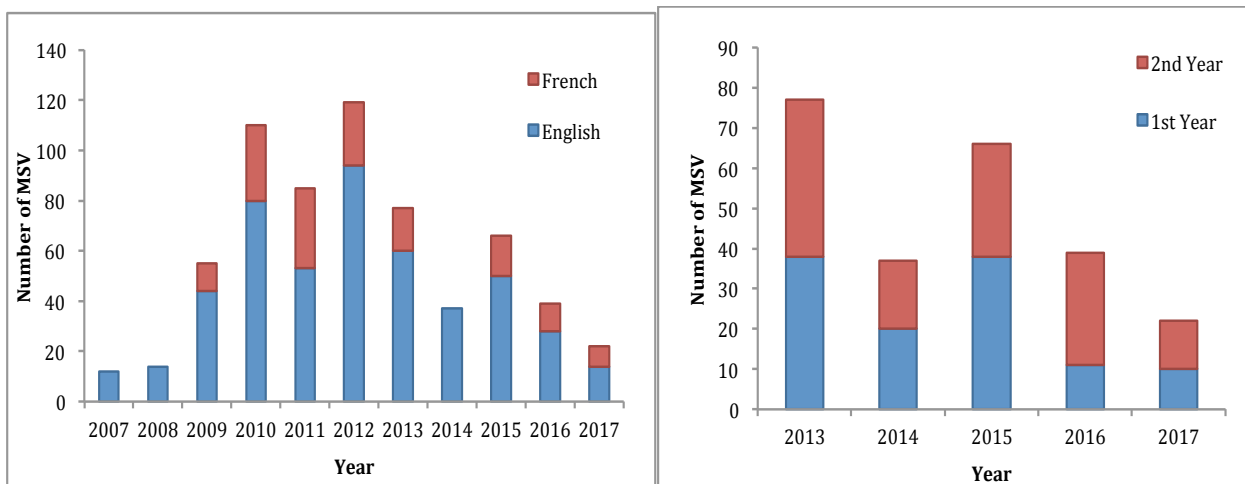


Figure 3. Demographics data for total number of medical school students (MSVs) who participated between 2007 and 2017 by language stream (left) and year of study (right)*. The distribution of English to French MSVs was approximately 4:1, reflecting the relative demand of the classrooms. First and second year MSVs were approximately equal.

*Note that MSV year of study was only documented in the most recent 5 cycles of program administration.

in the advocacy program. Survey response rate was 59%. Of the respondents, 70% of the participants were involved in the program for the first time, 25% had engaged in the program once before and 5% of participants participated in the program three or more times. The majority of the MSVs participated in one presentation (75%), while 15% participated in two presentations, and 10% participated in three or more. Twelve percent stated that they became involved in the program through peer advertisement while 88% were recruited through social media (including Facebook postings and Interest Group Listserv).

MSVs attended a training session prior to delivering their presentation with an overall 82% attendance rate and subsequently evaluated the training session on 4 domains: convenience (time date, multiple sessions offered), organization (was the session well run?), presenters (were the presenters upbeat, knowledgeable?) and time allotted (was there enough time to cover the material). MSVs positively rated all 4 domains of the training session: convenience (4.54 ± 0.51), organization (4.67 ± 0.48), presenter (4.72 ± 0.46) and time allotted (4.68 ± 0.48) (**Table 1**; note that the Likert scale ranges from 1-5).

MSVs also rated the Brain Waves program on 3 domains: training adequacy, timing and competence. Survey results demonstrated that a high rating was given for training adequacy (4.72 ± 0.46) and confidence (4.80 ± 0.41) whereas the average score for timing was moderate (4.51 ± 0.66) (**Table 1**).

Qualitative feedback was taken from the students in the form of written responses to elicit strategies for quality improvement. The preponderance of comments from written feedback stated that the interactive activities were helpful in sustaining the students' attention. Multiple MSVs (3 out of 36) noted that one hour was not enough time to complete the planned material in its entirety. The activity booklets were described as a helpful adjunct to maintain students' fixation throughout the delivery of the presentation. The majority of MSVs were satisfied with their outreach experience and had a positive interaction with their collaborating classrooms with many volunteers (4 out of 36) expressing that they were able to challenge themselves by adapting to the demands of the students and achieving a heightened sense of advocacy in injury prevention.

Teacher Feedback

Survey response rate from participating teachers between 2016 and 2017 was 27.5%. Classroom demographic data

revealed the following: 5% grade 3 classes, 26% grade 4 classes, 39% grade 5 classes and 30% grade 6 classes.

Teachers rated the program on the following domains: presentation appropriateness (the program material was age appropriate), presentation clarity (the presentation was clear and easy to understand), presenter knowledge (presenters were knowledgeable in injury prevention), presenter engagement (the presenters were enthusiastic and engaging) and presentation timing (the length of the presentation was appropriate for the students (presentation timing). Overall, teachers rated the presenters highly for knowledge (4.70 ± 0.48) and engagement (4.80 ± 0.42) and moderately high for presentation appropriateness (4.50 ± 0.53) and clarity (4.60 ± 0.52). Teachers were in disagreement regarding the presentation timing (4.10 ± 0.99) (**Table 2**). Overall, teachers rated the program an average of 4.60 ± 0.52 ; moreover, all teachers who completed the survey, positively recommended the program. Teacher responses also revealed that 92% rated the program as "Good" or "Excellent" with all respondents expressing their interest in the program for the subsequent year.

Positive comments alluded to the well-organized nature of the presentations, the enthusiasm from the presenters and the activities and experiments with the students. Two teachers recognized the benefit of adding tangible props for the presentation such as using Jell-O brain moulds and helmet fitting exercises. Constructive feedback from teachers included distilling the presentations to fewer but more tangible key points, increasing the amount of interactive activities, engagement with the children, and that the one-hour time frame was too long to maintain the children's attention span.

DISCUSSION

Successes of the Brain Waves Curriculum

Advocacy remains an integral component of the CanMeds framework, despite difficulty implementing participation. Medical trainees often do not receive adequate exposure to injury prevention advocacy during their clinical education. One method of encouraging physician advocacy is through integration of community-based advocacy programs at the medical school level, such as through organizations like Thinkfirst/Parachute Canada, granting exposure to injury prevention and advocacy to medical students early in their training. Engaging medical students in an injury prevention program is important because they not only enable students to become exposed to



Table 1. MSV survey assessment of the quality of Brain Waves injury prevention program.

	No Response (% , n)	Strongly disagree (% , n)	Disagree (% , n)	Neither Disagree or Agree (% , n)	Agree (% , n)	Strongly Agree (% , n)	Average Rating
Training							
Convenient (timing and date)	33.3 (12)	0.0 (0)	0.0 (0)	0.0 (0)	30.6 (11)	36.1 (13)	4.54 ± 0.51
Organization (was the session well run?)	33.3 (12)	0.0 (0)	0.0 (0)	0.0 (0)	22.2 (8)	44.4 (16)	4.67 ± 0.48
Presenters (were they upbeat, knowledgeable?)	30.6 (11)	0.0 (0)	0.0 (0)	0.0 (0)	19.4 (7)	50.0 (18)	4.72 ± 0.46
Time allotted (was there enough time)	30.6 (11)	0.0 (0)	0.0 (0)	0.0 (0)	22.2 (8)	47.2 (17)	4.68 ± 0.48
Program							
Training was adequate for successful presentation	11.1 (4)	0.0 (0)	0.0 (0)	0.0 (0)	25.0 (9)	63.9 (23)	4.72 ± 0.46
An hour was enough time to get through the material	11.1 (4)	0.0 (0)	0.0 (0)	8.3 (3)	30.6 (11)	58.3 (21)	4.51 ± 0.67
I felt confident and competent in giving my presentation	2.8 (1)	0.0 (0)	0.0 (0)	0.0 (0)	19.4 (7)	77.8 (28)	4.80 ± 0.41

Participants were asked to rate the degree with which they agreed with each component of the program; responses ranged from 1 = strongly disagree to 5 = strongly agree.

Table 2. Teacher survey assessment of the quality of Brain Waves injury prevention program.

	Strongly disagree (% , n)	Disagree (% , n)	Neither Disagree or Agree (% , n)	Agree (% , n)	Strongly Agree (% , n)	Average Rating
The program was age appropriate	0.0 (0)	0.0 (0)	0.0 (0)	50.0 (5)	50.0 (5)	4.50 ± 0.53
The presentation was clear and easy to understand	0.0 (0)	0.0 (0)	0.0 (0)	40.0 (4)	60.0 (6)	4.60 ± 0.52
The presenters were knowledgeable	0.0 (0)	0.0 (0)	0.0 (0)	30.0 (3)	70.0 (7)	4.70 ± 0.48
The presenters were enthusiastic and engaging	0.0 (0)	0.0 (0)	0.0 (0)	20.0 (2)	80.0 (8)	4.80 ± 0.42
The length of time was appropriate for the student's attention span	0.0 (0)	10.0 (1)	10.0 (1)	40.0 (4)	40.0 (4)	4.10 ± 0.99
Overall rating of program	0.0 (0)	0.0 (0)	0.0 (0)	40.0 (4)	60.0 (6)	4.60 ± 0.52

Participants were asked to rate the degree with which they agreed with each component of the program; responses ranged from 1 = strongly disagree to 5 = strongly agree.

the community setting but also plant the seed of advocacy early on in a physician's training while encouraging future work in this avenue.

Over the past eleven years, the Ottawa's Brain Waves program has been successful in the recruitment of 636 medical students in delivering the curriculum to 9848 elementary school students. Since its initiation in 2007, the program has expanded considerably and currently offers the program in both official languages, English and French. Our data suggests that the distribution of English to French MSVs was approximately 4:1, reflecting the relative demand of the classrooms. Furthermore, MSV participants in first and second year were approximately equal in number. Prior assessment of the ThinkFirst curriculum effectiveness demonstrated a beneficial role of advocacy improving education and safety awareness in the community. A study conducted by Gresham and Zirkle assessed the impact of ThinkFirst program on the knowledge of 1st to 3rd grade children in San Diego in a 6-week intervention curriculum (13). Pre- and post-test results exhibited significantly improved knowledge in each grade level regarding brain and spinal cord. Safe behaviours to prevent traumatic injury and a reduction in self-reported, high-risk behaviours were also reported (13). Likewise, a Canadian study was conducted on teenagers and showed marked increase in students' knowledge of risk factors related to injury prevention (14). These preliminary findings suggest that school-based advocacy programs offered by ThinkFirst may have an impact on prevention education (14). Nevertheless, future studies should aim at investigating whether this gain in knowledge also leads to subsequent reductions in injury.

Challenges of the Brain Waves Curriculum

Several challenges in recruitment from both the MSV and school board side were observed. There was a noticeable serial drop after 2012. The reason is multifactorial and can be accounted for by factors such as the school teachers job action in 2013 with reduction in school extracurricular activities, emergence of an advocacy community outreach program by post-graduate students at another university in Ottawa, and involvement of medical students with other volunteer opportunities that were not previously available through alternative community-based groups.

Lessons for Future Integration

Several valuable lessons can be applicable to future advocacy or service learning programs aimed at school outreaches at the

medical school level. First, the timing of the didactic period should be a major point of consideration. While many MSVs expressed that 1h was insufficient to deliver all the planned content, the teachers felt that beyond this time-frame, the students would be unable to maintain attention. Strategies may be incorporated to address this issue such as incorporation of multiple breaks, use of activity booklets for students to follow alongside verbal lessons, distilling lessons to main points and saving questions for the end of the presentation.

Second, incorporation of activity-based learning can be successful with an emphasis on the students being an active participant of the pedagogical experience. This can entail group-oriented discussion, blackboard writing, models and demonstrations. Such a strategy also accounts for learning and shared experience for individuals who are ESL learners. Moreover, activity booklets given at the start of a presentation can augment the experience of the outreach session. Benefits of activity workbooks include increasing the engagement of school children, stimulating questions based on material presented in booklet and enabling students to remember the lesson and also have something tangible to take home to show their parents. Nevertheless, one should also be mindful that the use of activity booklets may also serve as a distraction and potentially prolonging the timing of the session.

Lastly, recruitment of schools is another challenge especially during the initiation phase of a program. This may be addressed by recruitment of schools from alternative boards within the same city and initiating the process of recruitment early (i.e., in the Spring). These lessons have implications for future service learning and advocacy programs at the medical level aimed at establishing partnerships with community schools.

In the upcoming 2018 cycle, the Brain Waves program has been incorporated into the Community Service Learning (CSL) curriculum with three incoming first year students taking part in the program as site coordinators. The CSL program at the University of Ottawa is an academic and experiential program where students contribute to 30 hours of community outreach and engagement through approved service placements. The added support from students through a Faculty recognized program not only improves recruitment efforts but also encourages communication with teachers and students, problem solving within a team environment and advocacy of

injury prevention and awareness among the broader community.

Study Limitations

One limitation present in this study is that all data collected was limited to a local sampling of schools in the Ottawa region. Thus, the generalizability of the results is uncertain in other cities. Moreover, the questionnaires gathered are in a limited time frame of 2 years, which does not adequately reflect the changing nature of the program due to expansion and refinement. Another limitation is logistical, as the MSVs can only leave after their scheduled medical school classes which typically end at noon, and commute to the elementary school to be done by the time the school ends. As such, the elementary schools cannot be located too far away from the medical school, especially if the MSVs do not have a car and need to take public transport. Lastly, it would be beneficial for future studies to incorporate a reflection of the survey from medical students and their feelings on how this has enriched their thoughts on advocacy and their pre- and post-attitudes towards advocacy and injury prevention.

CONCLUSION

In conclusion, current and future physicians play a vital role in the education and prevention of injury. Brain Waves is both a fun and didactic initiative that reaches out to the community to educate children and their teachers regarding the importance of the brain, what happens when head injuries occur, and how to prevent this from happening by thinking first and wearing a properly fitted helmet. Through engagement in the program MSVs learned many useful skills including raising awareness on injury prevention, simplifying the complexity of the brain in words that are appropriate for a younger audience, adapting to the needs of the classroom, which ultimately enables them to be engaged in the community, and sparking their curiosity and interest in future advocacy-related work.

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Experiences of Transgender People in the Healthcare System: A Complex Analysis

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ABSTRACT

A nursing perspective following McIntyre and McDonald's framework was used to unpack the complex issue of challenges faced by transgender people in the Canadian healthcare system, considering historical, ethical, legal, social, cultural, political, and economic perspectives. Transgender people have unique healthcare needs which are often misunderstood or unaddressed by healthcare professionals, leading to poorer outcomes and inequities. Issues concerning transgender people are becoming a focus and a higher priority for society. This literature review reveals the complexity of this issue as the roots in historical, ethical, legal, social, cultural, political, and economic contexts are explored. A variety of barriers and facilitators exist to addressing and resolving this issue, including transgender people avoiding healthcare, intolerance, lack of knowledge and understanding, lack of healthcare provider training, media representation, and economic costs. The analysis of this issue can be used to inform resolution strategies to utilize facilitators and overcome barriers, including increasing awareness and knowledge, improving education and healthcare provider competency, and utilizing nurse leaders as advocates, role models, and agents of change. Improving care of transgender people is a nursing leadership priority. By implementing the suggested resolution strategies, the healthcare system can begin to move towards a more inclusive, understanding, and holistic model of care to improve healthcare access and outcomes for transgender people.

RÉSUMÉ

Une perspective infirmière s'inspirant du cadre de McIntyre et McDonald a été utilisée pour mettre au jour le problème complexe des défis auxquels sont confrontés les transgenres dans le système de santé canadien, compte tenu des perspectives historiques, éthiques, juridiques, sociales, culturelles, politiques et économiques. Les personnes transgenres ont des besoins de soins de santé uniques qui sont souvent mal compris ou ignorés par les professionnels de la santé, ce qui entraîne des résultats et des iniquités plus faibles. Les questions concernant les personnes transgenres deviennent une priorité et une priorité pour la société. Cette revue de la littérature révèle la complexité de cette question à mesure que les racines des contextes historiques, éthiques, juridiques, sociaux, culturels, politiques et économiques sont explorées. Divers obstacles et facilitateurs existent pour traiter et résoudre ce problème, notamment les personnes transgenres évitant les soins de santé, l'intolérance, le manque de connaissances et de compréhension, le manque de formation des prestataires de soins, la représentation des médias et les coûts économiques. L'analyse de cette question peut être utilisée pour éclairer les stratégies de résolution et utiliser les facilitateurs et les agents de changement. L'amélioration des soins aux personnes transgenres est une priorité du leadership infirmier. En mettant en œuvre les stratégies de résolution proposées, le système de santé peut commencer à évoluer vers un modèle de soins plus inclusif, compréhensif et holistique pour améliorer l'accès aux soins et les résultats pour les personnes transgenres.

Transgender people face challenges and barriers in the healthcare system, resulting in health disparities and inequities (1). The transgender experience is not well understood, leading to barriers with healthcare professionals in recognizing and addressing the unique needs of this population. This complex issue will be analyzed using McIntyre and McDonald's framework of exploring nursing issues by considering various perspectives including historical,

ethical, legal, social, cultural, political, and economic; and facilitators and barriers will be identified and appropriate resolution strategies suggested (2).

LITERATURE REVIEW

A literature review was conducted in order to determine current beliefs, views, and knowledge regarding transgender people and the issues they face in the healthcare system. The literature

Keywords: Transgender; Nursing; Health Disparities; Inequity; LGBT; Gender Identity

review included peer-reviewed articles from medical, nursing, behavioral medicine, and LGBT bioethics journals published within the last nine years, ranging from 2009 to 2015. These articles included literature reviews and syntheses, reviews of best practice, implications for practice, and one survey analysis study. There is consensus across the literature that transgender people have complex and unique healthcare needs (3,4). A gap was identified in knowledge and understanding among healthcare providers regarding these needs and the transgender experience (1). A significant body of research indicated that the transgender population often avoids or delays accessing the healthcare system due to fear of incompetent or insensitive care (4,5,6), leading to health disparities (7).

Through the literature review, it is clear that there are still conflicting views regarding transgender people. Though they are becoming more understood in society, Redfern and Sinclair found that individuals intolerant of transgender people tended to be "social conformists, heterosexual, religious, fundamentalists, male, morally dogmatic, ego-defensive, homophobic, and lacking self-esteem" (8). Personal clinical observations and public opinion polls have identified a trend in which older generations often lack understanding of the transgender experience or the need to accommodate their unique needs (9). Some physicians and healthcare professionals do not approve of gender reassignment and still hold the viewpoint that being transgender is a neurotic disorder (8). The current literature reviewed as a whole indicates a need for improvements in this area.

COMPLEX ANALYSIS

Historical

Transgender identity has existed over the course of history, however, has recently gained attention as an important issue. It has been recorded in history since ancient times, as reflected in Greek mythologies involving "a woman raised as a male ... being transformed into a man" (10). Though homosexuality is different from being transgender, the history of homosexuality is relevant because often transgender people are grouped and understood in the context of the lesbian, gay, bisexual, and transgender (LGBT) community. In the past, homosexuality was seen as a mental disorder or an abnormality (11). This is evidenced by the appearance of "homosexuality" in outdated versions of the Diagnostic and Statistical Manual of Mental Disorders (DSM) up until 1973, when it was reclassified as "sexual orientation disturbance" (11). Complete removal of

homosexuality-related diagnoses from the DSM in 1987 opened the door to acceptance and improved understanding (11). Despite this, many countries still do have laws and punishments against homosexuality (12).

Transgender identity was introduced to the DSM in 1980 as a mental disorder referred to as "gender identity disorder" (13). In the DSM-V revisions, this was changed to "gender dysphoria", which provides more accurate terminology (14). Acknowledgment of gender dysphoria is important to a holistic understanding of the transgender experience, as healthcare visits often trigger dysphoric feelings, contributing to the tendency of transgender people to avoid healthcare (5). However, the existence of "gender dysphoria" in the DSM contributes to the incorrect association of transgender identity with mental illness. With the recent terminology changes and increasing representation of transgender people in media and news, societal attitudes are shifting, moving towards awareness and acceptance of this population. However, the historical context of transgender identity as a mental illness still impacts how it is viewed today. This creates an even greater need for addressing barriers faced by transgender people in healthcare, as more people are coming out and seeking gender reassignment.

Ethical/ Legal

Addressing barriers and disparities in care of transgender patients is a nursing responsibility. This falls under nearly all sections of the Canadian Code of Ethics for Registered Nurses (15). This document specifies "providing safe, compassionate, competent and ethical care" and "promoting justice" as responsibilities of registered nurses (15). In order to meet these competencies, it is absolutely necessary to understand the transgender experience and ways to address their unique needs, which is currently lacking in the healthcare system (16). It is the responsibility of nurses to be accountable to their practice and address this discrepancy in order to improve care to the ethical standards of the Canadian Nurses Association.

The Canadian Human Rights Commission acknowledges that discrimination, exclusion, and hostility impair transgender peoples' access to healthcare (17). On May 17, 2016, new legislation addressed this issue as "gender identity" and "gender expression" gained protection against discrimination and harassment by federal law in the Canadian Human Rights Act (17).

Social/ Cultural

Social and cultural movements involving transgender people are often understood collectively as part of the LGBT alliance. Inclusion of transgender people into this group has potential to provide support as the voice of the alliance is highly recognized and valued in society. However, Merryfeather and Bruce reported that transgender people sometimes face discrimination from the homosexual community (18). Inclusion of transgender people in the LGBT alliance contributes to misconceptions of gender identity being on the same spectrum as sexual orientation, when in fact it is entirely different. Transgender people face unique issues that, though similar in some aspects, are different from those faced by homosexual individuals (18). Research working to generate a knowledge-base and understanding of the LGBT community largely focuses on sexual orientation, with significantly less emphasis on gender identity (19). This reflects a barrier and a lack of knowledge, understanding, and competency with the transgender population.

Society today is predominantly heterosexual and gender-conforming, making the transgender population a stigmatized minority (20). It has been seen in popular culture, social media, music, and through celebrity advocates, that acceptance and tolerance of minorities is becoming a priority as society is shifting towards cultural competence. A sociocultural shift away from shame and rejection of the LGBT community is reflected by growing numbers of individuals who now feel comfortable, safe, and able to come out as part of the LGBT community (21). Many cities across Canada promote acceptance by hosting pride parades every year, which are attended and supported by thousands of people including LGBT individuals, straight allies, community groups, corporations, churches, and political figures such as city mayors (22). It has been observed that churches and public buildings are starting to fly rainbow flags as symbols of acceptance, indicating that action and change in a positive direction will be embraced more now than ever before.

Both support and opposition for this societal shift are reflected in news and media. News has been reporting transgender rights issues such as the controversial introduction of gender-neutral bathrooms into public schools and acceptance of transgender girls into Girl Guides (23,24). The way these agendas are reported in the news adds to a movement towards societal acceptance and tolerance of transgender people, but also creates a space where opposing opinions can be voiced. The

public is becoming more aware of the transgender experience, as this population is beginning to be reflected in media such as TV series including *Degrassi* and *Wentworth* (25,26). When represented accurately, this can increase societal acceptance and understanding by normalizing the transgender experience. Unfortunately, much of the media representation of the transgender population exists in comedies which reduce the experience to humour and ridicule (27). This representation opposes steps taken towards acceptance and understanding and creates a public opinion that the transgender experience is something to be taken lightly, joked about, and made fun of.

Political

LGBT rights have become a relevant topic in Canadian politics recently. This is a nursing issue, as nurses have influence in politics, laws, policies, and regulations regarding care of transgender patients, and thereby must act as advocates to bring the issues to the attention of those who can facilitate change. Political figures may be invested in addressing these issues in order to gain voters popularity, but also because they are the ones who are able to advocate for those who lack a voice. The Alberta Government addressed the needs of transgender children in the school system through the document "Guidelines for Best Practice: Creating Learning Environments that Respect Diverse Sexual Orientations, Gender Identities and Gender Expressions" (28). Here it is specified that "providing safe access to washroom and change-room facilities" is a priority for transgender children, and this has been a popular topic in current politics (28). The controversial suggested changes, which are now being implemented into school systems, include allowing students access to appropriate washroom facilities according to their gender identity, having behavioural expectations to ensure safety, as well as adequate supervision in washrooms and change rooms (28).

There are still groups in society who resist political changes that would improve LGBT rights, including some Catholics and Protestants who oppose same-sex marriage and gender reassignment surgery (9). To combat opposition, the Trans Equity Society of Alberta (TESA) is a group which acts as a voice for transgender people, and is a great advocate for change in politics, education, and community development (29). TESA's vision to "open opportunities for formal engagement with authorities who otherwise overlook the unique needs of the larger [transgender] community" aligns with the Human Rights Act in protecting against discrimination and harassment based on

gender identity or expression (17,29). TESA's vision also aligns with Canadian nurses' Code of Ethics, as it promotes justice, raises awareness, and voices concerns; thereby ensuring "safe, compassionate, competent, and ethical care" as required by the Canadian Nurses Association (15).

Economic

Transgender healthcare presents an economic issue, as there are certain areas that have been seeking government funding and coverage for critical aspects of care. It was only as recent as 2012 that funding for gender reassignment surgery was reinstated in Alberta (30). This topic generated controversy and debate, but ultimately led to positive changes in policy and funding. Currently, there is only one facility in Canada, located in Montreal, which preforms genital gender reassignment surgery (30). Alberta Health Care covers the cost of transportation to hospital, including flights, but does not cover accommodations in hospital or take-home medications and equipment (30). Other gender reassignment-related surgeries such as mastectomies are covered and performed in Alberta, while some procedures that are deemed "cosmetic" such as facial feminization are not (30).

Hormones, injection supplies, and other necessary equipment are currently not covered by Alberta Health Care and can be costly to transgender people. Introducing funding in these areas involves careful consideration of multiple dimensions of the issue in order to determine economic priority. There is an economic consideration when looking at physician training as well, as many physicians are able but unwilling to prescribe hormones for transgender patients due to a lack of training (31). There is still a need for increased funding in order to improve research on the transgender experience and training of physicians and healthcare providers. This would increase access and reduce waitlists, making gender reassignment easier and less traumatic, thereby improving quality of life for transgender people (32).

Barriers

Barriers to resolving the issues that transgender people face in the healthcare system are embedded within multiple contexts of the issue. Association with the homosexual spectrum, inaccurate media representation, and the history of homosexuality as a mental illness results in a misunderstanding and lack of knowledge regarding unique transgender experience, needs, and care. There is still much opposition to changing laws and

increasing acceptance of transgender people, including groups of certain religious individuals, homophobics, and fundamentalists (8).

A significant barrier to resolving the issue is lack of transgender people accessing the healthcare system. Fear of discrimination and misunderstanding causes transgender people to avoid healthcare and to avoid disclosure of transgender status if possible, creating a situation where many healthcare providers may not ever knowingly care for a transgender patient (33). This creates a barrier to establishing relevance of the issue and gaining support to prioritize solutions amongst healthcare providers. Another significant barrier, but also an opportunity for nursing leadership, is the lack of education, training, understanding, and awareness of the transgender experience. This results in healthcare providers who are unfamiliar and uncomfortable with addressing needs of transgender patients (34). Overcoming these barriers is essential to improving quality of care and reducing health disparities and inequities of transgender people.

Resolution

Care of transgender patients is currently below the standard that it should be, and nursing advocacy and leadership are needed to influence policies and practices that are currently lacking (35). The Canadian Human Rights Commission reported that "immediate action is required" to address issues faced by the transgender population (17). Following Kotter's eight steps for change would be an effective approach to resolving this issue (36). Kotter recommends beginning by creating a climate for change, followed by enabling and engaging the organization, and finally, implementing and sustaining change (36). This can be accomplished for the transgender community by beginning with raising awareness, acceptance, and understanding of the transgender experience, thereby creating interest in the issue and setting the stage for change (36). Public service announcements, social media, and adjustments to public education systems could be utilized to disperse accurate knowledge and increase understanding of the transgender experience.

Once the importance of the issue and the need for change have been established, the healthcare system can be enabled and engaged through implementing specific training into healthcare provider education programs. This should include education on identifying and addressing unique care needs of transgender patients (37). This will ensure that healthcare providers

are knowledgeable and prepared to create therapeutic relationships with transgender patients, enabling them to become advocates on behalf of this population (38).

Nursing leaders are needed to act as advocates for underserved populations such as the transgender community for successful implementation and sustainment of change (6). The Canadian Human Rights Commission suggested establishing specific advisory groups to influence policy, government changes, education, and awareness raising (17). Joint Commissions support this with a similar suggestion that healthcare leaders “appoint a high-level advisory group to assess the climate for LGBT patients and make recommendations for improvement” (6). This would be an ideal role for a nursing leader who could influence change by advocating to provincial health services and government organizations to increase funding for transgender-related services, including improving training and expanding availability of surgeons, physicians, and other healthcare professionals who can deal with gender reassignment needs.

Nurses should advocate for introduction of specific clinical guidelines to help healthcare providers deliver competent and comprehensive care to the transgender population (38). Joint Commission clearly outlines additional roles of nursing leaders with suggestions of facilitating equality by adopting non-discriminatory policies and strategies for reporting discrimination or disrespectful treatment, as well as monitoring system approaches to implementing transgender-competent care (6). This would increase access and significantly decrease wait times for transgender-related care such as psychological assessments, hormone therapy, and gender reassignment procedures.

There are a number of simple ways that any nurse can utilize leadership skills to influence change in this area. Utilizing a transformational leadership style to create enthusiasm in the workplace and using “idealized influence” to act as role models would increase motivation to change and improve care of transgender patients (39). Modeling proper use of patients’ preferred pronouns and names, sensitive terminology for body parts, and not disclosing transgender identity to others unnecessarily can lead to significant improvement in care and add to an organizational atmosphere of respect, acceptance, and transgender-competent care (5).

By increasing awareness, providing training, and implementing change, healthcare providers would be more comfortable

and competent in identifying and addressing unique needs of transgender patients (5). Many barriers would be eliminated if this outcome was experienced by transgender people, as they would be less inclined to avoid the healthcare system (6). Ultimately, this would lead to improved care, health, and equality of the transgender population.

CONCLUSION

It is clear that many healthcare providers have difficulty recognizing and addressing unique needs of transgender patients, leading to reduced quality of care, health disparities, and health inequities amongst the transgender population. Through the multi-contextual analysis of this issue, specific barriers and facilitators were identified to inform resolution strategies. Increasing awareness, improving education, and utilizing nursing leadership on this issue will ultimately improve quality of care, leading to better health outcomes for the transgender population.

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Getting to 2020: A Clinical Review of the Diagnosis, Treatment and Prevention of Trachoma

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ABSTRACT

Objectives: The goal of this clinical review is to undertake a review of the literature to provide information to clinicians and trainees about the epidemiology, diagnosis, treatment and (most importantly) prevention of trachoma—the leading infectious cause of blindness worldwide. This review also serves to highlight the “SAFE” Strategy (Surgery, Antibiotics, Facial Cleanliness, and Environmental Improvement), which comprises the key trachoma treatment and prevention framework endorsed by the World Health Organization (WHO).

Methods: English articles were retrieved from the following databases: Medline, Clinical Key, the Cochrane Collaboration, the Association for Research in Vision and Ophthalmology, and the National Institute of Health Clinical Trials Database, using the following MeSH terms: trachoma, infectious eye disease, chlamydia trachomatis, SAFE, community prevention. Information originating from international public health agencies, as well as evaluation reports on the success of both community-based and international treatment and prevention programs were prioritized.

Conclusions: The diagnosis of trachoma is typically a clinical one, and is made by identifying the key clinical signs of conjunctival inflammation and scarring, trichiasis and corneal opacification, especially in the context of a trachoma-endemic region. Discussion of the pathology and epidemiology of trachoma, as well as an evaluation of the overall success in the treatment and prevention of the disease is especially important as the WHO’s target trachoma elimination year of 2020 approaches.

RÉSUMÉ

Objectifs: Le but de cette revue clinique est d’entreprendre une revue de la littérature afin d’informer les cliniciens et les étudiants de l’épidémiologie, du diagnostic, du traitement et, plus que tout, de la prévention du trachome — la principale cause infectieuse de cécité à l’échelle mondiale. Cette revue sert aussi à souligner la stratégie « CHANCE » (Chirurgie, Antibiothérapie, Nettoyage du vis-à-vis, Changement de l’Environnement), qui comprend à la fois le traitement clé du trachome et le cadre de prévention approuvés par l’Organisation Mondiale de la Santé (OMS).

Méthodes: Des articles en anglais ont été extraits à partir des bases de données suivantes : « Medline », « Clinical Key », la Collaboration Cochrane, « Association for Research in Vision and Ophthalmology » et « National Institute of Health Clinical Trials Database », en utilisant les termes MeSH suivants (en anglais) : trachome, maladie infectieuse de l’œil, chlamydia trachomatis, CHANCE, prévention communautaire. L’accent a été placé sur l’information provenant d’agences internationales de santé publique, ainsi que de rapports d’évaluation sur le succès de programmes de traitement et de prévention communautaires et internationaux.

Conclusions: Le diagnostic du trachome est habituellement un diagnostic clinique, et se base sur les signes cliniques clés suivants: l’inflammation et la cicatrisation conjonctivale, le trichiasis, et l’opacification de la cornée, particulièrement lorsqu’on les retrouve dans une région où le trachome est endémique. Il est particulièrement important de discuter de la pathologie et de l’épidémiologie du trachome, ainsi que d’évaluer la réussite globale du traitement et de la prévention de cette maladie, puisque la date cible pour l’élimination du trachome par l’OMS en 2020 approche à grands pas.

Trachoma (also known as granular conjunctivitis and Egyptian ophthalmia), is the leading infectious cause of ocular infection and blindness worldwide, affecting over 80 million individuals (1). Trachoma is a form of conjunctivitis caused by repeated infections with the

gram-negative bacteria *Chlamydia trachomatis*, which can lead to conjunctival scarring, tarsal distortion, and the subsequent inward turning of the eyelashes (trichiasis), leading to abrasion of the cornea. Along with the loss of conjunctival goblet cells and resultant dysfunctional tear syndrome, this can re-

Keywords: Ophthalmology; Infectious Disease; Trachoma

sult in an irreversible form of blindness (2). Largely eradicated in most socioeconomically developed nations, trachoma tends to affect marginalized and resource-deficient individuals in developing countries (2). Its transmission is closely associated with poor hygiene, and thus the condition typically predominates in regions with inadequate access to water and good sanitation (1,3).

The World Health Organization (WHO) identifies trachoma as an avoidable cause of blindness, and as such, endorses systematic and coordinated efforts focusing on all levels of prevention (4). Strong prevention efforts and rapid treatment of existing-disease are the cornerstones of the WHO Alliance for Global Elimination of Trachoma by 2020: the "GET 2020" campaign. GET 2020 endorses "SAFE", a four-pronged approach to trachoma prevention and management that focuses on the importance of Surgical Intervention, Antibiotics, Facial Cleanliness, and Environmental Improvement strategies (4).

METHODS

English articles were retrieved from the following databases: Medline, Clinical Key, the Cochrane Collaboration, the Association for Research in Vision and Ophthalmology, and the National Institute of Health Clinical Trials Database, using the following MeSH terms: trachoma, infectious eye disease, chlamydia trachomatis, SAFE, community prevention. Information originating from international health agencies, as well as evaluation reports on the success of both community-based and international treatment and prevention programs were prioritized for selection.

EPIDEMIOLOGY

Trachoma is presently endemic in 54 countries and is most commonly found in developing nations across the African continent, the Middle East, Latin America and in remote communities across Australia (2). Over 40 million people have active trachoma (3). Of these, 7 million have active trichiasis and an additional 1.3 million are affected by the blinding sequelae of trachoma (1,3). The highest prevalence of trachoma is found in northeast Africa, where in some regions the active disease affects more than 50% of the population under ten years of age (1). Infection with the causative organism is typically seen in pediatric patients, with disease incidence peaking in children between four and six years of age. It is notable that children are most likely to develop active trachoma, while adults are more likely to experience blindness as the result of repeated

infection and sequential worsening of the disease over time (5). This is likely because trachoma-related blindness is a consequence of inflammation resulting from the immune response to the infection occurring over many episodes (5). In certain hyper-endemic regions, however, such as present-day South Sudan, cicatricial complications of the disease may be seen at an earlier age than what might be typically expected (6). One study identifies that 3% of children under fifteen years of age may be affected by the cicatricial complications of trachoma in regions where the population prevalence of active trachoma exceeds 80% (6).

Women are disproportionately affected by trachoma; the demographic distribution of trachoma prevalence affects nearly six times the number of women than it does men (5). This has been explained by the increased likelihood of women having ongoing and intimate contact with children who may be infected with *C. trachomatis* (5). Trachoma is a disease which clusters at the level of the community and within households (7). Infection is typically spread through close personal contact, and by eye-seeking flies of the species *Musca sorbens*, which are attracted to pus, mucus, open sores and ocular secretions (8,9). Secretions around the eyes have consistently been associated with increased rates of infection, as have crowded living conditions (8,9). Poor personal hygiene and low levels of community sanitation have been identified as primary factors supporting the transmission of *C. trachomatis* (9,10). The disease is commonly spread from infected ocular or nasal secretions on fingers or through eye-to-eye contact such as that which might occur in close-quarters sleeping arrangements, as well as through indirect means such as the sharing of facecloths (11). It is important to note that prolonged contact with infected individuals is necessary for the transmission of *C. trachomatis* (2).

PATHOLOGY

Trachoma is caused by infection with the A, B, Ba and C immunotypes of *C. trachomatis*; a gram-negative bacteria of the same genus that can cause genital infections (which occur with infection with the D through K types) (2). *C. trachomatis* is an intracellular bacteria, and as such, is unable to replicate outside of a host cell. It survives in the extracellular environment in an inactive form; it is only when it attaches to the host's epithelial cells and is internalized that it begins to differentiate into its active form (2).

Repeated episodes of infection carry an increased risk of conjunctival inflammation, which can result in scarring in the sub-tarsal conjunctiva. Long-term conjunctival scarring can lead to the inward turning of the upper eyelids (a process known as 'entropion'). This can lead to the eyelashes physically touching and abrading the cornea, which can give rise to trichiasis. Eventually these multiple insults to the cornea (along with the loss of conjunctival goblet cells and resulting tear film dysfunction) can lead to corneal opacification (2). Corneal scarring usually develops slowly and over many years. The importance of repeated infection is reaffirmed here in the pathogenesis of trachoma; blindness from the disease rarely results from a single episode of infection (5).

Children infected with *C. trachomatis* tend to have higher bacterial loads than adults and tend to have longer durations of infection. This is likely a product of the acquired immune response developed by adults over the course of repeated infection. Despite the decreased duration of infection, adults are more likely to develop more intense conjunctival scarring (and therefore a higher likelihood of developing trichiasis) as the result of cumulative infectious damage (5).

CLINICAL MANIFESTATIONS & DIAGNOSIS

The clinical manifestations of active trachoma result from chronic inflammation of the conjunctiva and include the following: the appearance of follicles (subepithelial accumulations of small yellow elevations), papillae surrounding the follicles, and the enlargement and thickening of small vessels in the conjunctiva (12). Other symptoms include the general signs of any other type of conjunctivitis: discomfort or pain, photophobia, and erythema (2). A pathognomonic sign of trachoma is the presence of Herbert's pits; depressions in the upper margins of the cornea resulting from the resolution of conjunctival follicles (2). These clinical manifestations are true for all forms of active trachoma and are not as common in chronic or asymptomatic trachoma. It is important to note that most individuals with active infection often tend to be asymptomatic (2,13).

A simplified trachoma grading system (STGS) was developed in 1987 by the WHO to aid in the rapid diagnosis of trachoma at the community level (see Table 1) (12). This grading system classifies the severity of the infection on a scale of 1-5 and is widely used in international trachoma surveillance and treatment programs (4).

Ocular Examination

An ocular examination should be performed with at least 2.5x magnification and a strong light. The conjunctiva should be evaluated for discharge or inflammation, and it should be noted whether eyelashes rub against the cornea. The conjunctival fornices should be evaluated for foreshortening, as this finding may be identified in advance of more significant conjunctival scarring. A physical examination of the eye should also include an evaluation of the corneas for inflammation and opacification. As the process of entropion tends to preferentially affect the upper eyelid, this should be reflected upwards in order to better visualize the tarsal conjunctiva for evidence of follicles, inflammation, or scarring (4,12).

Diagnosis

The diagnosis of trachoma is ultimately based on the clinical manifestations of the disease, and the findings from the examination of the eye can be used to categorize the disease according to the WHO classification (4,12). Laboratory testing (including PCR and cytology) are typically confirmatory but are not widely available in the low-resource settings in which trachoma is typically found (2).

THE SAFE STRATEGY

In 1998, The Alliance for the Global Elimination of Trachoma (under the aegis of the WHO) established a global initiative for the elimination of all causes of avoidable blindness by the year 2020 (4). Trachoma was one of the five priority diseases identified as part of this initiative. The WHO, in collaboration with various non-governmental organizations, has designed a program intended to eliminate blinding trachoma through a four-component strategy known as SAFE. The first two elements of the strategy (Surgery and Antibiotics) may be understood as the direct treatment of the disease through surgical procedures and pharmacotherapy, while the second two elements (Facial cleanliness and Environmental improvement) refer more generally to a set of public health approaches that may help prevent the spread of the disease.

Treatment: Surgery & Antibiotics

Infection with *C. trachomatis* does not itself lead to blindness in all cases; rather, individuals for whom infection has been frequent and repeated may be at an elevated risk of blindness due to chlamydia-related trichiasis (1). Surgery is the most direct way to prevent blindness from trichiasis (14).

Table 1. World Health Organization Trachoma Simplified Grading Card (Modified from (12))

Classification	Identifying Features
Trachomatous inflammation (follicular) TF	5 or more follicles of >0.5 mm on the upper tarsal conjunctiva
Trachomatous inflammation (intense) TI	Papillary hypertrophy and inflammatory thickening of the upper tarsal conjunctiva, obscuring more than 50% of the deep tarsal vessels
Trachomatous conjunctival scarring (TS)	Grossly visible scars in the tarsal conjunctiva
Trachomatous trichiasis (TT)	1 or more ingrown eyelashes touching the globe, or evidence of epilation (eyelash removal)
Corneal opacity (CO)	Presence of corneal opacity blurring part of the pupil margin

Bilamellar tarsal rotation is the surgical treatment of choice, wherein an incision is made parallel to the eyelid margin and the eyelid is rotated outwards and sutured in a fashion to ensure the eyelid and eye-lashes are no longer in contact with the cornea (14). Despite the effectiveness of surgical intervention, there exist substantial barriers to its implementation and uptake. Studies have indicated that even when surgery is provided at no charge, patients are often unaware of the availability or benefits of surgery or are unable to afford transportation to the surgical site (15-17).

The medical treatment of trachoma recommended by the WHO is azithromycin, administered once annually at a dose of 20mg/kg (18). Topical tetracycline (1%) taken twice daily has also been shown to be equally efficacious, and is suggested as an alternative in areas where azithromycin is unavailable. A single dose of oral azithromycin has been found to be as effective as a long course of topical tetracycline for active trachoma (18-19). Although tetracycline is widely available, compliance rates are often low due in part to undesirable side effects including a tingling sensation and temporarily blurred vision (18). Azithromycin, in contrast, is well-tolerated and is associated with higher compliance and fewer adverse effects compared with tetracycline (18). In communities where the prevalence of trachoma among children aged 1-9 years is greater than 10%, evidence supports the use of mass antibiotic treatment with azithromycin in particular (19).

As with the administration of any antibiotic over long periods of time, there have been concerns about the possibility of resistance. While studies have documented azithromycin resistance in the D through K immunotypes associated with urogenital infection, evidence suggests there is no significant increase in resistance after treatment for ocular *C. trachomatis* in endemic regions (20). In light of these reassuring findings, the importance of incorporating ongoing surveillance for resistance as part of azithromycin-distribution trachoma programs has been emphasized, as the development of macrolide resistance would pose substantial challenges for the global elimination of trachoma (20).

Prevention: Facial Cleanliness & Environmental Change

While the surgical and medical treatment of the complications of trachoma can be highly effective, it is important to recognize that the blindness associated with trachoma results from repeated infection with *C. trachomatis*. The SAFE strategy endorses the notion that public health and preventative approaches aimed at decreasing the transmission of *C. trachomatis* can play an important role in helping decrease the incidence and prevalence of trachoma at the population level (21). A strategy focused on reducing individual and community risk factors should thus be considered integral to any effort at controlling the spread of disease (21,22). This is most likely to occur in response to effective implementation of the F and E components of SAFE (21). Evidence strongly suggests that individuals with clean faces clear of visible ocular and nasal discharge are far less likely to have active trachoma (23). This is of particular importance because facial cleanliness is an easily modifiable risk factor. It has yet to be demonstrated, however, that face washing alone is directly associated with a decrease in trachoma prevalence (23). Emerson et al. explain that increasing water supply and quality, improving access to latrines, reducing crowding within households, providing health education, and decreasing the density of eye-seeking flies should decrease the transmission of trachoma (24). Research examining the use of insecticide to control the population of eye-seeking flies is contradictory; some studies have shown a statistically significant decrease in the prevalence of active disease while other studies have found no difference (13, 23). Evidence to support the role of latrines in directly controlling transmission is similarly inconclusive (23, 25).

Despite often contradictory studies, it is arguable that an increase in the quality and quantity of preventative strategies

and community health education would play a considerable role in the overall control of disease transmission. While evidence is not available to directly support a causal relationship between specific preventative approaches and reduced disease transmission, the argument can be made that preventative approaches could (and should) still play an important role in combating the spread of trachoma. The impact of preventative efforts would likely occur in concert with the other elements of the SAFE program to help decrease trachoma transmission and overall incidence (11).

Recently emergent approaches in the prevention of trachoma have been directed at providing health education at the community level, and providing training for paraprofessional community health workers to lead trachoma prevention strategies in their own communities (22). Examples of such initiatives include increasing facial hygiene education and face cloth distribution for school-aged children, providing training to paraprofessionals on the dosing and administration of azithromycin, and providing financial support through micro-finance for a community member to establish a business selling home-made soaps for face-washing (22,26). Though evidence supporting these initiatives is at this point largely anecdotal, community-directed innovation in leading trachoma prevention initiatives may have the potential to play a key role in future preventative efforts, and should not be discounted.

CONCLUSION

Trachoma is the leading infectious cause of blindness worldwide, with repeated *C. trachomatis* infection leading to conjunctival scarring, trichiasis, and ultimately corneal opacification. This disease is particularly amenable to prevention efforts, which when implemented successfully, may help decrease the transmission and overall incidence of trachoma. The particular responsiveness of trachoma to surgical and medical treatment as well as environmental risk factor prevention place this condition at the nexus of curative and preventative medical work. The initiatives undertaken to date have highlighted the importance of strengthening local public health systems, as well as the success that can come from community engagement in trachoma elimination strategies (27). It is reaffirming that several countries have recently reported having reached WHO elimination treatment targets (4). These successes illustrate that trachoma elimination is indeed possible and a goal towards which medical and preventative care should continue to strive as we near closer to the target elimination year, 2020.

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REVIEW AND CLINICAL PRACTICE

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Anatomical Variation of the Brachial Plexus: An Ancillary Nerve of the Middle Trunk Communicating with the Radix of the Median Nerve

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ABSTRACT

Purpose: Variations in brachial plexus anatomy are common. As such, the knowledge of variations is essential for surgeons and anesthesiologists to decrease the risk of iatrogenic injuries. Moreover, brachial plexus variations often co-exist with aberrant vasculature. The median nerve is formed from contributions by the lateral and medial cords. This case report details a unique variant in the formation of the median nerve.

Methods: The anatomical variant presented was identified during an upper-limb dissection of an adult cadaver.

Results: The anatomical variant presented demonstrates a bifurcation of the middle trunk of the brachial plexus that coalesces to the radix of the median nerve. Although prior studies have demonstrated median nerve brachial plexus variations, the aforementioned variant arises directly from the middle trunk and communicates directly with the median nerve, while previously mentioned variants often connect to the medial or lateral cords.

Conclusion: The communicating branch between the anterior division of the middle trunk and radix of the median nerve represents a unique and uncommon anatomical variation.

RÉSUMÉ

Objectif: Les variations de l'anatomie du plexus brachial sont fréquentes. En tant que tel, la connaissance des variations est essentielle pour les chirurgiens et les anesthésiologistes afin de diminuer le risque de lésions iatrogènes. De plus, les variations du plexus brachial coexistent souvent avec un système vasculaire aberrant. Le nerf médian est formé de contributions par les cordes latérales et médiales. Ce rapport de cas détaille une variante unique dans la formation du nerf médian.

Méthodes: La variante anatomique présentée a été identifiée lors d'une dissection d'un cadavre chez un adulte.

Résultats: La variante anatomique présentée montre une bifurcation du tronc médian du plexus brachial qui coalesce avec la base du nerf médian. Bien que des études antérieures aient démontré des variations médianes du plexus brachial, la variante susmentionnée provient directement du tronc central et communique directement avec le nerf médian, alors que les variantes mentionnées précédemment se connectent souvent aux cordons médiaux ou latéraux.

Conclusion: La branche communicante entre la division antérieure du tronc central et la base du nerf médian représente une variation anatomique unique et peu commune.

The brachial plexus is formed by contributions from the anterior rami of spinal nerves C5-T1. Spinal nerves C5-C6 continue to form the superior trunk; C7 continues to form the middle trunk, and C8-T1 forms the inferior trunk. Each trunk then divides into anterior and posterior divisions. The anterior divisions of the superior and middle trunk form the lateral cord, while the anterior division of the inferior trunk forms the medial cord. Finally, the lateral cord and the medial cord unite to form the median nerve proper (**Figure 1**) (1).

Studies by Miller et al elucidate the origins of the brachial plexus. The brachial plexus is a pervasive structure apparent since the existence of amphibians. The structure began as no more than several nerve segments in amphibians that progressed and differentiated into its current intricate and complex state (2-5). The evolution of the brachial plexus can be attributed to the diversification of the corresponding blood supply and musculature. The orientation of the axillary artery is responsible for the intrinsic variation, meanwhile the foundation of the brachial plexus is dependent on the musculature. For instance, the branching

Keywords: Brachial plexus; Variation; Anatomy; Median nerve; Middle trunk; Cadaver

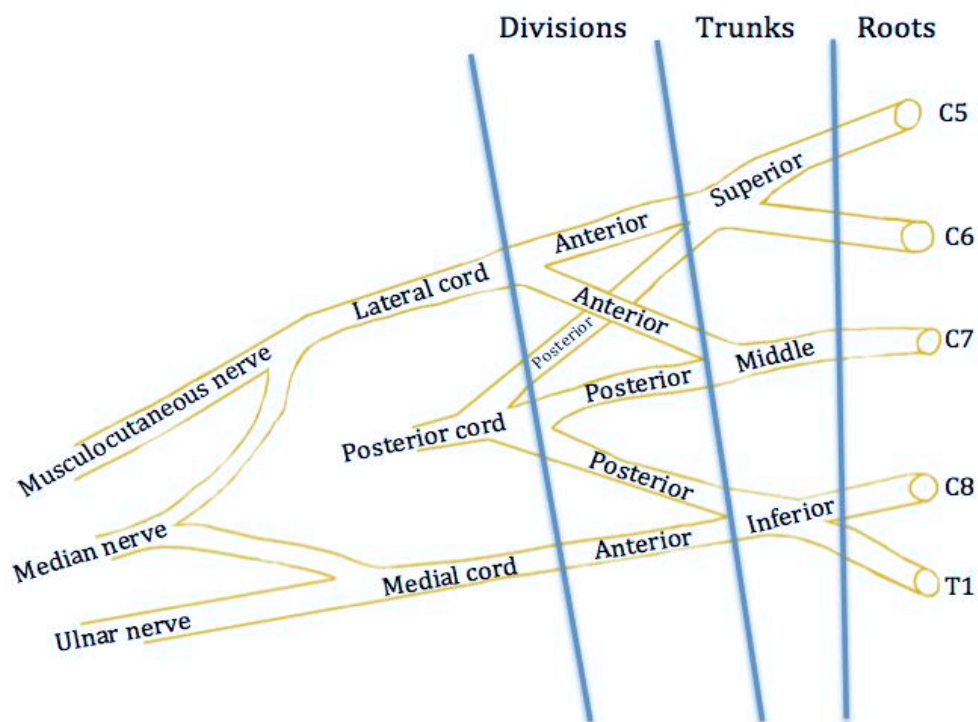


Figure 1. Illustration demonstrating normal brachial plexus anatomy.

pattern of the musculocutaneous nerve is dictated by the muscle it innervates. In primitive species, such as the lemuroids, the coracobrachialis muscle contains three heads. Consequently, their brachial plexus contains additional nerve branches superior to the musculocutaneous nerve from the lateral cord. These additional nerve fibres are not found in higher-level species. In apes, the coracobrachialis and biceps are almost completely fused, thus, these nerve fibres have completely regressed (4,5). Normally, the development of the brachial plexus in humans starts at the 34th to 35th day of intrauterine life and proceeds to the definitive adult pattern by the 46th to 48th day (2-5). Any alteration in the signaling between mesenchymal cells and neuronal growth cones can lead to significant brachial plexus variations (1-3).

METHODS AND RESULTS

The anatomical variant presented was identified during routine upper-limb dissection of an adult cadaver through the Faculty of Medicine, Ottawa, Ontario. Upon dissection, anatomical variations of the brachial plexus were carefully noted. The anatomical variant presented demonstrates a bifurcation of the middle trunk of the brachial plexus that coalesces to the radix of the median nerve. Permission to take the photo in this article was

granted by the University of Ottawa Faculty of Medicine by the Department of Anatomy.

DISCUSSION

Previous Descriptions of Similar Variants

Common aberrations in the structure of the brachial plexus have a tendency to share vestigial features of more primitive species. For example, in humans, the correct anatomical orientation of the axillary artery is deep to the plexus. Conversely, the majority of primitive species have their artery superficial to the nerves and represent one of the most common human variations. Therefore, brachial plexus variations are due to errors during the embryological developmental process and are often remnants of vestigial structures (4,5). The purpose of this case report is to detail a unique variant in the formation of the median nerve.

Several anatomical median nerve variants have been previously reported. For example, in a study of 130 brachial plexus variants in 1999, Uzun and Bilgic found that 14 of 130 brachial plexuses (10.80%) demonstrated “a connection between the medial radix of the median nerve and ventral division of the middle trunk.”



Figure 2. Median nerve variant demonstrating additional ancillary branch (MNV) arising from the middle trunk (MT) and uniting to form the median nerve (Mn) at the union of the lateral (LC) and medial cords (MC) of the median nerve. Abbreviations: Ulnar nerve (Un), median nerve (Mn), musculocutaneous nerve (Mc), medial cord (MC), lateral cord (LC), median variant (MNV), normal anterior division (NAd), superior trunk (ST), middle trunk (MT).

Additionally, 2 of 130 plexuses contained a contribution from the posterior division of the middle trunk connecting to the medial cord (6). In 2006, Goyal and colleagues reported a bilateral cadaveric anomaly. On the right side, the median nerve was formed by the lateral and medial cords with a supplementary branch from the lateral cord. The proximal aspect of the lateral cord gave rise to a small communicating branch, which eventually joined the median nerve. In the left axilla the median nerve was formed by a similar, but more complex union of two lateral cord roots and one medial cord root. The anomalous proximal contribution of the lateral cord diverged from the an-

terior division of the middle trunk and lateral cord proper and provided an additional small communicating branch that traveled medially to reach the medial cord. Finally, the distal contribution of the lateral cord united with the medial cord normally to form the median nerve proper (7). More recently, Padur and colleagues, studying lateral cord variations in 82 cadaveric brachial plexuses, demonstrated 6 anomalies. Notably, in one limb the median nerve was formed by three roots; two of the roots arose directly from the medial side of the lateral cord, and the last root arose from medial cord. The three roots joined to form the trunk of the median nerve, and encircled the axillary artery

(8).

Discussion of Variant and Clinical Implications

Most commonly, reported median nerve variants demonstrate either a) additional roots arising from the lateral or medial cords uniting to form the median nerve; or b) roots diverging from the middle trunk to join the lateral or medial cords. The anatomical variant presented, however, demonstrates an uncommon additional anterior division arising directly from the middle trunk and uniting to form the median nerve at the union of the lateral and medial cords of the median nerve (**Figure 2**).

Although the anatomical variation presented may not have impacted limb function directly, variations in brachial plexus anatomy may have clinical significance for surgical and anesthesiological operations performed around the brachial plexus and its vasculature (e.g., neck surgeries). Moreover, previously reported data suggests that brachial plexus and median nerve variations correlate with variations in the anatomy of the axillary artery (9). For example, Singhal et al, reporting several anomalous cord variations in a single cadaveric brachial plexus, identified an abnormal relationship of the median nerve to the axillary artery, such that “the median nerve lay medial to the axillary artery” (9). Current anesthesiological methods for assessment of brachial plexus anatomy prior to surgical operation include: 1) blind approach; 2) peripheral nerve stimulation; whereby a nerve is stimulated to produce paresthesia; and 3) ultrasound guidance. The first and second methods generally increase the risk of complications if aberrant anatomy exists, whereas ultrasound guidance renders a lower potential risk of operational complications, given the increased rate of detection of anatomical abnormalities. As demonstrated in this case, the potential for anatomical and vascular variations to exist is not uncommon. This emphasizes the need for thorough preoperative evaluation of brachial plexus anatomy, including ultrasound guidance, in order to detect anatomical variations, and decrease the rate of complications (10).

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A Cry for Help: Suicide Attempts by an Iraqi Refugee and the Role of Community Service Learning

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ABSTRACT

Community Service Learning (CSL) is a method of teaching where students learn through active participation in thoughtfully organized community service. CSL has emerged as a promising training method to address the changing needs of medical students and to improve their social accountability (1,2). Medical schools are beginning to incorporate community service learning into their curriculums as a way to introduce students to the complicated world of delivering care to vulnerable populations.

Mr. A, a refugee from Iraq, immigrated to Canada in June 2015 with his family. Five months later, during a CSL medical intake interview with two medical students and an Arabic interpreter, he revealed to have ongoing suicidal ideation and multiple suicide attempts. Due to significant cultural taboos and stigma around mental illness, Mr. A was initially very hesitant to seek medical help. However, with the help of the CSL program he was able to get much needed medical care.

RÉSUMÉ

L'apprentissage par le service communautaire (ASC) est une méthode d'enseignement où les élèves apprennent en participant activement à un service communautaire bien organisé. Le CSL est une méthode de formation prometteuse pour répondre aux besoins changeants des étudiants en médecine et pour améliorer leur responsabilité sociale (1,2). Les facultés de médecine commencent à incorporer l'apprentissage par le service communautaire dans leurs programmes d'études afin d'initier les étudiants au monde complexe de la prestation de soins aux populations vulnérables.

Monsieur A, un réfugié d'Irak, a immigré au Canada en juin 2015 avec sa famille. Cinq mois plus tard, au cours d'une entrevue d'admission médicale CSL avec deux étudiants en médecine et un interprète en arabe, il a révélé avoir des idées suicidaires en cours et de multiples tentatives de suicide. En raison de tabous culturels importants et de la stigmatisation entourant la maladie mentale, Monsieur A était initialement très hésitant à demander de l'aide médicale. Cependant, avec l'aide du programme CSL, il a pu obtenir des soins médicaux indispensables.

Increased rates of Post-Traumatic Stress Disorder (PTSD) and depression among refugees in Canada is of concern (3,4). This trend of increased mental health disorders can be attributed to pre-migratory, migratory, and post migratory stressors related to finance, shelter, education, and health (5). Hence, family physicians, as primary care providers, should be well equipped with the tools necessary to recognise, assess, and treat mental health issues present in vulnerable populations. One such tool is the awareness of cultural stigma towards mental health disorders and the ability to provide un-prejudiced care on the basis of a trusting patient-physician relationship (3).

CASE DESCRIPTION

Mr. A, a 38-year-old Iraqi refugee arrived in Canada in June with his wife and 3 children. Approximately 5 months later the family was paired with 2 medical students and an International Medical Graduate (IMG) Arabic interpreter for a Medical Intake Interview as part of a Community Service Learning (CSL) placement. Mr. A stated he slept poorly — often sleeping only 2 hours a day and smoking 4 packs of cigarettes daily. He said his only goal was to bring his children to Canada, away from the war torn area in Iraq. Now that his mission was accomplished he felt his job was done and had no desire to pursue a career in Canada. His family commented that he was sad all the time and he had lost interest in friends and activities. Despite being diagnosed

Keywords: Community Service Learning; Refugees; Mental Health

with depression a few months prior and taking antidepressants, Mr. A did not feel any better.

Mr. A did have a history of depression in Iraq and disclosed sustaining multiple gunshot wounds to his left leg during the war. His leg was not treated by a medical doctor at the time of injury due to his immense distrust in the Iraqi medical system. Although there was no infection in the leg, currently it remained painful to walk, and he admitted to engaging in self-mutilation, where he intentionally peeled his own skin. The combination of his self-mutilating behaviour, poor sleep patterns, loss of interest in life, and depression prompted the question: “Have you ever had thoughts of suicide?”

Mr. A disclosed that he did have thoughts of suicide for many years and had already tried committing suicide, as recent as 2 weeks ago in Canada, by electrocution. During the conversation, he was suicidal and had no desire or hope to live through the night. He stated, “I would rather die than to let anyone know about this [suicidal ideation]” and asked the medical students and interpreter not to tell his family. Throughout the conversation Mr. A had a very calm demeanor, but he was visibly unhappy and teared up occasionally. A family doctor, who is also the advisor for the CSL program, was immediately consulted and had advised that Mr. A’s case was urgent and required an immediate visit to the Emergency Department (ED). As stigma around mental health issues persist, and more so in Arab cultures, Mr. A initially refused to go to the ED in fear that he would be admitted to the hospital, causing his family to find out about his mental illness. After much reassurance and encouragement by the interpreter, family physician, and medical students, Mr. A agreed to go to the ED provided that the interpreter and medical students accompanied him.

At the ED, Mr. A revealed details of trauma which included witnessing the death of his brother as well as his best friend. Mr. A refused the assistance of a male Arabic interpreter in the ED and stated he felt that he was being “judged”. He insisted on the presence of someone he was familiar with. Therefore the CSL interpreter and then Mr. A’s settlement counsellor took turns assisting the ED staff with translation during Mr. A’s interview. Later, Mr. A was discharged home with a prescription for anti-depressants and a referral to a psychiatrist. Mr. A makes weekly visits to his psychiatrist with good progress. His family physician was also updated on this incident and is following up with Mr. A more frequently. He is currently keeping very well and is able to sleep for a longer duration with signifi-

cantly decreased suicidal ideation. He is able to spend more time with his family and is reconnecting with other Iraqi friends.

DISCUSSION AND CONCLUSION

Refugees are often marginalised and unable to access health care effectively. Those with pre-existing conditions like depression are most at risk. As this case illustrates, mental illness is often stigmatized among refugee families—often leading to refugee patients dealing with their illness in isolation, without any family support. PTSD has been reported in many refugees, making integration into the new community even more difficult. The University of Ottawa CSL program aims to support settlement agencies in providing assistance as well as a bridge to primary health care for refugee families.

CSL provides a unique opportunity for medical students to gain confidence and competence in communication skills, advocacy, and collaboration with community agencies and other health-care workers. It also carves out space outside the traditional classroom to allow students to build trusting relationships with often vulnerable and marginalized populations like refugees. Refugees are able to experience health care via CSL in a gentler, less intimidating way, thereby often leading to more positive outcomes.

Developing and maintaining the trust of Mr. A was crucial to him disclosing his suicide attempts and proceeding to the ED to seek help. The students and Arabic interpreter continued to visit Mr. A and his family at their home. The sense of being welcomed by the students clearly has had a profound effect on Mr. A as he continues to do well from a mental health perspective. The fact that our Arabic interpreter was an IMG helped us tremendously in this situation. For example, her past medical experience helped her to quickly identify the signs of a major depressive episode, PTSD and suicidal ideation while simultaneously, she was able to apply her own personal cultural knowledge to delicately delve deeper into Mr. A’s story to develop a trusting rapport in a culturally competent manner. This is an example of how IMGs, in the context of new incoming refugees, can have a vital role as part of a refugee family’s circle of care.

In conclusion, CSL provides early learners with the experiences of working with vulnerable populations, which has the potential to not only lead to more social accountability amongst health care providers, but also the creation of physician leaders.

KEY POINTS

1. Experiential, community-based training should be an integral part of medical students' education to learn the social determinants of health from the perspective of vulnerable populations.
2. Improved mental health education is required for refugee families, as well as increased resources to support their mental health needs.
3. IMGs can be a valuable addition to the preventative health-care team for overcoming cultural and language barriers when interacting with refugees or immigrant families.

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The Power of Global Surgery: A Medical Student's Experience At Save A Child's Heart (SACH)

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ABSTRACT

This elective report provides an overview of the experience of a 1st year medical student completing a global pediatric cardiac surgery elective at Save A Child's Heart (SACH), an Israeli Non-Governmental Organization (NGO). SACH provides life-saving cardiac surgery to children from developing countries, who would otherwise be unable to access care. Children are screened in their home countries, and brought to Israel for these complex surgical procedures. This elective is unique, as it exposes medical students to leading experts in cardiac surgery, cardiology, pediatric ICU, as well as international residents and patients.

RÉSUMÉ

Ce rapport électif donne un aperçu de l'expérience d'un étudiant en médecine de première année qui complète un cours de chirurgie cardiaque pédiatrique mondiale à Save A Child's Heart (SACH), une organisation non gouvernementale (ONG) israélienne. SACH fournit une chirurgie cardiaque vitale aux enfants des pays en développement, qui autrement seraient incapables d'accéder aux soins. Les enfants sont examinés dans leur pays d'origine et amenés en Israël pour ces procédures chirurgicales complexes. Cette option est unique, car elle expose des étudiants en médecine à des experts de premier plan en chirurgie cardiaque, cardiologie, soins intensifs pédiatriques, ainsi que des résidents internationaux et des patients.

From the moment I walked into the SACH house, I realized that my international elective experience would be inspiring and unique. Though I recognized that SACH performs life-saving heart surgeries for children from developing countries, seeing smiling and waving children throughout the house was not what I had been expecting from a medical internship of this nature. After all, as a medical intern, I was expecting to see sick children pre-operation (pre-op), and recovering children post-operation (post-op), from extensive cardiac surgery. This was the first time I experienced the power of global surgery at SACH.

SACH is a UN-sponsored Israeli NGO, providing life-saving cardiac care for children from developing countries. SACH is based out of Wolfson Medical Centre, a pediatric cardiology Centre of Excellence, in Holon, Israel (1). SACH has reliable partnerships in developing countries that participate in the diagnosis, referral, and screening of children to SACH in Israel. SACH also provides programs in Israel designed to train medical and surgical staff from developing countries, with the goal of their returning to their home country to develop independent and sustainable cardiac care (2).

My initial objectives while participating in this elective were to gain further insight into the different fields of medicine and determine where my interests may lie in the future, as well as to learn more about global surgery (e.g., creating access to safe and high quality surgery in low-middle income countries) (3). I initially participated in the SACH internship to gain exposure to a variety of specialties, including: cardiac surgery, cardiology, pediatrics, intensive care, anesthesia, imaging, and global surgery, but ended up achieving much more.

DISCUSSION

What made my SACH internship unique, was being able to spend time playing with children in the house pre-op, seeing their surgery or catheter lab procedures, checking on them post-op in the pediatric intensive care unit (PICU), and later on the wards. Every day, before and after our hospital shifts, we would go say hello to the SACH children on the wards, and in the PICU. Seeing them smile, and recognize our familiar faces in the intimidating hospital setting of a foreign country was touching, and added a deeper level of humanism to every surgery we observed. For example, X., a 13 year old girl from Ethiopia, was born with Tetralogy of Fallot (TOF). TOF is the most common form of cyanotic congenital heart disease and is characterized

Keywords: Cardiac Surgery; Global Health; Pediatric surgery; Cardiology; Compassionate Care

by having a ventricular septal defect (VSD), an over-riding aorta, right ventricular outflow obstruction, and right ventricular hypertrophy (4). In Canada, children with TOF are diagnosed before or immediately after birth, and receive surgery within three to six months of birth (4). The surgery for TOF generally entails closing the VSD (allowing blood to now flow from the left ventricle to the aorta), cutting away obstructive muscle in the right ventricle, and enlarging the right ventricle outflow tract (5). Unfortunately for X., she was only diagnosed with TOF after having presented with symptoms, including shortness of breath, in gym class months earlier. Performing a TOF surgery on a 13-year old is not common in the developed world, as it carries a higher complication rate (6). Knowing this about TOF, I asked one of the SACH doctors what the indications were to operate, and if the risks were too high, particularly given this patient profile. The response was that this child would not survive much longer with her condition, and that at SACH, “we give children a chance, even when it isn’t easy; we work as hard as we can to give them this chance”. This statement embodies the power that global surgery can have; with a group of motivated and dedicated individuals, global surgery has the power to transform lives, give children a chance to live and thrive, and provide global equity. Regardless of where a child is born, global surgery has the ability to save lives and improve quality of life.

This particular patient highlighted the humanity and impact that doctors can have, and provided a different experience than what is generally available to medical students in Canada. During Canadian pre-clerkship surgical electives, pre-clerkship students see the patient in the OR, but don’t experience the fears and anxiety that the patient experiences in the weeks leading up to the surgery. Post-op, as a student with the surgical team only the surgical follow-ups are seen. However, within Canadian pre-clerkship education, it is not typical to see a patient from the perspective of a surgeon, a pediatrician, and a critical care doctor, simultaneously. X. allowed me to see how so many health care professionals, such as caregivers, nurses, and doctors, from different specialties, all have immense power to contribute to an individual patient’s care.

It is hard to describe a ‘typical’ day at SACH, as each day provided new experiences, challenges and exposures. As a medical intern, I was able to join PICU rounds, pediatric cardiology clinics, pre-op and post-op echocardiogram clinics, teaching sessions by the SACH staff, and observe cardiac catheterization and cardiac surgeries. The care of Rheumatic Heart Disease (RHD) at

SACH is an illustration of such a comprehensive medical internship experience. RHD is a disease that damages heart valves caused by untreated rheumatic fever. RHD is largely considered a “disease of the past” in Canada (7). However, RHD is the most commonly acquired heart disease in Africa (8), and accordingly, there were many SACH children with RHD. Depending on the severity of RHD, some children were treated in the cardiac catheterization lab, where percutaneous valve replacements, stents, and balloons were used. More severe cases required extensive open heart cardiac surgery to repair the valves. Children required pre-op and post-op evaluation in the cardiac clinic and with echocardiography, to evaluate the valve damage. After surgery and catheterization, children were monitored in the PICU. All of this information was then integrated and expanded on during designated teaching sessions. These various clinics and experiences allowed me to explore the multiple perspectives of the cardiac conditions being treated at SACH.

Part of SACH’s mission is to train residents and fellows from developing countries, so that in the future, complex heart surgeries and post-operative care will be available in all countries of the world. Some countries where these residents originate from are Zanzibar, China, Romania, and Kenya, to name a few (2). These residents and fellows leave their families for years, sometimes 2, 5, or more, leaving young children, spouses, and parents behind, to come to a foreign country (Israel), with the ultimate goal of contributing to the healthcare system of their home country. To me, this is a remarkable manifestation of the Hippocratic Oath.

Indeed, my recognition of the immense power of global surgery was enhanced by medical trainees from countries around the globe at SACH. For example, one of the trainees from Tanzania vividly described to me how, for months, he had cared for a dying child with a congenital heart defect. Due to a lack of resources and expertise, he was only able to provide palliative care. SACH arrived in Tanzania on an outreach mission, performed the needed surgery and saved this child’s life. That was the moment when the trainee decided to move to Israel to train to be a cardiac surgeon at SACH. Upon completing his cardiac surgery training at SACH, he is set to return to his home country of Tanzania to provide life-saving surgery to young children. Clearly, global surgery has the power to create waves of change. Each child treated at SACH creates a wave of hope, prosperity and newfound life upon returning to the child’s home country. In conjunction therewith, the medical residents at SACH from

around the globe are the ripples in this powerful ocean. They sacrifice time with their family and friends in their home country, as well as the comfort of their known medical system, to train in Israel so that they can then return home to create a powerful wave of hope, prosperity, and life. This very power of global surgery is one to be encouraged, grown, and expanded, so that patients, physicians, and countries around the world continue to benefit.

CONCLUSION

This global surgery elective at SACH not only provided me with new knowledge about the fields of cardiac surgery, cardiac care, and rheumatic heart disease, but provided me the opportunity to reflect on the power of global surgery. This elective provided me with personal stories, patient memories, and inspirational teaching opportunities that have strengthened my understanding of the ripple effect that global surgery can have on patients, physicians, and trainees on an international scale.

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Call For Submissions

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Issue 8.2 is therefore intended to explore advances in basic and clinical genetic science, as well as the inherent barriers to progress in a dynamic and rapidly-growing field. The submission deadline of our **Fall 2018** issue is **September 1st, 2018**. High quality writing will be recognized with an honorarium award. Submissions can be made online, and details regarding article formatting and the submission process can be found on our website at www.uojm.ca.

Teslin Sandstrom & Danny Jomaa
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Appel de soumissions

Le Journal de Médecine de l'Université d'Ottawa (JMUO) est une revue à comité de lecture publiée par des étudiants diplômés et des étudiants en médecine de la Faculté de médecine. Le JMUO est la seule revue médicale institutionnelle bilingue au Canada, accueillant des présentations de haute qualité en anglais ou en français. Les articles acceptés comprennent la recherche originale, les critiques et la pratique clinique, les nouvelles et les commentaires, les rapports de cas, les rapports facultatifs, et les entre-vues. Le JMUO accepte actuellement des soumissions pour notre prochain numéro **d'automne 2018: Génétique**.

Dans la courte histoire depuis que le code génétique a été fissuré, la découverte scientifique a conduit à des avancées remarquables dans notre compréhension de la biologie du développement, la maladie génétique et la thérapie, le génie génétique, la biologie des cellules souches, l'épigénétique, et plus encore. Au-delà des blocs de construction de l'ADN lui-même, la science des gènes a amélioré notre capacité à aborder les domaines plus vastes de la santé humaine, y compris l'immunologie, le cancer, les neurosciences, les maladies chroniques et bien d'autres. L'avènement des technologies d'édition de gènes et de la génomique personnalisée a encouragé des discussions opportunes entre les scientifiques, les cliniciens et les intervenants en matière de politiques de santé publique et de bioéthique.

Ainsi, le numéro 8.2 vise à explorer les progrès de la science génétique fondamentale et clinique, ainsi que les obstacles inhérents au progrès dans un domaine dynamique et en croissance rapide. La date limite de soumission de notre numéro **d'automne 2018** est le **1er Septembre 2018**. L'écriture de haute qualité sera récompensée par un prix d'honneur. Les soumissions peuvent être faites en ligne, et les détails concernant le formatage de l'article et le processus de soumission peuvent être trouvés sur notre site Web à www.uojm.ca.

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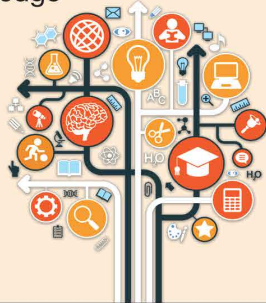
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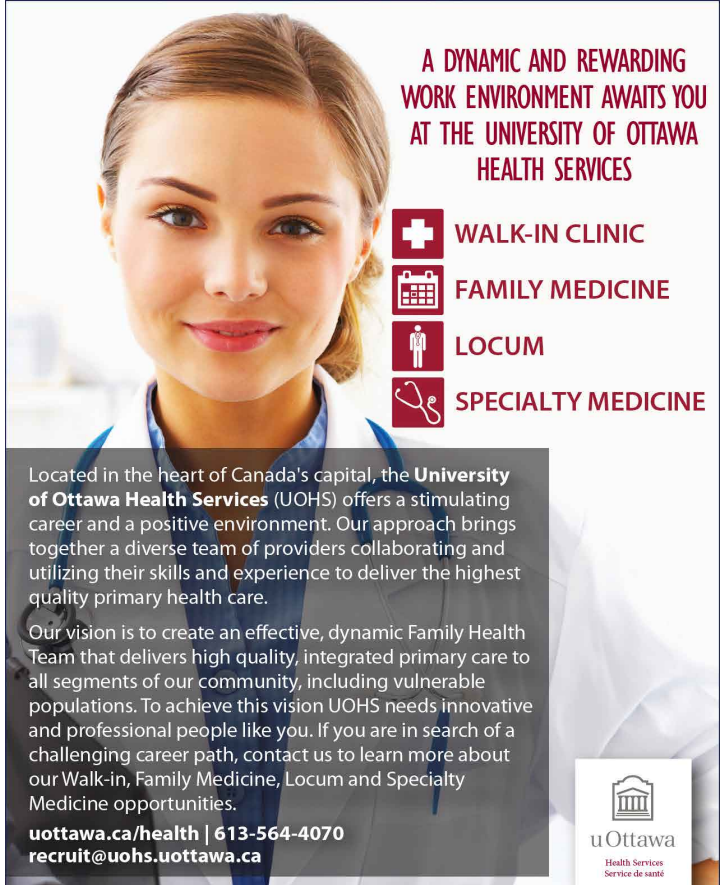
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