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Editor's message

Racism in healthcare

On the quiet evening of March 13th 2020, Mr. Kenneth Walker and his partner, Ms. Breonna Taylor, laid sleeping in their bed in a residential neighborhood in Louisville, Kentucky. Just minutes past midnight, without announcement or warning, three men dressed in street clothes pounded down their door using a battering ram. Awakened by the startling sound of wood cracking, Ms. Taylor yelled out numerous times, "Who is it?", to no answer. In desperate hopes to protect his partner and himself from the home intruders, Mr. Walker armed himself with his legally licensed firearm, prepared to act wholly in self-defense. As the door gave way, Mr. Walker shot one of the intruders in the leg. In retaliation, over 20 rounds were blindly unloaded, which carved their way through nearly the entire household; eight bullets hit Ms. Taylor, killing her in her home. The three assailants, as it turned out, were plainclothes police officers who falsely believed that the residence was connected to two men they thought were selling drugs, which prompted them to execute a no-knock warrant. Later investigation following the murder revealed that no drugs were found at the residence. On the quiet evening of March 13th 2020, Breonna Taylor, a 26 year old Black woman, was murdered in her home by three white police officers. As of writing this editorial, Breonna Taylor's killers walk free.

Just over two months later on May 25th, George Floyd, a Black man from Minneapolis, Minnesota, was murdered in the street by Derek Chauvin, a white police officer. Mr. Floyd was arrested at gunpoint, despite being completely unarmed; Chauvin then knelt on Mr. Floyd's neck with his knee for eight minutes and forty-six seconds, causing mechanical asphyxia and cerebral hypoperfusion, ultimately leading to his death. Throughout those eight minutes, Mr. Floyd cried out "I can't breathe" numerous times and even pleaded for his mother just before going unconscious. The pleas were ignored by Chauvin.

The murders of Breonna Taylor and George Floyd are only a small sampling of the horrors that have been inflicted on Black individuals, both in America and Canada. Eric Garner, Michael Brown, Trayvon Martin, Elijah McClain—the names of those lost could fill up this page—and it continues to grow daily (for a more comprehensive list, and to pay respect to all those lives lost to police brutality, please follow the #SayTheirNames campaign). These murders have sparked a global uprising calling for racial justice. Police brutality is one glaringly violent function of society, and these killings underpin something much more sinister and malignant: that is, our institutions continually uphold systemic racism and racial injustice.

Systemic racism permeates through every facet of society, including our workplaces, schools, communities, and neighborhoods. While many have advocated this fact for years, others still deny it, even in Canada. Politicians and citizens alike ignorantly wield the Canadian patriotic values of justice, equality, and truth as if they alone somehow shield those without white privilege from white hegemony. Rather, those values are simply ideals, and there is no evidence that we have ever achieved them, especially within the lens of racial justice. For those unaware, a fact: Black Canadians continue to suffer from systemic racism. Another fact: this racism still pervades our healthcare institution in many ways.

First, I would like to bring attention to how Black patients experience healthcare. A recent systematic review examining implicit bias—which helps define systemic racism—found that regardless of specialty, most physicians demonstrated an implicit preference for treating white patients[1,2]. Strikingly, one study revealed that emergency medicine and internal medicine physicians who held implicit biases against Black individuals were less likely to administer thrombolysis for acute myocardial infarction, which can be a life-saving intervention. Similarly, Black patients treated by surgeons whose caseload is mostly white individuals in fact have poorer outcomes and face greater complications[3]. Another recent study from Ontario revealed that compared to white patients, Black patients requiring home dialysis were at significantly higher risk of developing technique failure, which predisposes poor outcomes[4]. While I don't intend for this editorial to be a comprehensive review of the literature, it is clear that implicit anti-Black racism is deeply embedded in our medical practice, even in Canada.

So, how can healthcare experiences and outcomes be improved for Black patients? It is well-described that race-concordance in patient-physician relationships can be immensely beneficial to the patient: visits tend to be longer, and patients tend to leave feeling more satisfied[5]. As an example, Black patients who are paired with Black healthcare workers are over twice as likely to have their breast cancer screening abnormalities addressed within a timely fashion[6]. Thus, the key lies in increasing Black representation within the healthcare team; however, Black individuals are significantly marginalized in nearly every medical specialty[7,8]. In Canadian medical schools, Black students have

historically been and are still vastly underrepresented, with classes comprised mostly of urban-living, high household income-earning, white students[9]. And even within Canadian medical school curriculums, discussions of race are commonly left out[10]. In the name of racial justice, it is the responsibility of faculties, universities, high schools, and even grade schools (and their respective policymakers to explore where these systemic injustices exist. In response, they should address their internal processes and resources that disadvantage Black students. Most of all, they should understand that what Black students require is not more support within an inherently racist system, but more equitable pathways to succeed like their white counterparts.

Yet, even once Black medical students become physicians, they still face profound systemic injustice. On average, American Black male physicians make nearly $100,000 less than their white colleagues[11] (Canadian data is not currently available). In their everyday lives, Black physicians face racism regularly. Like in 2019, when a female Black physician, Dr. Tamika Cross, was met with doubt and was initially prevented from providing medical care to an airplane passenger who needed a physician immediately[12]). The flight attendants demanded for proof of her medical credentials and repeatedly questioned their legitimacy, before finally allowing Dr. Cross to help. To make matters worse, the airlines' largely unempathetic response was merely to say that all doctors are routinely questioned to produce their credentials when needed, thus dismissing the microaggressions that Dr. Cross faced. Ultimately, it goes to show that these kinds of microaggressions serve to uphold the institutional racism that all Black individuals face, regardless of their personal story, personal circumstances, and socioeconomic background.

Over the years, racism in Canada has become more covert, allowing many of those with privilege to become complacent, believing that racism is no longer an issue and the civil rights movement is no longer necessary. Thus, it is simply not enough to believe you as an individual are not racist. This is far too passive for any change to be made and is merely the bare minimum. Addressing systemic injustice requires active anti-racism. At the individual level, this means utilizing our social privilege for the advancement of racial justice. This means one must accept the racist roots our society has been built upon and understand where ones' privilege comes from. It means identifying and naming covert racism and implicit biases when they happen. And it means continuing to educate yourself and others on how underprivileged groups face injustice daily, as well as taking actionable steps to counteract that. At the systems level, politicians, teachers, and policymakers need to institutionalize changes against systemic injustices. For example, non-elective anti-racism courses throughout school curricula, better social support systems for those impacted by systemic racism, revision of white skin-focused curriculums (as a singular example, dermatology in medical schools), fee-deferral programs to combat hefty application fees to professional programs like medicine; to name a few. These are all just a few examples of the immense work that needs to be done to address systemic racism in our medical education.

As this editorial comes to a close, I still feel as though not nearly enough has been said on this topic. However, something I would like to touch on is that as physicians (and community leaders), we have an immense societal privilege that is awarded to us which can be utilized for anti-racist activism. In medical education, healthcare systems, and personal practice, physicians can be advocates in the fight against systemic racism. I hope that by pointing out just a small selection of ways in which systemic racism hinders Black patients, students, and doctors from living equitable lives, readers are able to reflect on what can be done within medicine to institute justice for Black individuals who live with systemic racism every day. The time to take action is now. Because Black patients matter, Black students matter, Black doctors matter, and Black lives matter.

Dan Vidovic
Editor-in-Chief

For those who feel they do not currently have the voice to advocate for our Black friends, please still take the time to further educate yourself about how our institutions, including healthcare, continue to uphold systemic racism. Teach your children, nieces, nephews, and the next generation this someday, as they are the ones to continue to institute change. Please, advocate wherever you can. And if you still feel you aren't able to contribute to change, please consider donating to organizations whose mandate is to combat anti-Black systemic racism and racial injustice. I have attached a short list of such organizations below; many more can be found online.

The Africville Heritage Trust
Association of Black Social Workers
Black Lives Matter (Canada chapters)
Birchtown Black Loyalist Society
Black Solidarity Fund
Black Health Alliance
Association of Black Social Workers
Black Youth Helpline
Roots Community Services
Black Cultural Society of Nova Scotia
Federation of Black Canadians
Black Mental Health Supports Fund
The Delmore Buddy Daye Institute
Federation of Black Canadians
Black Women In Motion
Black Legal Action Centre
DESTA Black Youth Network
Canadian Civil Liberties Association
Canadian Race Relations Foundation
Keep6ix
BLXCK HOUSE
LOVE Nova Scotia
GameChangers902
Hope Blooms
902 Man Up
Justice for Regis GoFundMe

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Humanities

Working with interpreters: An important skill for medical students

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For health care providers, communication is a key aspect of interacting with patients and their family members. When a common language between health care provider and patient is not spoken, having a simple conversation, taking a history, or explaining a treatment plan or procedure becomes complicated and unclear. Language barriers mean information is more likely to be misunderstood, recommendations are less likely to be followed, and timely health care negatively impacted[1–3].

As a medical student, one interaction in particular in which a language barrier was present has resonated with me throughout my learning. During a pediatric elective, I was asked to take a patient history from the patient's parents. As I called the family into the clinic room, I quickly realized we did not share a common language. Thankfully, an interpreter had been booked for the appointment ahead of time. As we patiently waited for the interpreter to arrive, I attempted to make small chat and engage the child with activities while the family settled in the room. During that short time, I felt an increased sense of unease and uncertainty. As I fumbled my way through introducing myself and asking how they were, there was obvious confusion and worried looks, from the family and undoubtedly myself. As the interpreter arrived, there was a significant sense of relief and calmness that followed. The remainder of the appointment went smoothly and the family's concerns were heard and explored, with an agreeable plan made.

Not surprisingly, language differences have been identified as a barrier to accessing health care, whether it is screening, routine, or specialized care. Additionally, language barriers have been identified as affecting other social determinants of health such as employment and social supports, therefore also affecting income, social justice, and social isolation[4,5]. As future health care providers, understanding and knowing how to utilize strategies and supports that currently exist will allow students to help patients overcome barriers such as language and cultural differences, thereby improving health care access and promotion[6,7].

In 2017, Canada welcomed over 280,000 new permanent residents which included immigrants and refugees. Of recent immigrants and refugees from 2015-2017, approximately 24-26% did not speak basic English or French[8–10]. Currently, there are over 200 languages spoken in Canada, and among immigrants the most common languages spoken include Tagalog, Mandarin, Arabic and Hindi[11]. Providing informed and inclusive health care necessitates that patients are both understood and understand their health care providers.

Interpreters ensure patients understand their rights within the health care system and ensure patients are receiving accurate information to make informed decisions regarding their care. Depending on the health care facility, there are varying interpreter and translation services available. Currently within Nova Scotia's health care system, the cost of interpretation services is free to patients and families. These services include telephone interpretation, face-to-face interpretation, and sign language interpretation. Additionally, as the IWK serves a larger population, French interpreters are available on site.

As students, key factors to know ahead of time when working with an interpreter include the following[12]:

- The language spoken by the patient and family
- Nature of the encounter
- Whether an in-person interpreter is available or if a telephone interpreter is required
- Date, time, and length of time requiring an interpreter - book interpreter ahead of time if possible
- Appointments/interactions take longer, so allocate more time than usual to ensure the encounter is not rushed
- If patient does not speak or read any English, interpreting services can call the patient/family for you to ensure they are aware of an appointment
- For future visits, make a note on the patient chart and the booking slip that an interpreter is needed to aid in facilitating the booking process

As a health care provider, interpreting session tips include the following[12]:

- Speak directly to the patient, NOT the interpreter
- Like any other patient interaction, explain to the patient that their information is confidential
- Avoid the use of slang, jargon, or highly technical vocabulary
- Use shorter sentences with frequent pauses to

allow the interpreter to render all information
- Be mindful of vocabulary differences, there may not be a direct word translation for common words or phrases. You may need to explain these in more detail
- Always ask if there are any questions. It is not the interpreter's responsibility to ensure the patient understands, so make sure to check with patient during and prior to completing the interaction
- Diagrams can be useful and help to explain the information. These can also be taken away by the patient
- A properly trained interpreter is the best interpreter. Using family or community members may bring biases and impair the accuracy and impartiality of the information and interaction

Finally, be respectful and conscious of cultural differences. Communication varies among different cultures and we should be open and receptive to cues and diverse practices. Should you have any questions, feel free to ask the patient or interpreter for guidance.

In reflection after my experience during my paediatric elective, I recognized that the sense of uncertainty was my fear of being unable to communicate and provide the best patient care I could for that family. I felt inadequate. I grasped to the means of basic non-verbal communication, smiling. If I could not take a history, then I would at least make them comfortable. Thankfully, with the help and support of an interpreter, the appointment was made possible and patient centered care was able to be provided.

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Review

Liability issues for the use of artificial intelligence in health care in Canada: AI and medical decision-making

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Abstract

This paper explores Canadian liability concerns flowing from the integration of artificial intelligence (AI) as a tool assisting physicians in their medical decision-making. It argues that the current Canadian legal framework is sufficient, in most cases, to allow developers and users of AI technology to assess each stakeholder's responsibility should the technology cause harm.

I believe this artificial intelligence is going to be our partner. If we misuse it, it will be a risk. If we use it right, it can be our partner.

Masayoshi Son, Founder of SoftBank

Introduction

Artificial intelligence (AI) is gaining traction in a variety of industries, including the financial, legal, and health care (HC) sectors. Within HC delivery, AI offers a plethora of benefits. In particular, it helps HC professionals in making decisions in a more timely fashion and even in performing their work. AI technologies are increasingly being developed as tools to assist physicians in diagnosing diseases and identifying appropriate treatments for their patients' condition. For instance, using AI may allow a physician to assess whether his or her patient will respond to chemotherapy. Imaging, combined with deep learning, may also speed up the diagnosis of some cancers, such as those of the lung and skin. AI apps are also increasingly appealing to clinical care users as it has been demonstrated that they may decrease human fatalities and hospitalizations due to human error[1]. The integration of AI in HC attracts attention not only due to its potential to improve the quality and efficiency of HC in Canada in terms of hospitalization and fatality rates, but also because it can significantly reduce labour costs[2,3].

Nonetheless, despite its potential, the integration of AI in HC is still limited in Canada. There is reluctance to embrace AI technologies, particularly within the medical community, due to uncertainties regarding the potential liability attached to the use of AI. The ongoing legal dispute in Great Britain over investment losses allegedly caused by AI is one of the first lawsuits in the field[4]. As case law evolves, more light will be shed on the risks of developing and using such technologies. For now, however, legal uncertainty seems to have a chilling effect on the further integration of AI in HC. The purpose of this paper is to provide the medical community with a better understanding of the liability risks surrounding the integration of AI in medical decision-making.

AI as a tool for medical decision-making refers to technologies that help physicians in their decision-making process, through the use of apps or other devices. For instance, IBM's supercomputer, "Watson", can scan genetic data from the tumours of patients with brain cancer in only a few minutes[5]. Researchers in Canada are currently developing AI technology aimed at informing surgeons of imminent cardiac arrests while patients are undergoing surgery. If successfully launched, this new technology will enable physicians to react promptly in order to prevent the cardiac arrest and avoid its adverse side effects, such as cognitive impairment[6]. Other AI tools assist physicians in identifying the most suitable drug for their patient according to that patient's genetic profile[7]. The margin of error associated with AI-assisted HC decision-making is seen as relatively low compared to the risk associated with decisions made by humans alone[2]. And while AI-assisted decision-making still carries a risk of misdiagnosis, so does the failure to use a technology that is increasingly available to HC professionals.

Who Should Be Held Liable for a Mistaken Diagnosis Made While Using AI as a Tool for Medical Decisions? The Hypothetical Case of Ms. Lafrance

Below is a fictional case highlighting the liability issues that may arise when misdiagnosis occurs while using AI as a decision-making tool.

Ms. Lafrance

Ms. Lafrance, aged 70, consults her physician, Dr. Knapp. It has been a few months since her last appointment and she has recently had a bad cough. Dr. Knapp orders a CT scan that shows a four-millimetre nodule in her left lung. Let us assume that the accepted

medical standard of care for nodules under five millimetres is to order follow-up scans every three months until the nodule reaches ten millimetres. In light of the costs associated with this protocol, and his duty to control HC expenditures, Dr. Knapp decides to rely on a new AI technology that combines deep learning and radiomics. Deep learning is a subset of AI . As for radiomics, this technology allows mineable high-dimensional data to be extracted from clinical images[8]. This new technology allows Dr. Knapp to inform Ms. Lafrance immediately after the first scan that she does not have cancer. Six months later, Ms. Lafrance goes back to her doctor as she is not feeling well. Dr. Knapp orders another CT scan which shows that the nodule has now reached fifteen millimetres. A subsequent biopsy reveals that Ms. Lafrance has a malignant tumour. By the time treatment is initiated, her prognosis has become bleak.

Ms. Lafrance v. Dr. Knapp

In the common law provinces—all Canadian provinces except Quebec—Ms. Lafrance would have to first demonstrate a physician-patient relationship between herself and Dr. Knapp in order to establish that her physician owes her a duty of care under the tort of negligence. A doctor-patient relationship giving rise to a common law duty of care normally arises as soon as a physician attends to a patient. Therefore, it is clear that Dr Knapp owes Ms. Lafrance such a duty as he is her regular physician. She would then have to prove a breach of this duty, in that the physician failed to meet the required medical standard of care and was therefore negligent.

Meanwhile, in Quebec, where civil law governs liability principles, Ms. Lafrance would typically have to show that her physician failed in his contractual obligation of means, in that he did not use reasonable means to establish a proper diagnosis, thereby committing a fault (art. 1458)[9]. If the misdiagnosis does not result from the physician's lack of prudence and diligence in providing medical services, but results instead from a malfunctioning of the AI device used to provide such services, the physician is bound by the same warranties as the seller of that device (art. 2103)[9].

Whether Ms. Lafrance attempts to demonstrate a departure from the common law standard of care or a breach of the civil law obligation of means, her burden of proof is similar. She must show that Dr. Knapp did not exercise the level of skill, diligence, and judgment that would be expected from a reasonable physician in the same circumstances, in accordance with accepted medical practice[10-11]. In both legal traditions, it is common for expert opinion to be used to establish the accepted standard of medical practice in the circumstances.

Assuming that standard consists in the above-mentioned protocol of ordering a scan every three months for a nodule under five millimetres until it reaches ten millimetres, it is arguable that, by delegating his duty to diagnose to the AI technology rather than following this accepted standard, Dr. Knapp was negligent (in common law terms) or did not comply with his obligation of means (in civil law terms). Indeed, it could be asserted that he should only have used the AI as a tool to assist him in his decision-making process, just as he would ask a colleague for advice[12,13]. Following this line of argument, reliance on these new technologies could be treated similarly to a pharmacist's use of software to flag incompatible drug treatments in a patient's file. It has long been recognized in Quebec that pharmacists can be held liable if they rely solely on the software and do not fulfill their duty to duly read the patient's file[14].

In both legal systems, Ms. Lafrance would also need to prove that the physician's fault or negligence caused her alleged injury. In other words, proving Dr. Knapp's negligence is insufficient. The common law requires the patient to show that the type of injury she sustained resulted, in fact, from the physician's negligence, and was reasonably foreseeable[4,15]. The civil law requires the patient to prove that her injury was the direct and immediate result of the fault (art. 1607)[9]. In order to fulfill her burden in both legal traditions, Ms. Lafrance must demonstrate that it is more likely than not (balance of probabilities standard) that a proper diagnosis would have prevented her injury. For instance, she would have to prove that a proper diagnosis and prompter treatment would have led to a favourable prognosis (e.g., a greater than 50% chance of survival). While the demonstration of a causal relationship between the misdiagnosis and the ensuing injury will be fairly straightforward in a number of cases, it may sometimes be more difficult, as it is not always possible to assess whether the patient's condition was treatable, and the outcome likely to be good, at the time of the misdiagnosis. This is especially so in cancer cases where the stage of the patient's cancer at the time of the misdiagnosis may be unknown.

The integration of AI in HC has the potential of involving a new party in liability claims, namely the AI company. Could the AI company be held liable toward Dr. Knapp for contractual breach or to Ms. Lafrance for the injury she suffered? These two questions raise distinct considerations and shall therefore be analyzed separately.

Dr. Knapp (or the hospital) v. the AI Company

If held liable to his patient, can Dr. Knapp (or the

hospital, should it be the purchaser of the technology) sue the AI company ? In answering this question, one needs to take into consideration the terms of the contract between Dr. Knapp (or the hospital) and the AI company. The company's responsibility toward its clients is contingent on the terms of the contract and, in particular, on the scope of the obligations outlined therein.

Most contracts are likely to provide a warranty against a technology's defects, either through the terms of the contract itself or through the legal provisions governing the contract. If no such conventional or legal warranty is applicable, finding a breach of contract is likely to be more complex. The physician (or the hospital) will have to prove that the technology was defective and that this defect was in breach of a contractual undertaking.

Regardless of the existence of a warranty, the misdiagnosis in our example is probably not due to a defect in the technology, but is instead the result of a foreseeable risk of misdiagnosis due to the inherent limitations of such technology. These limitations do not, in and of themselves, qualify as a defect. However low their rate of error may be, no AI technology can ever be 100% reliable—just as no human can ever be. One could argue that the risk of misdiagnosis is "reasonable" given that the AI is meant "to be more accurate on average than a physician" and that such accuracy is intended to improve a physician's knowledge, not to replace it[2]. Therefore, any liability on the part of the AI company would require proof of an actual defect, such as a malfunction which distorts or omits essential data, or proof of a failure on the part of the AI company to warn users about the inherent limitations of the technology.

Ms. Lafrance v. the AI company

The absence of a contract between Ms. Lafrance and the AI company does not prevent her from claiming damages against the company under the rules of extra-contractual liability (Quebec) or the tort of negligence (common law provinces). The common law tort requires that the patient prove negligence on the part of the company. The product safety rules in civil law are more favourable to her. The AI company's liability can flow from a mere safety defect (art. 1468)[9], i.e., where the technology does not afford "the safety which a person is normally entitled to expect" (art. 1469)[9]. This regime imposes strict liability (i.e., "no-fault" liability) on the manufacturer, the provider, and some of the intermediaries in the chain of distribution, which eliminates the need to demonstrate negligence in the manufacturing process.

In fact, the civil law concept of safety defect is highly dependent , on users' expectations regarding the technology[16]. As AI decision-making tools becomes more widespread and understood, their low risk of inaccuracy will necessarily increase patients' expectations as to the reliability of the AI tools. However, to the extent that the technology cannot be entirely accurate, a manufacturer would then benefit from a defense based on normal expectations regarding the product's safety, rather than the actual expectations on the part of the patients – provided that the manufacturer properly disclosed the inherent risks and dangers that the technology involves and the means to avoid them. This information would normally be disclosed to the competent intermediary, the HC professional, who uses the AI technology and is in a better position to lower the patients' expectations to a realistic level as to the technology's accuracy. Therefore, it is unlikely that Ms. Lafrance would be successful, unless she can prove that the tool was actually defective in its functioning (in civil law terms) or negligently manufactured (according to common law rules), causing it to mislead her doctor, which would generally be rare. The same observation goes for the application of the warranty against latent defects: a mere demonstration of the inherent limitations of the technology in terms of its reliability as a tool for assisting HC professionals would be insufficient to bring the warranty into play, without evidence of actual malfunctioning of the technology.

Can a manufacturer's general warning as to the imperfect nature of a tool's reliability, in and of itself, actually lower the user's expectations in a legally relevant sense, thereby allowing the manufacturer to avoid strict liability? This is doubtful, in that expectations regarding a product's safety are judged according to an objective standard based on a normal user's reasonable expectations given the type of product, and not on the subjective expectations of a specific user. A general warning to users that the tool may not be entirely reliable may be intended as a waiver of liability, but such waivers are subject to important restrictions, notably where the defendant is a manufacturer or professional seller (art. 1732–1733)[9,17] or where the defect resulted in bodily or moral injury (art. 1474)[9].

Another question is whether the patient is required to choose between claiming against the treating physician or the AI company. If the conditions for liability are met, the victim may have a successful claim against both of them and seek conclusions for joint and several (common law) or solidary (civil law) liability. Going back to the hypothetical case of Ms. Lafrance, had the damage been caused both by Dr. Knapp's failure to follow the usual standards for a treating physician and by a defect of the decision-making AI tool, both the physician and the company could be held liable. If she chooses to sue only one party, that defendant could

bring an action in warranty against the other party to claim its contributive part in the damage suffered by Ms. Lafrance.

Can a Hospital or Physician be Held Liable for an Omission to Use AI as a Tool for Medical Decisions? The Obligation or Duty to Use AI Technology

The preceding analysis addresses potential liability issues flowing from reliance on AI technology in making medical decisions. However, it is equally conceivable that an omission to use such technology could lead to malpractice claims. This is especially so if AI offers physicians the opportunity to considerably reduce death and hospitalization rates attributable to human error.

In 2015, the University Health Network (UHN), a research organization, released an analysis of the costs associated with medical errors. According to UHN, "in 2013, inappropriate prescriptions written to older patients cost the Canadian health care system $419 million, […] and the costs to Canadians for preventable adverse events in acute care [amounted] to over $396 million every year"[3]. Moreover, "research suggests that about 70,000 patients a year experience preventable, serious injury as a result of treatments […]. More shocking, a landmark study published a decade ago estimated that as many as 23,000 Canadian adults die annually because of preventable 'adverse events' in acute-care hospitals"[18]. These statistics show the grim reality of errors in HC systems, but also lay bare the opportunity for positive changes through the use of AI.

Conclusion

Our analysis demonstrates that the current legal framework in Canada allows for clear identification of the liability risks surrounding the use of AI as a medical decision-making tool. Nevertheless, until the case law confirms how the Canadian common law and civil law frameworks regarding liability will apply to AI technology, measures seeking to reduce AI-related legal risks must be implemented in accordance with the precautionary principle. More precisely, promoters of AI technology in health care should ensure the best information possible is provided to users as to the limitations of AI tools, rather than relying on marketing strategies designed to attract users on the basis of unrealistic promises and expectations regarding the reliability of these tools. The drafting of good and detailed contracts may also help in the allocation of risks, although contractual technique alone cannot serve as a panacea because the scope of such clauses are narrowly construed by the legislator or the courts. In this unchartered territory, also in the spirit of the precautionary principle, it might be worth considering international guidelines on Good AI Design/Manufacturing Practice, similar to the Good Manufacturing Practice Guideline and the Good Clinical Practice Guideline developed by the International Council for Harmonization (ICH)[19,20].

Finally, one might wonder if, in the near future, both hospitals and doctors could have an obligation to integrate AI technology into their practice. If good medical practice evolves in such a way that the use of AI becomes the norm, a failure to take advantage of this technology, such as when reviewing test results, could eventually trigger liability if the patient can demonstrate a causal connection between the damage suffered and the omission to use the technology. To date, however, the case law suggests that a hospital's liability is likely to be limited if this omission is due to a lack of financial resources[21] .

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COMMENTARY

Viral bronchiolitis and the detrimental effects of sleep

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Abstract

Infants recovering from bronchiolitis and no longer requiring supplemental oxygen will have brief episodes of oxygen desaturation during sleep when monitored with pulse oximetry. These episodes can be explained by the inhibition of the tonic activity of the inspiratory muscles during rapid eye movement sleep. Pulse oximetry monitoring should be discontinued, and these infants considered for discharge.

Although there can be no doubt that sleep is beneficial for adults and children, sleep for some individuals may be detrimental or even fatal, such as falling asleep while driving. The ill effects of sleep may also be apparent in those with sleep disordered breathing, such as obstructive sleep apnea. Many physicians may not be aware of the negative influence of sleep on infants recovering from acute viral bronchiolitis. This is best illustrated by a brief case history.

Baby Jane, a previously healthy six month old infant, had the misfortune to contract a respiratory syncytial virus (RSV) infection and was admitted to hospital. In addition to her respiratory distress and poor feeding, it was her need for supplemental oxygen by nasal prongs that triggered her admission. Her oxygen saturation by pulse oximetry (SpO2) was 85% in room air, below the cut-off of 90% used by the emergency department as one of the criteria for admission. In spite of her cough, tachypnea, subcostal retractions, mild wheeze, and inspiratory crepitations, her course in hospital was uneventful. Supportive care and oxygen were provided, and she was fed orally. On Day 3 of admission, she had minimal respiratory distress and was feeding well. Because she was receiving supplemental oxygen, she remained on continuous SpO2 monitoring. Anticipating discharge, she had her SpO2 measured while breathing room air, awake, and in her mother's arms. SpO2 was 93% and oxygen supplementation ceased. She remained connected to the pulse oximeter and the staff noted her SpO2's remained 92-93% awake but fell to 88-89% when asleep. She was restarted on supplemental oxygen when sleeping but taken off nasal prongs when awake. Baby Jane remained in hospital two more days until it was determined that her SpO2 would not fall below 90% during sleep in room air.

This scenario is repeated frequently during the annual bronchiolitis season and leads some physicians to believe that monitoring by pulse oximetry has led to an increase in length of stay (LOS) for infants with bronchiolitis[1,2,3].

Pulse oximetry is a simple non-invasive monitoring device, used initially in acute care settings – emergency departments, intensive care units, and operating rooms since the early 1980's. Known as the "fifth vital sign" pulse oximetry is now widely used on pediatric wards in patients at risk for hypoxemia[4].

Acute viral bronchiolitis is the leading cause of hospital admission in infants less than 12 months of age. Most admitted patients are hypoxemic and monitored with pulse oximetry. Admission rates for bronchiolitis have increased in recent years and some physicians believe this is associated with the overdiagnosis of borderline hypoxemia by pulse oximetry[5,6].

Guidelines for pulse oximetry, spot checks versus continuous monitoring, and acceptable SpO2 levels have varied. SpO2 minimums have fallen from 94%[7] to the generally accepted levels of 90%. The American Academy of Pediatrics (AAP)[8], Royal Children's Hospital (Melbourne)[9], and Canadian Pediatric Society (CPS)[10] recommend 90% while the UK National Institute for Health and Care Excellence (NICE) recommends 92%[11,12].

Focusing on the circumstances around the time of discharge and considering that as many as 25% of infants with bronchiolitis will have an increased LOS as a result of a perceived need for oxygen[2], what do the guidelines recommend? The AAP does not specify discharge criteria, simply stating, "clinicians may choose not to administer supplemental oxygen if the oxyhemoglobin saturation exceeds 90% . . . "[8]. The guideline does recognize that transient desaturation is a normal phenomenon in healthy infants where as many as 60% will exhibit a transient oxygen desaturation below 90% to values as low as 83%[13]. The Royal Children's Hospital guideline recommends discontinuing oxygen when SpO2 is persistently ≥ 90% but also state stopping SpO2 monitoring if not requiring oxygen for 2 hours[9]. They note that "infants with bronchiolitis will have brief episodes of mild/moderate desaturations to levels less than 90%. These brief desaturations are not a reason to commence oxygen therapy." The CPS, while not specifically focusing on discharge, does recognize that transient oxygen desaturations can occur and that continuous monitoring may lead staff to react to normal transient dips in SpO2 and restart oxygen therapy[10].

The only guideline to mention sleep is NICE[11]. For discharge, NICE recommends that infants ". . . . have maintained oxygen saturation over 92% in air for four hours, including a period of sleep." This recommendation, unfortunately, will lead to

the re-institution of oxygen therapy when brief desaturations less than 92% occur. In August 2019 NICE proposed that they needed to update their guideline stating that "the update will focus on safe and effective levels of oxygen saturation when discharging patients"[11].

Recognizing that healthy infants and infants with bronchiolitis can have brief oxygen desaturations, how might this be related to sleep?

Tonic activity of the intercostal muscles and diaphragm are important for the maintenance of functional residual capacity (FRC) in infants. During rapid eye movement (REM) sleep, the tonic activity of inspiratory muscles is inhibited and in healthy newborns the thoracic gas volume is reduced 31%[14]. The lack of tone in the intercostal muscles may cause the chest distortion to be readily apparent in the infant with a compliant chest wall. The fall in FRC leads to a subsequent drop in SpO2 detected by the pulse oximeter.

Seeking to determine whether episodes of desaturation prior to discharge in patients with bronchiolitis were associated with sleep, Kaditis et al performed continuous SpO2 measurements from 10 pm to 8 am[15]. They compared patients recovering from bronchiolitis with patients without lung disease and those with chronic partial upper airway obstruction without lung disease. Prior to discharge, infants with bronchiolitis exhibited low basal SpO2's and multiple abrupt SpO2 drops during the night. The authors speculated that the low SpO2's reflected the sleep associated reduction in FRC and deterioration in ventilation-perfusion (V/Q) mismatch. They also commented on the frequent clinical scenario of re-instituting oxygen administration during sleep in infants with bronchiolitis who have been weaned off oxygen while awake, the point of this article. We have physiological evidence for drops in SpO2's during sleep in infants with bronchiolitis, a phenomenon that also occurs in adolescents with asthma[16,17].

What might be possible solutions to address this issue? The Choosing Wisely campaign recommends avoiding continuous pulse oximetry in children admitted for respiratory illnesses who are not using supplemental oxygen[18]. The AAP clinical practice guideline on bronchiolitis suggests similar advice[8]. The message is that continuous pulse oximetry is more likely to detect transient oxygen desaturations of uncertain significance. The CPS guidelines also recommend intermittent monitoring except for high risk patients[10].

This author suggests one step further. When an otherwise healthy infant is recovering from bronchiolitis and (1) has minimal respiratory symptoms, (2) is feeding satisfactorily (75% of normal intake), (3) is maintaining SpO2's ≥ 90% when awake in room air for more than 2 hours and not requiring supplemental oxygen, and (4) there are no social/family issues to prevent discharge, discontinue pulse oximetry monitoring and send the patient home.

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RESEARCH

Prehospital times in primary percutaneous coronary intervention: The new frontier for improvement

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Abstract

Background: Primary percutaneous coronary intervention (PPCI) remains the treatment of choice for patients presenting with ST-elevation myocardial infarction (STEMI). With STEMI, total ischemic time is an important predictor of myocardial injury and other short and long-term adverse events including mortality. Several studies have examined 'Door to Balloon' times, but few studies have examined pre-hospital and in hospital component times as individual pieces that make up total ischemic time. Methods: Total ischemic and component times for patients who received PPCI from 2012- 2015 in the Queen Elizabeth-II Halifax Infirmary were described. Median total ischemic times and component times were calculated and compared. Regression modeling was performed to identify which component times and component variables explained the most variation in total ischemic times. Results: 551 patients who had successful PPCI and complete component times were identified. Most were male (76%) with a median age of 59.2 years (IQR: 52.7-68.0 years). The longest component time was 'Symptom Onset to First Medical Contact' (Median: 61 min, IQR: 32-138 min). 'Symptom Onset to First Medical Contact' was found to account for most of the variation seen in total ischemic time (R2= 61%). Conclusions: We determined that most time in the component of receiving PPCI lies in the pre-hospital setting and that component variables including EHS use and pre-activation of the cardiac catheter lab reduce total ischemic time. More research needs to be devoted to reducing patient delay, as there appears to be little room for improvement in hospital component times.

Introduction

ST-Elevation Myocardial Infarction (STEMI) is a medical emergency that requires immediate intervention. Longer total ischemic time (time taken from symptom onset to provision of coronary reperfusion), is directly related to adverse outcomes in STEMI patients[1-4]. Coronary reperfusion can be achieved with either timely administration of fibrinolytic therapy or primary percutaneous coronary intervention (PPCI). Several studies have demonstrated that PPCI is superior to fibrinolytic therapy in reducing adverse outcomes if provided in a timely fashion. At the time of this study, guidelines stressed that the first medical contact to device time for STEMI should be less than 90-120 minutes depending on the site of presentation of the patient[5].

There is extensive literature on the outcomes following PPCI, but few studies have examined component times (the discrete times that make up the process starting from symptom onset to revascularization) in PPCI[6-9]. Of these, most examined the total ischemic and door to balloon times (time from arrival at hospital door to first balloon inflation in the coronary artery). At the time of this study, only a handful of studies had attempted to show the detailed components of PPCI from a patient perspective[10-12]. Total ischemic time for PPCI is made up of several component times that can each result in delays and contribute to variation in total ischemic time (Figure 1). For example, symptom onset to first medical contact time, first medical contact to diagnostic (ECG) time, diagnosis to cardiac catheter lab activation time, catheter lab activation to catheter lab arrival/ready time and catheter lab arrival/ready to device insertion time (balloon inflation or stent deployment or thrombectomy catheter).

The objective of this study was to determine, in a tertiary care centre in Halifax, Nova Scotia, Canada, which parts of the process of receiving PPCI for STEMI contribute most to total ischemic time and explain variation in total ischemic time. Secondary objectives were to assess the effect of Emergency Health Services (EHS) and pre-activation of cardiac catheter lab prior to patient arrival reduced total ischemic time.

Methods

Study Design

The study examined all patients (n=607) undergoing PPCI for STEMI during the period of January 1, 2012 to June 30, 2015. Patients who received fibrinolytic therapy or percutaneous coronary intervention (PCI) after fibrinolytic therapy (rescue PCI) were not included. The data were obtained from the Philips Cardiovascular Information System (CVIS)®. This database is used in the Queen Elizabeth II Health Sciences Centre in Halifax,

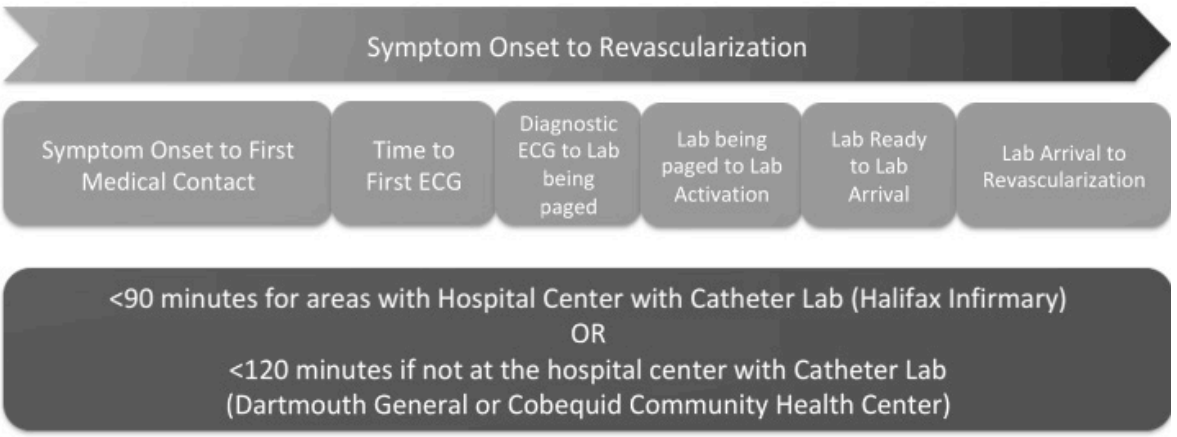

Figure 1. Total ischemic time and different points in the process of receiving PPCI. Total ischemic time measured as symptom onset to revascularization.

Nova Scotia to record patient data for those receiving cardiac catheterization, coronary angiography and percutaneous coronary intervention. The Nova Scotia Health Authority Research Ethics Board approved the study.

Study Cohort

This study was conducted in Nova Scotia, Canada. The province has a single, integrated health care system that serves a population of 940,000. PPCIs are exclusively performed in a single tertiary centre in Halifax, equipped with four cardiac catheterization laboratories. Approximately 400,000 people reside within 60 minutes of the total transport time to the cardiac catheter lab. Component times are routinely recorded as a quality assurance process in our centre. By describing the data for patients undergoing PPCI, we were able to disaggregate total ischemic time into its pre-hospital and hospital components, identify which components make the largest contribution to variation seen in total ischemic time. Patient demographics retrieved included age, sex, and available cardiac risk factors (diabetes, hypertension, dyslipidemia, and smoking history). Previous history of myocardial infarction (MI), coronary artery bypass graft (CABG), and percutaneous coronary intervention (PCI) were retrieved from our database.

STEMI was defined as presence of typical symptoms and >1mm ST-segment elevation on electrocardiogram (ECG) in at least two contiguous leads. All patients included presented with less than 12 hours of symptom duration. Five patients had PPCI for STEMI in hospital as inpatients and six patients had cardiac arrest prior to EHS arrival. These eleven patients were excluded from the study. Three other patients who received PPCI were from outside the catchment area (more than 60 minute driving distance) and were excluded. Forty-two patients had missing data and were removed. A total of 551 patients were included for final analysis.

Outcome Measures

The outcome variables were total ischemic time and each of the component times (which, when aggregated, equated to the total ischemic time). Total ischemic time was defined as symptom onset to device time. "Device" included intervention via balloon, thrombectomy device or stent. Symptom onset was defined by the patient as the onset of noticeable symptoms, and device time was the moment when revascularization was achieved. Component times were defined as symptom onset to first medical contact, first medical contact to first ECG, first diagnostic ECG to cardiac catheter lab activation (using a paging system for the PPCI on call team through the hospital telecommunication system), catheter lab activation to catheter lab ready, catheter lab ready to patient arrival in the catheter lab and catheter lab arrival to device time. Our centre also routinely collects door-to-balloon time for quality assurance and here we report our median time for consistency among the literature.

Additional process variables were included in the analysis, as they were hypothesized to influence variation in component times: use of EHS, pre-activation of the cardiac catheter lab, and activation after hours. "Use of EHS" refers to the patient calling 911 and being transported via ambulance. Paramedics in Nova Scotia are trained to recognize STEMI on ECGs and can activate the cardiac catheter lab prior to hospital arrival. "Pre-activation of the cardiac catheter lab" indicates that a diagnostic ECG was obtained prior to hospital

Table 1. Patient demographics and cardiac risk factors.

	N=551
Age (IQR)	59.2 (52.7-68.0)
Female Sex	129 (23.4%)
Hypertension	253 (45.9%)
Diabetes	94 (17.1%)
Dyslipidemia	223 (40.5%)
History of Smoking	275 (49.9%)
Previous PCI	56 (10.2%)
Previous MI	61 (11.1%)
Previous CABG	11 (2.0%)

arrival by paramedics and, through consultation with an emergency room physician, activation of the cardiac catheter lab occurred prior to hospital arrival. At our centre, the catheter lab is staffed during the week from 0800-17:00. On weekends, holidays, and outside the 08:00-17:00 window, the cardiac catheter lab staff are not in hospital and must be called in for PPCI. Therefore, cardiac catheter lab activation after hours is an important variable that could contribute to the total ischemic time.

Statistical Analysis

All statistical analyses were performed using STATA 13.1 statistics package[13]. Age is reported as a median with interquartile range (IQR). Frequencies were used to report sex, history of hypertension, diabetes, dyslipidemia, smoking, PCI, myocardial infarction (MI), and coronary artery bypass graft (CABG). Median times with interquartile ranges were calculated to describe total ischemic and component times. This allowed identification of component times that had the largest contribution to total ischemic time, and helped to determine which parts of the process were most amenable to intervention.

Total ischemic and component times were compared by process variables: use of EHS, pre-activation of the cardiac catheter lab, and activation after hours. Kolmogorov-Smirnoff tests were used to determine if the distribution of total ischemic and component times differed by process variables.

The proportion of variance in total ischemic time attributable to each component time was estimated via regression. Separate OLS regression models of each component time on total ischemic time were estimated. R-squared values for each regression measured the percent of variation in total ischemic time explained by each component time. As the distribution of the dependent variable total ischemic time was positively skewed, it was log transformed. Coefficients were estimated from OLS regressions of each process variable on the log of each measure of total ischemic time in order to identify which process variables were associated with reductions in total ischemic time.

Results

Among the 551 patients analyzed, most were male (76%) and the median age was 59.2 years (IQR: 52.7-68.0 years). A more detailed description of patient demographics and cardiac risk factors is shown in Table 1. Median door-to-balloon time was 81min (IQR: 55-103min) and the median first-medical contact to device time was 100min (IQR: 86-123). The median total ischemic time was 173min (IQR: 137- 257min). Quintiles for total ischemic times and component times are shown in Table 2. The longest component time was symptom onset to first medical contact (Median: 61min, IQR: 32-138min).

The majority of the variation in total ischemic time was accounted for by the earlier stages of receiving PPCI (Table 3). Symptom onset to first medical contact was found to account for most of the variation seen in symptom onset to device time (R2= 61%). All other component times were found to account for less than 10% of the variation in total ischemic time. Not all patients had a first ECG as diagnostic; 95 patients (17%) had a diagnostic ECG after their first ECG. The median was 39min (IQR: 18-72min) between first ECG and diagnostic ECG (R2 = 0.18).

The total ischemic time was significantly associated with the three process variables examined (Table 4). Most of our sample used EHS to transport to our centre (n= 296, 53.7%) and of those, 284 (96%) received a pre-hospital ECG. Both use of EHS and pre-activation

Table 2. Quintiles of total ischemic and component times in minutes.

Time (N=551)	10%	25%	50%	75%	90%
Total Ischemic Time Symptom Onset to Device Time	107	137	173	257	430
Component Times					
Symptom Onset to First Medical Contact	18	32	61	138	311
First Medical Contact to First ECG	0	5	8	13	21
Diagnostic ECG to Catheter Lab Activation	5	9	15	23	35
Catheter Lab Activation to Lab Ready	3	10	25	35	43
Catheter Lab Ready to Patient Arrival in the Lab	5	10	10	18	32
Catheter Lab Arrival to Device Time	20	26	32	40	48

Table 3. Percent of the variance in total ischemic time explained by each component time[a]

Time	Symptom Onset-First Device Time
Component Times	**Percent**
Symptom Onset to First Medical Contact	0.61
First Medical Contact to First ECG	0.07
Diagnostic ECG to Catheter Lab Activation	0.01
Catheter Lab Activation to Lab Ready	0.01
Catheter Lab Ready to Catheter Lab Arrival	0.02
Catheter Lab Arrival to Device Time	0.04

[a]Percent variation explained is estimated as the R-squared from OLS regressions of each component time on the log of each measure of total ischemic time.

of cardiac catheter lab were found to significantly reduce symptom onset to device time. Activation after hours of the cardiac catheter lab was associated with significantly longer symptom onset to device time (p=0.003). Specific component times were also significantly associated with process variables (Table 4). Patients who contacted EHS had significantly shorter pre-hospital component times, while the catheter lab activation to catheter lab ready times were significantly longer during after hours activation (p<0.001 and p=0.005 respectively). When EHS was called, symptom onset to device time was reduced by 27% (Coefficient: -0.28, 95%CI: -0.37, -0.19). Pre-activation was also found to have a similar effect (Coefficient: -0.27, 95%CI: -0.36, -0.17).

Discussion

We have determined that the majority of total ischemic time occurs prior to hospital arrival, and that component times following arrival have far less of an impact on total ischemic time. We also found that the use of EHS and the pre-activation of the cardiac catheter lab at our centre resulted in significantly shorter total ischemic times.

At the time of this study, the majority of the literature had extensively examined door-to-balloon times as a performance measure to assess and reduce

Table 4. Median component times comparing use of EHS, pre-activation of cardiac catheter lab and after hours activation.

Time	Median Times (IQR) in minutes		
	Used EHS (n=296)	**Self-Transport (n=255)**	**p-value[a]**
Total Ischemic Time	155 (126.5-208)	201 (151-327)	<0.001
Symptom Onset to First Medical Contact	48 (26-87)	94 (48-208)	<0.001
First Medical Contact to First ECG	6 (3-10)	11 (7-16)	<0.001
Diagnostic ECG to Catheter Lab Activation	16 (9-25)	13 (8-19)	<0.001
Catheter Lab Activation to Catheter Lab Ready	25 (10-35)	25 (10-35)	0.86
Catheter Lab Ready to Catheter Lab Arrival	10 (10-15)	10 (10-20)	0.41
Catheter Lab Arrival to Device Time	31 (25-38)	33 (27-41)	0.11
	Pre-activation (n=209)	**No Pre-activation (n=342)**	**p-value[a]**
Total Ischemic Time	148 (122-196)	192.5 (148-295)	<0.001
Symptom Onset to First Medical Contact	50 (29-85)	74.5 (38-175)	<0.001
First Medical Contact to First ECG	6 (3-10)	10 (5-15)	<0.001
Diagnostic ECG to Catheter Lab Activation	15 (9-21)	14 (9-24)	0.5
Catheter Lab Activation to Catheter Lab Ready	27 (13-35)	25 (9-35)	0.11
Catheter Lab Ready to Catheter Lab Arrival	10 (8-15)	10 (10-20)	0.3
Catheter Lab Arrival to Device Time	31 (25-38)	32 (26-41)	0.15
	Regular Hours (n=366)	**After Hours (n=185)**	**p-value[a]**
Total Ischemic Time	169 (119-239)	177 (140-270)	0.003
Symptom Onset to First Medical Contact	61 (33-138)	60.5 (32-136)	0.98
First Medical Contact to First ECG	8 (5-13)	8 (4-13)	0.69
Diagnostic ECG to Catheter Lab Activation	13 (8-20)	15 (9-23)	0.08
Catheter Lab Activation to Catheter Lab Ready	6 (3-20)	30 (22-37)	<0.001
Catheter Lab Ready to Catheter Lab Arrival	10 (10-25)	10 (10-15)	0.006
Catheter Lab Arrival to First Device Time	32 (26-38)	31 (26-40)	0.83

[a]Percent variation explained is estimated as the R-squared from OLS regressions of each component time on the log of each measure of total ischemic time.

total ischemic time[10,14]. More recently, research has focused on total ischemic time from the perspective of first medical contact to device time[15]. In the Canadian context, recent guidelines have been updated to include a prehospital and component time focus for the acute management of STEMI with a target of first medical contact to device time being <120min where possible[15]. Over the past decade, improved pre-hospital assessment and pre-activation systems have reduced total ischemic times[16,17]. However, in our centre, as in many others[18], there is limited potential for further reductions in component times within hospital. The real potential for reduced total ischemic time is much earlier in the process, before contact with health care has even occurred. Considering this, total ischemic time is more related to patient factors than hospital system issues.

The new frontier in reducing total ischemic time must be at the level of the patient. Identifying high-risk patients, educating them on signs and symptoms of acute myocardial infarction and stressing the importance of seeking care as soon as possible are all ways that pre-hospital component times could be reduced. Thanks to studies using the Framingham Heart Study data, health care providers are well aware of what factors predict the risk of myocardial infarction[19-21]. Although physicians may be aware of which patients are most at risk for STEMI, they may not always communicate this effectively to patients themselves. It is crucial that these high-risk patients know the signs and symptoms of STEMI and when to seek care. It is crucial to communicate to patients that using EHS, and not self-transporting to hospital, may lead to improved outcomes. That said, pre-hospital patient delay might be explained through reluctance to receive medical evaluation. Reluctance to seek care is not a new phenomenon, and patients may not benefit from education programs in symptom recognition[22,23]. At the community level, these interventions have not had high levels of retention[24,25]. A more targeted approach to high-risk patients (as opposed to general media campaigns) has been thought to have a higher rate of uptake among patients who are likely to have PPCI for STEMI, but unfortunately this has also been unsuccessful[26]. Despite this, more effort in a personalized approach to reduce patient delay is warranted to improve short and long term outcomes in patients who have STEMI.

Study Limitations

This study has certain limitations. This study was performed before more recent Canadian Guidelines regarding optimizing management of STEMI were published, and thus our findings may not be entirely reflective of current practice[15]. In addition, the symptom onset time was derived from patient history. Recall bias aside, these patients are in a critical state when seeking medical care and may not be able to provide an accurate time of when their symptoms started. Another limitation of this study is that only patients who received PPCI were included in analysis. Those that died on the way to hospital, in-hospital prior to PPCI, arrested prior to EHS arrival, or died during PPCI were excluded. Although these were very few in number, these patients did not have the full process of receiving PPCI and their exclusion may have subsequently biased the results. It is possible that these are the patients who had the longest delay. For the purpose of this study, we wanted to examine the majority of patients who went through the entire process of PPCI in order to have a clear picture of where delays occur on average.

Conclusion

Studies have indicated cannabis may have the potential In conclusion, this study identified where most of the total ischemic time occurs in the process of receiving PPCI for STEMI, and that EHS and pre-activation of the cardiac catheter lab reduce total ischemic time. The analysis in this study indicated that the majority of delay occurs in the earlier stages of total ischemic time, prior to first medical contact. This would suggest that to improve total ischemic time new strategies that focus on targeting high-risk patients at the individual level need to be evaluated. Comparing our findings with more current data would be beneficial to determine whether the updated Canadian Guidelines have had an impact on delivering care for those who receive PPCI for STEMI. Further investigation into patient perspectives of acute coronary syndrome and patient delay in seeking medical care is warranted. Overall, however, it appears that the length of component times in receiving PPCI for STEMI are short from first medical contact onward and that system delays are low at our PPCI centre in Halifax, Nova Scotia.

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RESEARCH

The impact of preoperative anemia on red blood cell transfusion in primary and revision hip arthroplasty: A retrospective analysis

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Abstract

Rationale: Lower extremity joint arthroplasty can lead to significant blood loss, and the need for blood transfusion. The use of blood products is associated with a variety of adverse outcomes including infection, circulatory overload, and transfusion reaction. Objectives: The objective of this quality improvement study is to identify the prevalence of preoperative anemia at our institution, and elucidate its impact on perioperative transfusion in elective patients undergoing primary or revision hip arthroplasty. Methods: Data for this study was collected from four databases at our institution. Elective patients undergoing primary or revision hip arthroplasty were selected. Transfusion was defined as the receipt of a red blood cell transfusion on the surgical day through to postoperative day five. The primary outcome was the effect of preoperative anemia on transfusion rates. Results: The overall transfusion rate was 7.6%. Transfusion rates for primary and revision arthroplasty were 5.8% and 18.7% respectively. Patients with a preoperative hemoglobin between 100 and 120 g/L were 4.5 times more likely to be transfused than those with a hemoglobin between 121 and 140 g/L, and 15.4 times more likely than those greater than 140 g/L. Preoperative anemia was common, with 11.5% of all patients having a preoperative hemoglobin of 120 g/L or less. Conclusion: Preoperative anemia was common and was significantly associated with higher transfusion rates. These findings reinforce the need to optimize hip arthroplasty patients prior to surgery, where possible. As a quality control study, these findings may help direct policy regarding the deferral of elective hip arthroplasty patients who are anemic preoperatively.

Introduction

Lower extremity joint arthroplasty can lead to significant blood loss, and the need for blood transfusion[6]. Primary hip arthroplasty is associated with a transfusion rate between 18 – 68%[1-2,9-10]. IIn a recent study of over nine thousand total hip arthroplasty surgeries, Hart et al reported a transfusion rate of 22.2% within 72 hours of surgery[6]. Numerous blood conservation strategies have been implemented for joint arthroplasty including preoperative autologous donation, cell saving, erythropoietin, and tranexamic acid[11-13]. TThe use of blood products is associated with a variety of adverse outcomes including infection, circulatory overload, and transfusion reaction[6]. Restrictive transfusion protocols have been shown to be appropriate in both critical care, and following hip surgery[4,7]. Preoperative anemia has been associated with an increased incidence of perioperative transfusion[3,6,8] and a higher rate of prosthetic joint infection[5]. The Hart et al. study found preoperative anemia carried an odds ratio of 3.6 for red cell transfusion within 72 hours[6]. The aim of this quality improvement study is to identify the prevalence of preoperative anemia at our institution, and elucidate its impact on perioperative transfusion rates in patients undergoing elective primary or revision hip arthroplasty.

Methods

After obtaining approval from the institutional research ethics board, we began by creating a transfusion database by linking data from various existing sources at our institution. Data for this study was collected from four databases:

1. The intraoperative anesthesia information system (AIMS) contains all recorded intraoperative data including intraoperative procedures, physiologic data (vital signs, gas monitoring, among others), and all medications and therapies administered to patients during the course of intraoperative anesthetic care. (AIMS (Innovian® Anesthesia, Drager Medical Inc, Telford, PA))
2. The laboratory reporting system (Millennium Laboratory Information System, Cerner, Kansas City, MO) contains all laboratory and transfusion data within the Central Zone of the Nova Scotia Health Authority.
3. The perioperative surgical manager (Horizon Surgical Manager (HSM), McKesson, San Francisco, CA) contains perioperative nursing care notes, and documented surgical procedures performed.
4. The institution's admission, discharge and transfer registration system (STAR system) contains all registration data associated with a medical encounter within Central Zone, Nova Scotia Health Authority. This includes the patient's planned disposition post-operatively,

whether as an outpatient or as a same day admission.

This data was linked by the senior database analyst and the quality improvement and safety officer for the Department of Anesthesia, Pain Management, and Perioperative Medicine. This was performed using medical record numbers and/or encounter numbers and subsequently assigning a unique, anonymous study ID with the original medical record and encounter numbers removed. The data elements collected from the aforementioned databases are described in Table 1.

The Innovian database was searched for all elective surgeries between January 1st 2011 and June 30th 2015. Same day admission patients undergoing hip arthroplasty were selected and identified as undergoing primary or revision surgery. Transfusion for the purpose of this study was defined as the receipt of a red blood cell transfusion on the surgical day through to post-operative day number five. The degree of pre-operative anemia was assessed using preoperative complete blood count collected between pre-operative day 1 – 20. Patients without this blood work were excluded, however as all of the same day admission patients are seen in pre-operative anesthesia clinic, very few patients were excluded for this reason.

Statistical Analysis

The primary outcome was the effect of preoperative anemia on transfusion rates. This was analyzed using logistic regression. First, a set of univariate binary regressions were run to examine the effect of each of the predictors. Then a multivariate regression was used to examine the effect of each predictor while controlling for the others. As the primary predictor (preoperative hemoglobin) was a numerical variable, Kendall's Tau testing was used. When the predictor was a dichotomous categorical variable such as Primary or Revision surgery, or TXA use vs no TXA use, Mann-Whitney U tests were used. The dataset was also characterized using descriptive statistics to examine transfusion rates.

Table 1. Data elements collected and the institutional database source.

Data category	Data element	Database(s)
Demographic	Age, sex, height, weight, operative procedure, medical record number (required for linking)	HSM[1]
Type of surgical admission	Designation as "same day admit" (SDA) surgery (to enable exclusion of ambulatory surgical/day surgery cases)	STAR
Medications and blood products	Type, dosage, timing	Innovian[2], Millenium[3]
Lab results	Preoperative and postoperative hemoglobin (Hgb) and hematocrit (HCT), date, time	Millenium[3]
Surgical variables	Procedure, type, anesthesia type (general, neuraxial, regional/peripheral nerve block), date, time	Innovian[2], HSM[1]

[1]HSM (Horizon Surgical Manager (HSM), McKesson, San Francisco, CA); [2]Innovian (Innovian® Anesthesia, Drager Medical Inc, Telford, PA); [3]Millenium Laboratory Information System, Cerner, Kansas City, MO

Results

1727 patients were included in the analysis. The overall transfusion rate was 7.6%. The transfusion rate for primary and revision arthroplasty was 5.8% and 18.7% respectively as shown in Table 2. Revision surgery (vs Primary) was a predictor of transfusion in univariate analysis (OR 3.712, P <.001), however this effect was not preserved in the multivariate analysis (OR 1.773, 95% CI 0.963; 3.264, P = 0.066).

There was an inverse relationship between preoperative hemoglobin level and transfusion risk with an OR of 1.10 (p<0.001) as shown in Table 3. Thus, for every one unit increase in preoperateive hemoglobin, patients were 10% more likely to not require a transfusion.

Transfusion rates were indirectly related to the degree of preoperative anemia, as shown in Figure 1. Patients with a preoperative hemoglobin between 100 and 120 g/L were 4.5 times more likely to be transfused than those with a preoperative hemoglobin between 121 and 140 g/L, and 15.4 times more likely than those with a hemoglobin greater than 140 g/L. Though the data visualization in Figure 2 suggests that there is a slight trend towards more transfusions in the revision group, the magnitude of the preoperative hemoglobin effect does not vary across Primary vs. Revision group.

Table 2. Descriptive statistics split by primary vs reivsion surgery.

Numerical variables		
Variable	Primary median (IQR)	Revision median (IQR)
Transfusion amount (mL)	297 (71.25)	294 (66)
Length of stay (days)	5.50 (2)	9 (10)
Preoperative hemoglobin (g/L)	121.5 (17)	120 (25)
Procedure duration (min)	80 (31)	154 (72)
Categorical variables		
	Primary N (%)	Revision N (%)
Transfused (yes)	99 (5.8%)	50 (18.7%)
TXA (yes)	681 (40.2%)	173 (64.8%)

Table 3. Binary logistic regression results when predicting transfusion (yes/no)

			95% CI for odds ratio	
	p	Odds ratio	Lower	Upper
Univariate				
No TXA vs TXA	0.018	1.529	1.077	2.172
Primary vs revision	<0.001	3.712	2.568	5.366
Preoperative hemoglobin	<0.001	0.907	0.893	0.921
Procedure duration	<0.001	1.013	1.009	1.017
Multivariate				
No TXA vs TXA	<0.001	4.171	2.487	6.996
Primary vs revision	0.066	1.773	0.963	3.264
Preoperative hemoglobin	<0.001	1.10	1.09	1.13
Procedure duration (min)	<0.001	1.020	1.014	1.027

This is supported by a non-significant interaction effect (Odds Ratio = 1.02, p = .20).

Preoperative anemia was common in our study population, with 11.5% of all patients having a preoperative hemoglobin of 120 g/L or less (as shown in Table 4). The percentage of primary and revision arthroplasty patients with a hemoglobin of 120 g/L or less was 10.4% and 18.0% respectively. Men were more often anemic than women with 38.5% of men having a preoperative hemoglobin of 140 g/L or less, whereas 17.4% of women had a preoperative hemoglobin of 120 g/L or less.

There was no relationship between degree of anemia and transfusion volume in either the primary or revision groups. The majority of patients received 1-2 units of blood if transfused, this is shown in Figure 3.

Tranexamic acid (TXA) use had a statistically

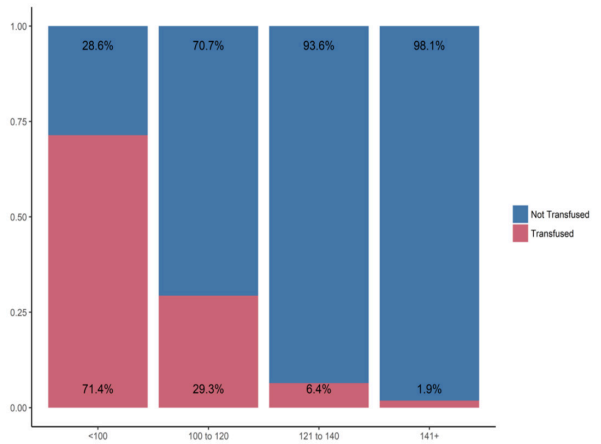

Figure 1. Comparison of transfusion rate by preoperative hemoglobin group.

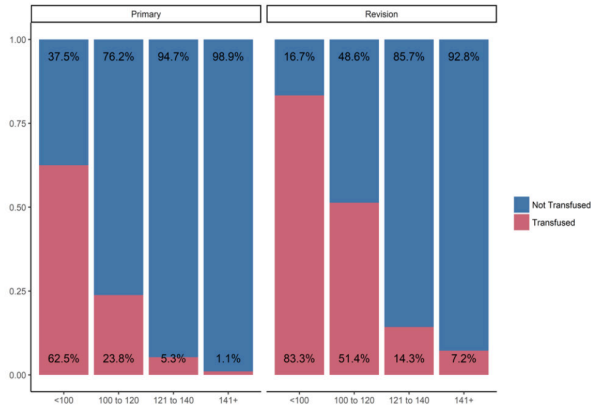

Figure 2. Bar plot comparing transfusion rate and preoperative hemoglobin, grouping into preoperative hemoglobin groups, splitting by Primary vs. Revision.

significant effect on transfusion risk. Patients who did not receive TXA had an odd ratio of 4.171 of requiring transfusion (OR 4.171, 95% CI 2.487,6.996, P < .001). Procedure duration was a predictor of transfusion risk in both the univariate (OR 1.013, 95% CI 1.009,1.017, P < .001) and multivariate logistic regression (OR 1.020,

Table 4. The frequency of patients in each preoperative hemoglobin group.

Group	Preoperative hemoglobin (g/L)	Frequency	Percent (%)	Cumulative percent (%)
All	<100	14	0.8	0.8
	100 to 120	184	10.7	11.5
	121 to 140	886	51.3	62.8
	141+	643	37.2	100
	Total	1727		
Female	<100	14	1.5	1.5
	100 to 120	149	15.9	17.4
	121 to 140	616	66.0	83.4
	141+	155	16.6	100
	Total	934		
Male	<100	0	0	0
	100 to 120	35	4.4	4.4
	121 to 140	270	34.1	38.5
	141+	488	61.5	100
	Total	793		
Primary	<100	8	0.5	0.5
	100 to 120	147	9.9	10.4
	121 to 140	774	52.0	62.4
	141+	560	37.6	100
	Total	1489		
Revision	<100	6	2.5	2.5
	100 to 120	37	15.5	18.0
	121 to 140	112	47.1	65.1
	141+	83	32.9	100
	Total	238		

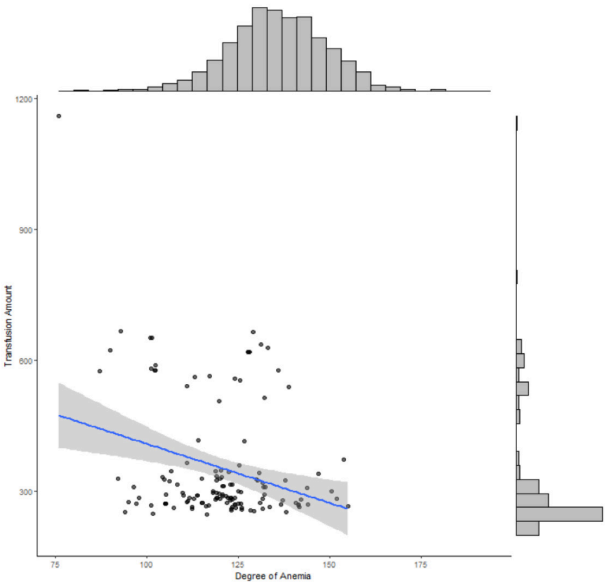

Figure 3. Scatterplot of transfusion amount (mL) and preoperative hemoglobin in g/L.

95% CI 1.014,1.027, P < .001).

Discussion

Despite only including elective, same day admission patients in our analysis, preoperative anemia was common. The rates of preoperative anemia of 120g/L or lower were high in all groups, but were especially high in the revision arthroplasty group.

Preoperative anemia had a significant impact on transfusion rates, which suggests that preoperative optimization of patients undergoing hip arthroplasty is essential. The data from this study provides an opportunity to evaluate the pre-anesthetic assessment process at our institution. The results of this study, as well as others in the literature suggest a strong relationship between preoperative anemia and transfusion rates, yet a significant number of elective patients in this study entered the operating room anemic. Transfusion rates were significantly higher in patients with preoperative anemia, but we were not able to analyze the impact of these transfusions on significant outcomes such as prosthetic joint infection, or mortality. The literature to date has however presented a convincing case for the relationship between preoperative anemia, transfusion, and prosthetic joint infection[5].

The data in this study is from 2011-2015, during which time there was a movement towards blood conservation strategies in joint surgery. The use of TXA has been increasing over the past decade, and this is not reflected in our data. The current analysis has not attempted to track transfusion rates over time to elucidate the impact of blood conservation strategies such as TXA use. There was considerable heterogeneity in the tranexamic dosing in our data, with some patients receiving infusions, and some boluses of varying amount. We were also not aware of the context of the TXA use. It is likely that many patients received prophylactic bolus dosing, while others may have received TXA reactively when bleeding was encountered. It is due to this heterogeneity that we decided to include TXA as a binary variable in the analysis. Future study may attempt to analyze the impact of TXA dosing on transfusion rates in joint arthroplasty.

The preoperative hemoglobin value was defined as the closest hemoglobin measurement to the surgical day. We used preoperative day 20 as a cut off for preoperative hemoglobin value, as the majority of patients are seen in pre-anesthetic clinic within 3 weeks of their surgery. It is not known whether patients with preoperative anemia received any non-transfusion intervention prior to surgery, such as iron supplementation. It is possible that an anemic patient seen in clinic on preoperative day 20 may have a received corrective treatment and actually presented to the operating room with a hemoglobin higher than reported in our analysis.

Transfusion was defined as receiving packed red blood cells on the surgical day through postoperative day five. It is unclear for any of the transfused patients in the analysis what the transfusion trigger was. It is possible that patients were transfused unnecessarily, or at hemoglobin triggers higher than recommended in the literature[7], which may create a misleading transfusion rate. The data we collected was not capable of elucidating the decision making process for transfusion, which is a limitation. We do not feel there was a significant degree of unnecessary transfusion, given the transfusion rates reported in the study are lower than those reported in literature[1-2, 9-10], suggesting a restrictive transfusion attitude.

This study shows that preoperative anemia is common in elective hip arthroplasty patients at our institution, and has a significant impact on transfusion rates. Transfusion rates were predicted by the degree of preoperative anemia. From a quality control perspective, our data provides valuable insight into the perioperative impact of anemia at our center, and may help guide quality improvement strategies for elective arthroplasty patients. Future research should examine the clinical impact of this higher transfusion rate with respect to outcomes such as prosthetic joint infection, and mortality.

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RESEARCH

Patients' perspectives on methods of assessing pain

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Abstract

Pain questionnaires often serve as an assessment tool for initial consultations in chronic pain clinics. The Pain Management Unit (PMU) is a tertiary care centre in Halifax, Nova Scotia. A number of clinicians in the PMU have noted that some patients express that questionnaires are time consuming to complete and believe they are not used in a manner that is helpful to their health care. The effectiveness of questionnaire-based pain evaluation is an area of active research. Text-heavy questionnaires have been criticized for their reliance on literacy and for the format's inability to facilitate patient self-expression. Other methods of assessing pain have been suggested, including those that use pictograms, photographs and technology. This study was designed to gauge patients' opinions on the current pain assessment method used in the PMU. In addition, it aimed to evaluate if incorporating art and technology appealed to current patients. The ultimate goal of this study was to evaluate if improvements could be made to patients' pain assessment experience. Thirty patients were interviewed following their initial consultation appointments at the PMU. Interviews were transcribed verbatim and analyzed using NVivo Software to look for themes expressed by research participants. The study yielded a total of 20 different themes, such as repetition within the questionnaires, and the patient's desire to incorporate different technologies such as an iPad or computer. Recommendations are proposed based on these themes to help guide the creation or modification of pain assessment tools.

Introduction

Questionnaires are commonly used by physicians during consultations with patients with chronic pain. Originally developed in 1975, the McGill pain questionnaire (MPQ), is an example of such a questionnaire and is still used widely across Canada[1]. The Pain Management Unit (PMU) at the Queen Elizabeth II (QEII) Health Sciences Centre uses a similar form prior to initial consultations. This five-page assessment includes the following sections:

1. Demographic information: includes details of their living arrangements, education, employment, insurance and compensation.
2. Brief Pain Inventory, Short Form: includes a body template where patients may identify locations where they experience pain.
3. Short Form – 12 (Version 2): includes a Quality of Life survey.
4. Profile of Moods State: includes terms that patients may select to describe their feelings and the extent of those feelings in regard to their pain.

The concept for this study was derived from PMU clinician experiences. Physicians noted that patients frequently expressed that the questionnaire was frustrating, time consuming, and felt it was not used in a manner helpful to their healthcare. This study was designed to gain greater insight into how this part of pain assessment could become more patient-centered. Ultimately, the goal of the current research is to use these perspectives to inform the development of an assessment tool that is more acceptable to patients and better conveys their pain experiences.

Methods

The study was conducted at the PMU at the QEII Health Sciences Centre, a tertiary health care institution in Halifax, Nova Scotia. Patients with all types of chronic pain are seen in the PMU. Inclusion criteria were patients with chronic pain who were at least 18 years of age. Exclusion criteria were patients with psychiatric or medical conditions that precluded them from being able to provide an interview.

Members of the PMU health care team approached patients attending the PMU for their initial consultation to determine if they were interested in participating in the study. If interested, a research assistant obtained informed consent from each patient. The patient completed the usual pain assessment forms as per the clinic's usual practice and proceeded with their appointment as per the usual standard of care.

A qualitative approach was taken to address research participants' opinions on the pain assessment tool with the use of semi-structured interviews held with research participants after their clinic appointment. The interview discussion questions were posed in a general and non-directive manner to elicit patients' thoughts in their own words. There were some probing questions used to further explore initial answers. The questions were intended to assess patients' thoughts on the methods of pain assessment that were used, such as their ease of completion, ability to accurately assess their pain, and ability to facilitate conversations with the health care team. Patients were asked specifically for their opinion on incorporating the use of technology with pain assessment (such as using a tablet or computer), the use of art to aid their expression of pain, and the use of a body template.

Upon patient consent, interviews were recorded using an audio recorder so they could be transcribed verbatim. If patients did not consent to audio recording, notes were taken during the interview process. Patient recruitment and data analysis were performed until data saturation was reached.

NVivo software was used to analyze patient interviews. Transcripts were reviewed and independently coded into themes by the principal investigator and the research assistant. Following coding, a finalized list of themes was formed by both researchers.

Results

A total of 30 research participants were interviewed. Analysis of interview transcripts revealed 20 themes (Table 1).

Patients provided differing opinions regarding the use of technological devices to complete pain assessment questionnaires. For example, some patients preferred the use of a tablet:

"Yeah iPads are awesome. They're a lot easier, personally I don't like pens. They cramp my hands up because I can't use my hands, because they hurt. But I can tap on things a lot easier than using a pen."

Table 1. Patient pain assessment themes.

Node	% of Patients that referenced these themes during interview
Favoured the use of a technological version of the body template	80
Assessment tool was of appropriate length	57
Preferred not to use art	57
Favoured the use of technology	43
Preferred not to use technology	40
Questionnaires were thorough	40
Questionnaires contained repetitive questions	40
Favoured the use of art	37
Questionnaires were straightforward to complete	33
Mental health questions were important	30
Questionnaires were too lengthy	27
Questionnaires contained confusing terms	20
Scale-type questions were disliked	20
Questionnaires were not thorough enough	20
Preference for free text	17
Questions not related to the patient	17
Dislike of profile of mood state	13
Impression that questionnaires were designed to "trick" patients	13
Dislike of demographic questions	10
Preferred not to use technological version of body template	10

Other patients, however, preferred the traditional way of completing questionnaires:

"I don't know, I'm kind of old-school, I like paper. But I can appreciate the use of technology, it would be so much easier, right, to be able to swipe through or, and have it added to your file or whatever, however it goes. So, I can appreciate that but I like pen and paper."

Patients provided opinions regarding the length of the questionnaire. For example, some patients thought the length was reasonable and provided good care:

"I've filled out a lot of questionnaires and documents. I don't think it's no longer or shorter than any of the other documents. Maybe it's a little more longer on the specifics because they're trying to get more details for the pain management first and then filling out some more medical information, they're trying to get more from the patient with the documents to try to find out what actually is the pain."

Other patients, however, found the questionnaire excessively long:

"It would make it a lot easier for people if they were condensed."

Patients provided opinions regarding the repetitiveness of the questionnaire. For example, some patients thought the questionnaire had overly similar questions:

"Yeah, you've got just too many things that are kind of the same, like it's just another way of saying the same thing."

Patients provided opinions regarding the body template of the questionnaire (an illustration of a body on which they are able to mark where they feel pain). For example, some patients thought the body template was helpful and could be improved to convey more information:

"That would be really, I think that would be much better than what this is, it's fairly, you know you just kind of scribbling on it where the pain is, but that's a great idea, and especially with like you say, pin points of colour, different colours where you know, if you've got pain all down, you know from let's say your waist down to ankle, it is worse in different spots, and it's more intense in different spots than it is in others. I think that'd be a great idea."

Patients provided opinions regarding the questions

related to mental health included in the questionnaire. For example, some patients thought these questions addressed important subject matter:

"...looking at the whole person I think is really important, when I was asked about my mood and you know, and here when it talks about you know your quality of life, your sleep, because it does affect those areas of your life."

Patients provided opinions regarding perceived deception in the questionnaire. For example, some patients thought the similarity of questions was designed to catch them being inconsistent in their reporting of their pain:

"...but it seems like okay they're trying to catch you to see if you're paying attention or if you're, you know making it up I guess, so there's a few questions where it's like okay are they trying to catch me on this, like no I already answered this a couple questions ago..."

Patients were asked for their opinions on specific possible modifications. This included their thoughts on incorporating technology (with 43% favouring and 40% preferring not to use), incorporating art (37% favouring and 57% preferring not to use), and the use of a technological version of a body template (80% favouring and 10% preferring not to use).

Discussion

This study was designed to collect patient perspectives on a typical pain assessment used in clinical practice, as well as on possible future modifications that may better meet the needs of patients and better serve physicians in collecting information.

The effectiveness of current methods of pain assessment using multi-page, text-heavy questionnaires has been recognized as less than ideal for a number of reasons. First, patients may lack the literary capabilities to appropriately complete questionnaires[2]. Second, a language-reliant form may not facilitate patient self-expression or conversation with physicians[3], [4]. Third, a questionnaire format may not accurately convey the subjective experience of pain to physicians[3].

Various novel methods of assessing pain have been suggested, including those that use pictograms[2], drawing[5,6,7], and photographs[3,4]. Pictograms were studied with university students to determine if participants were able to accurately interpret the pictogram's meaning, thus making it a useful tool for symbolizing types of pain[2]. In several other studies, drawings were used to help children symbolize features of pain and progression over time[6,7]. The drawings were analyzed and a diagnosis was formed and compared to a clinical diagnosis, which revealed accuracy and usefulness of the drawings[6,7]. Another study had patients select photographs that they believed represented their experience with pain to present to a physician during initial consult, which facilitated understanding and discussion around pain, and influenced patient-physician interactions[3,4].

The results of the current study show that there are differing opinions among this patient cohort on how to best assess pain. Themes included contradicting interpretations from patients, such as 'Questionnaires were straightforward to complete' versus 'Questionnaires contained confusing terms', or 'Questionnaires were too lengthy' versus 'Assessment tool was of appropriate length'.

There was consistency of opinion in some areas of pain assessment. First, in regard to the length, the pain assessment being regarded as too lengthy was only cited as an issue by 8 participants (27%), whereas 17 participants (57%) made statements describing the length as acceptable. Many patients remarked that the questionnaire's length allowed it to be thorough, with 40% of patients describing the questionnaire as a thorough assessment. Second, patients reported feeling as though the questionnaire was designed 'to trick them' (13%). As is written in the book Chronic Pain: "nothing erodes trust in the physician faster than the patient feeling 'tricked'"[8]. It is well-recognized that patients with chronic pain experience stigmatization in their daily lives from friends, family, the workplace, and healthcare professionals[9]. They believe practitioners think their pain is exaggerated or imagined and they feel "blamed, misled, and even report being dismissed by health care providers"[9]. Participants explained that the impression of deception was based on the similarity of questions, and the belief that physicians would be checking how consistent patients were in their responses. Since repetition of similar questions caused suspicion and 40% of patients reported the questions as repetitive, it would be reasonable to explore options to reduce the number of similar questions. Third, there was a positive reaction to the idea of completing the body template drawing on an iPad. It was explained that using this modality, patients would have the ability to zoom in/out and colour could be used more easily. Many patients enjoyed the idea of using colours and offered explanations on how this would allow them to better express their pain. These results are consistent with studies that use body templates for self-expression of pain. For example, one study used a body template as a base on which patients could draw to express their experience of pain[5], with results showing that this method was effective in communicating physical and emotional pain[5].

A limitation of the current study is that it was

conducted at a single centre. Though this site is the only major pain management unit in Nova Scotia, we recognize that it is likely that individuals from more rural areas of the province may be underrepresented due to the difficulty of traveling for treatment. Additionally, the fact that some patients declined to participate in the study may have resulted in an inherently biased study sample.

Conclusion

There was a wide breadth of responses provided by research participants, yet options for improvement to the current method of pain assessment have been identified. Based on the results of this study, it is recommended that pain assessment tools include a technological body template on an iPad with the option to use colour. It is also recommended that the assessment be revised to include fewer repetitive questions so as to better suit patients' preferences and reduce the sense of the healthcare team seeking to "trick" or "catch them" through response inconsistency. Alternatively, the feasibility of crafting different modalities from which patients may choose from may be explored, thus offering patients a choice in terms of how to best express their pain.

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Commentary

Using Person-Centred Technology to Survey Older Adults at Northwood

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Service learning is an optional part of our Med 2 professional competencies class at Dalhousie University. In professional competencies, we learn about ethics, law, and the social determinants of health. While it has been interesting to discuss difficult cases in small tutorial groups, we – two 2nd year medical students – were excited to embark on a learning experience that would provide us with the opportunity to work with community partners to see how these principles apply in practice. We were told that this was not volunteering. Rather, service learning emphasizes the bidirectionality of the relationship with the community; in providing a service to our community partner, we were meant to reflect on our experience using a social determinants of health approach and to learn from the lived experiences of those we were helping.

After learning about the community partners, our interests tied nicely with the work being done at Northwood, a not-for-profit organization that offers community programming and residential living for a largely older population. We learned about age-friendly communities in class last year. It was clear to us that our communities were often built in ways that were not conducive to healthy aging – for example, the disproportionate concentration of resources in urban areas, lack of accessible transportation, and restrictive home-care services are all factors that differentially disadvantage and create inequities for older adults. As healthcare students, we are familiar with how aging tends to be equated with worse health outcomes. Many of our cases feature older adults and that representation is crucial. However, with our packed curriculum and many objectives to meet, the patient story risks becoming caricatured and diluted in order to emphasize medical principles or abstract concepts. As we have discovered with the new age of video-conferencing, nothing quite beats in-person human interaction. Our hope in working with Northwood was to return to a more humanistic understanding of aging in our community and to envision how our communities can be designed to be more age friendly.

For our service learning project at Northwood, we explored how innovative technology could be integrated into a system to facilitate a person-centred approach to meeting the needs of older adults with the goal of supporting healthy aging. We used the Age Care Technologies assessment tool, a digital, person-centred survey delivered in-person or over the phone. Along with other student volunteers, we worked through these surveys with participants at Northwood. Participants were asked 52 questions relating to their health, with the questions falling under 6 broad categories: looking after yourself; getting around; safety and relationships; accommodation and finances; mental health and wellbeing; and staying healthy. Participants would identify items that they viewed as a concern and were given the opportunity to select action items. Action items would match their specific concerns with existing community resources; for example, older adults who identified vision as a health concern would be asked if they wanted to learn about their nearest optometrist. At the end of the survey, participants were mailed a personalized wellness profile with a score that reflects the overall status of their well-being, independence, social engagement, and physical health (a WISH score). The purpose of these wellness profiles was to summarize areas of concern and provide referral to existing community resources. While it was illuminating for us to create a space to talk to participants about what really mattered to them, participants told us they were appreciative of the opportunity to learn more about themselves and how the community they lived in could best support them. Many felt the survey gave them an avenue to be heard personally and collectively, especially at a time when many older adults felt ignored in clinical settings and excluded from research and policy. In this way, the survey restored a sense of autonomy and reoriented the interaction to the person taking the survey.

Over 170 surveys were administered. Out of the 52 health items on the survey, participants on average reported 13 concerns. The top concern reported was loneliness (58%), followed by help with housework (52%), and poor sleep (50%). In our conversations with participants around loneliness, we became aware of how suddenly someone's social circle could collapse following the loss of family and close friends. Many of the older adults we interviewed were dealing with grief. However, through the interviews, we saw that isolation was not a necessary outcome of loss - one theme that became particularly striking to us was resilience through connection. Part of autonomy and independence involves recognizing when we need other people and seeking the community we desire, whether through community programming or by other means. As seniors in long-term care facilities deal

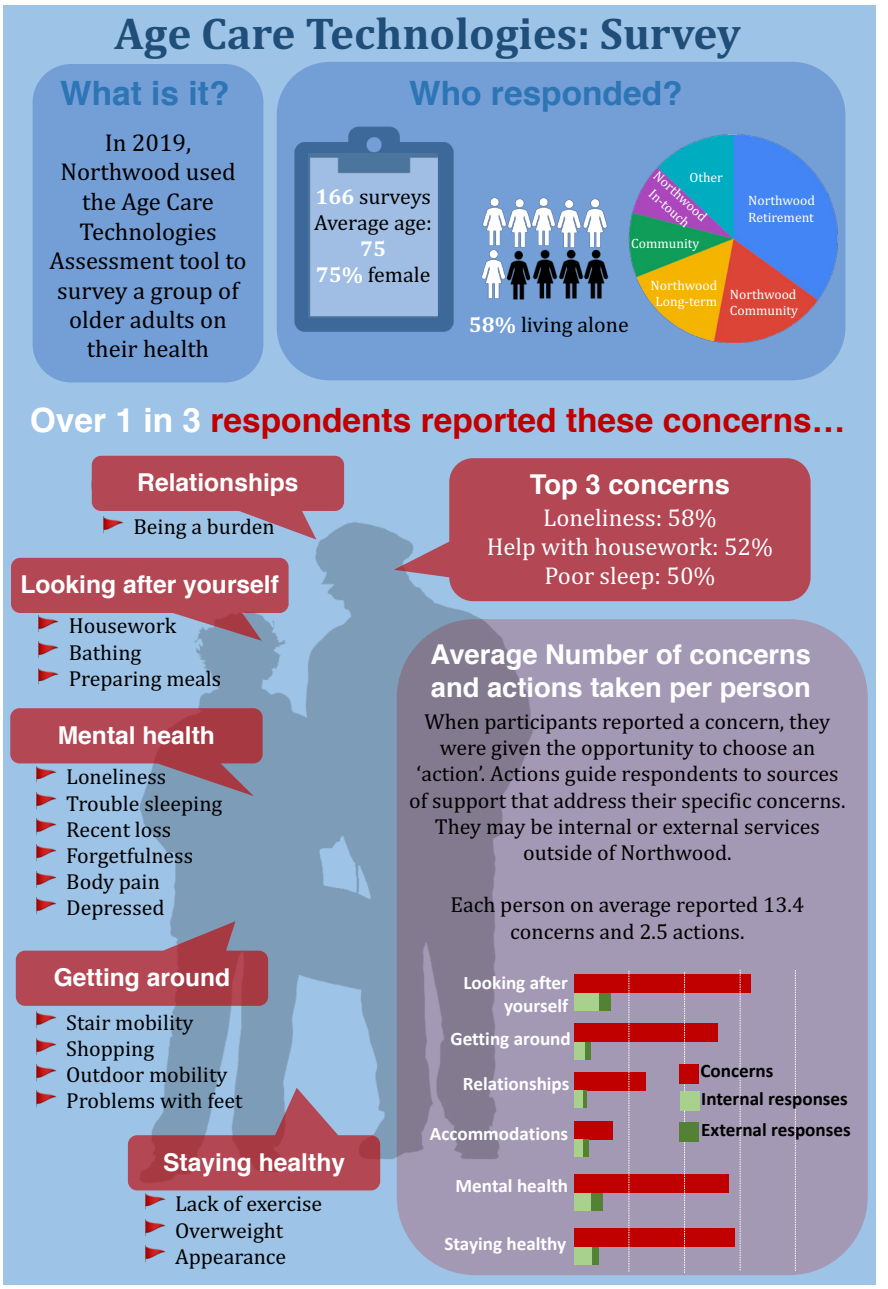

Figure 1. Infographic of the results from the ACT surveys administered at Northwood.

with tremendous loss while in forced isolation during the COVID-19 pandemic, it becomes more pressing to recognize our interdependence and to support one another.

The most frequently reported concerns fell under the domain of mental health and wellbeing, suggesting a need to direct more resources to this area. The least reported concerns were those relating to accommodation, having help in case of an emergency, and feeling safe. These findings have been presented to the board of directors of Northwood and to researchers in hopes of facilitating evidence-informed decision-making and resource allocation. We also engaged in conversations with stakeholders to explore how the use of the ACT survey can be expanded in the general community for research and policy development.

As the second part of our service-learning project, we created an infographic (Figure 1) to showcase the main points of this project in a way that was easy to understand. This infographic will be presented in the Northwood Newsletter as a way to ensure transparency

and accountability. While participants were mailed their individual wellness profiles, it was important that the participants at Northwood were able to access their collective data as well.

Over the past year, we have gained an appreciation for the capacity of a simple community-based intervention to empower older adults to identify the health priorities that mattered most to them and the resources necessary to meet those needs. On a larger, systematic scale, we have seen this tool be used for education, research, and advocacy. Service learning has been an incredibly rewarding learning experience that helped solidify our understanding of healthy aging, person-centredness, and social accountability. If you would like more information about service learning or any of the placements, see https://medicine.dal.ca/departments/core-units/global-health/education/programs/service-learning.html.

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Humanities

Where no child knocks in vain: A History of the Izaak Walton Killam Hospital for Children

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The Izaak Walton Killam (IWK) Health Centre is the premier referral hospital for pediatric patients in the Maritime provinces. It is also an important teaching site for Dalhousie University, providing clinical exposure for physicians, nurses, and other allied health professionals. The IWK in its current incarnation was formed in 1995 by the merger of the IWK Children's Hospital and the Grace Maternity Hospital. Prior to their amalgamation, these separate institutions each provided decades of care to families in Atlantic Canada.

This article summarizes the history of the Children's Hospital, describing its historical antecedents and its development over more than a century of service. Ever championed by the local community, the hospital has grown in leaps and spurts despite periods of financial turmoil. Time after time, its mission of advancing children's health has attracted support from substantial benefactors and the general public, alike. The Grace Maternity Hospital's history is summarized elsewhere[1].

The Children's Hospital

The first children's hospital in the British Empire was the Great Ormond Street Hospital for Sick Children, founded in London, England, in 1852[2]. The first one in Canada was the Hospital for Sick Children, opened in Toronto in 1875. Halifax would not have this type of facility until the turn of the century. By 1900, the Victoria General Hospital and Halifax Infirmary had become established as important general public hospitals in the city[3,4] but were not focused on pediatrics. Until the Victoria General opened a small children's ward in the 1890s, the children occasionally admitted there would have been housed alongside adult patients[5,6]. During this era, children commonly had to contend with such contagious diseases as diphtheria and tuberculosis[7], and Canada maintained a grim infant mortality rate around 20%[8]. Furthermore, children under 12 years old accounted for about 75% of all deaths in the country. Needless to say, much work was needed to improve the health of this vulnerable population.

The inception of the Children's Hospital in Halifax may be credited to the remarkable efforts of a single private citizen, Marion Morrow[7]. During an influenza outbreak, Morrow was moved by a newspaper report describing the plight of children unable to be admitted to the overburdened Victoria General Hospital[9]. This unfortunate state of affairs inspired her to lobby for a children's hospital to be created in the city. After she met with the mayor of Halifax, the city pledged to provide land for such a hospital, as well as $5 000 toward construction, and $500 per year for operating costs[7,10]. The provincial government declined to contribute toward capital construction, but offered to subsidize operating costs by paying 30 cents daily per patient[10]. The project, however, would require an additional $10 000 to be raised privately. Since Morrow's husband was a partner in the Halifax firm S. Cunard and Company Limited, she was able to leverage her social connections to strike a fundraising committee, comprising a group of influential Haligonians. After $5 000 had already been raised, local businessman Frederick Corbett generously contributed a further $10 000, and construction was able to begin[11-13].

The original Children's Hospital was completed in December, 1909, at a cost of $18 200[12-14]. An unassuming brick building on Morris Street – now, part of University Avenue – with 16 beds and a sun room at its rear, this was the first hospital east of Montreal solely dedicated to treating children (Figure 1)[8,12,13,15,16]. Surgeries were conducted two days a week in the hospital's lone operating room. During the hospital's early decades, the medical staff often worked for free[11,15], and they were initially assisted by a nursing staff of two trained nurses,

Figure 1. Nurses and patients at the Children's Hospital entrance. Photographer unknown. 1910s. Courtesy of Nova Scotia Archives, Halifax, Nova Scotia.

two nursing students, and a nursing superintendent[12]. The first patient at the Children's Hospital, a 4-year old with tuberculosis of the spine, was admitted December 28, 1909[17]. Thereafter, demand grew quickly, and the hospital was faced with long wait lists[8]. By 1912, the sun room would need to be converted into a 9-bed convalescent ward, affectionately known as the Veranda Ward or Rainbow Ward[7,11,18].

Starting in 1916, the Children's Hospital partnered with the Victoria General to establish a formal nursing school[7,10]. In subsequent years this training program would be operated in collaboration with many other institutions in the province: the Grace Maternity Hospital, the Nova Scotia Hospital, the Tuberculosis Hospital in Halifax, the Nova Scotia Sanatorium in Kentville, and the Victorian Order of Nurses. However, as nursing education in Nova Scotia was reorganized in later decades, the Children's Hospital School of Nursing was eventually phased out[11,19-21]. The school graduated its final class in 1971, having trained a total of 801 nurses[22].

The Halifax Explosion on December 6, 1917, devastated local communities and brought many injured to the city's hospitals[10,23]. Over 50 injured children were immediately treated at the Children's Hospital, which also suffered mild damage from the blast. The aftermath would keep the hospital busy for months following the catastrophe. One notable story from that event was that of Annie Liggins, the "ash pan baby," miraculously recovered amidst the rubble of her family home, safe under the kitchen stove's ash pan[10,11]. Although her mother and brother perished in the explosion, Annie was discharged several months later to the care of her father and lived to the age of 94.

From the very beginning of the Children's Hospital, it became apparent that the tiny facility would not be large enough to keep up with the great need for pediatric care[15]. A series of expansions to the building were necessary during the lifespan of the original hospital, starting in 1919 when construction began for a first additional wing. Built with $65 000 from community fundraising and furnished by the International Rotary Club, the Rotary Ward increased the bed count to 50. 1931 saw the opening of the nurses' residence, which would later be named after the hospital's longtime president Obed E. Smith. These residences freed up for renovation an area previously used as living quarters for the now 30-strong complement of nurses; this area was divided into an additional operating room and a new ward, which brought the bed capacity to 90[8,10]. Over time, the beloved Rainbow Ward's wooden construction came to be regarded as a fire hazard, and it was replaced in 1945 with another expansion, adding 46 more beds, some minor procedure rooms, and a new play room. Remarkably, these latest additions were still outgrown quickly. Finally, in 1950 the Children's Hospital acquired an adjacent plot of land that extended the length of the block from Morris Street to South Street[7,10,11,15]. Here, a large, $1.2 million East Wing was opened in 1953, with more administrative space and operating rooms, as well as living quarters for doctors, interns, and student nurses. This latest extension augmented the hospital's capacity to a total of 206 beds.

In spite of the relentless demand, the management and medical staff at the Children's Hospital were steadfast in their commitment to a founding principle of the hospital; specifically, that no child would ever be denied necessary treatment it if their family were unable to afford it[12]. This ethos was immortalized in the hospital's motto, "Where no child knocks in vain"[7]. A majority of patients at the Children's Hospital actually came from very poor families that, on average, only paid for a quarter of their total medical costs[11,15]. Since the remainder was covered by private donations and a minimal level of government funding, the hospital consistently and heavily relied on public support. In spite of this challenge, costs to patients were kept to a minimum. For instance, by 1937, the daily charge for a ward admission was $1, while a private room was $3, and the operating room fee was $5[24].

Unfortunately, the onset of the Great Depression meant that some major supporters did not maintain their usual donations to the Children's Hospital[15]. Operating deficits continued to grow and did not improve substantially over the course of the Second World War. Entering the 1950s, the Children's Hospital was clearly in a crisis, and the unsustainability of its funding model was becoming ever more apparent[11]. In 1953, the operating deficit exceeded $45 000, and grew to $133 000 by 1958[13]. By this time, owing $620 000 to creditors, the institution seemed on the brink of collapse[11,13]. Recognizing the great loss to the community that this would entail, the Cities of Halifax and Dartmouth, as well as Halifax County and the provincial government, were persuaded to jointly act as guarantors to the hospital's creditors. The implementation of the Provincial Hospital Insurance program in 1959 would also greatly ease financial pressures[10,11,25,26]. The program reimbursed the hospital for all patients at a standard ward rate, while still allowing the hospital to charge extra for private accommodation. In its first year, the Nova Scotia Hospital Insurance Commission accounted for almost 80% of the hospital's annual revenue, and the Children's Hospital was able to continue treating poor children without risking insolvency. After further savings from cost-cutting measures, the hospital's debts were paid off by 1961, four years sooner than promised to its

guarantors.

Towards a New Children's Hospital

Although the advent of Provincial Hospital Insurance greatly improved the Children's Hospital's fiscal situation, the removal of financials barriers also meant that more families came to seek care at the perennially busy institution[10]. The hospital continued to be cramped and its aging edifice was hurtling toward obsolescence[27]. To some, its future as Atlantic Canada's pediatric referral centre was uncertain, particularly since inadequate space constantly hampered clinical teaching for its health professions training programs[10,19,20]. In 1961, the Children's hospital commissioned an independent report on the building, which recommended construction of a brand-new hospital rather than further renovation of the existing structure. In 1964, preliminary plans for such a new facility were announced[28,29]. However, with limited provincial support for capital construction, the new hospital's anticipated $6 million cost presented a substantial obstacle.

It was auspicious then that the fundraising committee attracted the attention of philanthropist Dorothy Killam[5,30]. Her late husband, Izaak Walton Killam, was a Yarmouth-born financier whose diverse corporate acquisitions and investments had rendered him the wealthiest person in Canada[31,32]. After he died in 1955, her astute management of his estate had doubled the Killam fortune to $100 million. She met hospital officials in the spring of 1965 to negotiate a possible $5 million donation toward construction of the new Children's Hospital[5,7,30]. These discussions resulted in stipulations about the naming of the new hospital, its architectural design, and other matters. Overall, the prospects seemed favourable for finalizing the deal at a later date. Thus, her unexpected death that summer was an immense shock that threatened to derail the project's financing efforts[30,34,35]. Instead, hospital officials were pleasantly surprised when execution of her will revealed that her gift had been enlarged to $8 million.

Construction of the new Izaak Walton Killam (IWK) Hospital for Children started in 1967 (Figures 2, 3)[19,20]. Upon completion, the 325-bed hospital cost over $19 million, far in excess of original estimates. On May 28, 1970, 116 inpatients from the old Children's Hospital were transported via an underground tunnel connecting the two buildings, an efficient process completed within 2 hours[35-38]. During opening day, hospital staff began using the IWK's novel technologies such as its pneumatic tube network, intercom call bells, and pagers. As planned, the Halifax Infirmary permanently closed its 70-bed Pediatrics Unit at this time[27]. During the first year of the new IWK, 7992 patients were admitted, 5183 operations were carried out, and the Emergency Department saw 22 047 visits[39]; in comparison, there were 239 admissions during 1920[10].

Many new clinical services were introduced with the opening of the IWK. Pediatric Psychiatry would now be offered on both an outpatient and inpatient basis, and would supplement the Nova Scotia Hospital's Pediatric Psychiatry services[37,40]. The IWK had new wards for respiratory and infectious diseases, a Clinical Investigation Unit for complex endocrine and metabolic disorders, and 65 beds for family physicians to admit their own patients[37]. Ten operating rooms were now available, conveniently located next to a 15-bed Intensive Care Unit[27]. Neonates and burn patients could also be treated in state-of-the-art, dedicated

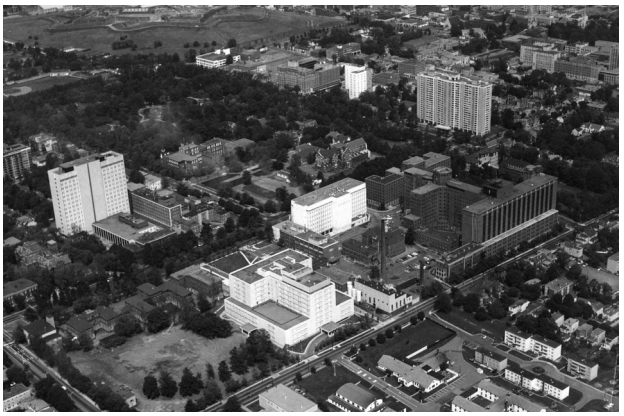

Figure 2. Aerial photograph of IWK Children's Hospital. The original Grace Maternity Hospital may be seen, as well as the Victoria General Hospital's "Jubilee Building," demolished in 1980 to make way for the Robert Clark Dickson Ambulatory Care Centre. ca. 1972. Courtesy of the Dalhousie University Photograph Collection, Dalhousie University Archives, Halifax, Nova Scotia.

Figure 3. Pediatricians, standing with interns and residents. Photographer unknown. ca. 1962. Courtesy of the Thomas John (Jock Murray) Fonds, Dalhousie University Archives, Halifax, Nova Scotia.

units. A new division of Pediatric Neurosurgery was established, meaning that children would no longer need to be admitted to the Neurosurgery service at the Victoria General Hospital[37]. To the delight of patients and families, the new patient rooms were large enough to accommodate parents rooming in[27].

A year after the IWK opened, a new Child Life Department was also introduced[5]. This program, integrating study and play, aimed to help children and families cope with hospital admission and its disruption to daily life. It had been preceded by a more rudimentary Play Therapy Department and Children's Hospital School, both founded in 1939[10]. Although Child Life at the IWK would face challenges in the 1990s, with budget cuts and reorganization, it remains vital service today[5,41,42]. Child Life's therapeutic clowns, introduced in 2006, have become a particularly visible and beloved part of life at the IWK[43,44].

The IWK-Grace

When the Salvation Army's Grace Maternity Hospital withdrew from the long-awaited Camp Hill redevelopment project in 1983, an opportunity arose for further cooperation and integration with the IWK[45-48]. Fruitful discussions ensued around sharing resources and by 1985 the IWK agreed to provide land for a new Grace Maternity Hospital to be built directly adjacent to the IWK[49]. Since both hospitals were confronted with funding shortfalls and operating deficits in the late 1980s into the 1990s, improving efficiency was imperative[50-57]. The new Grace Maternity Hospital opened April 10, 1992, connected to the IWK via a shared services building[58,59]. In 1995, the two hospitals formally merged into the IWK-Grace Health Centre for Children, Women & Families, and remained independent of the regional health authorities simultaneously being formed in Nova Scotia[60-62]. After 1999, the Salvation Army's partnership with the IWK-Grace was discontinued, and the hospital later became known as the IWK Health Centre[63-65].

The 2000s continued to bring growth and development to the IWK. In 2002, a helicopter landing deck was added to the roof of the complex[66]. This was followed in 2005 by the opening of the Richard B. Goldbloom Research and Clinical Care Pavilion, named after the hospital's esteemed former Chief of Pediatrics. 2009 was an especially monumental year for the IWK, as it celebrated the Children's Hospital's centenary[66]. The anniversary was observed with many special events and initiatives, including scientific symposia, a "Concert of the Century" featuring Symphony Nova Scotia and the Nova Scotia Youth Orchestra, an alumnae reunion of the Children's Hospital School of Nursing, and artistic commissions. A commemorative history of the hospital was also published, IWK: A Century of Caring for Families[67].

From its earliest years, the hospital enjoyed widespread community support, with volunteers providing instrumental assistance to patients and families. Fundraising for the hospital has been essential for upgrading equipment and facilities and, at least during the early decades of the Children's Hospital, for keeping the institution from bankruptcy. The Kermesse fun fair, named after a European festival, was first held in 1911 and raised over $500[10,12,68,69]. This popular yearly event was disrupted by the First World War, until 1946, when the newly founded Women's Auxiliary revived the Kermesse. The Kermesse now raises over $90 000 a year[70]. In 1985, the IWK inaugurated a new fundraising tradition, the IWK Telethon for Children, featuring local entertainers and patient testimonials[66,71]. The first telethon raised $614 000 toward new equipment and construction, becoming a pivotal annual campaign for the hospital. 2019's IWK Telethon, its 35th iteration, garnered $6.7 million in pledges, its greatest sum yet. The IWK Foundation, established in 1987, presently oversees fundraising for the hospital[11].

In 2012, the IWK was once again beneficiary of a large philanthropic gift, when automotive manufacturers, the Garron family, donated $10 million toward improved facilities for mental health, and obstetric and neonatal care[72]. This contribution was an important step toward construction of the IWK's $10 million Garron Centre for Child and Adolescent Mental Health, designed in consultation with youth and families who had lived experience of the hospital's old mental health facilities[73]. The Garron Centre was completed in 2014[74]. Sadly, the IWK also appears to have been victim to some rather uncharitable behaviour in recent years; its former CEO Tracy Kitch and former CFO Stephen D'Arcy presently await trial after independent auditors discovered Kitch spent tens of thousands of dollars on a corporate credit card, for "potentially personal" expenses[75-77]. Nonetheless, the IWK otherwise enjoys an abundance of goodwill and presently finds itself on firm financial footing.

The IWK remains a bustling institution; in 2018, the hospital saw over 33 000 Emergency Department visits and 4 300 pediatric surgeries[78]. Today, the hospital continues to adapt to the community's changing needs. For instance, in 2019, the IWK completed an extensive renovation of its Neonatal Intensive Care Units, converting an open unit design to 38 private rooms with improved amenities for parents[79]. Although the nursing residence had long been demolished, the IWK's O.E. Smith Auditorium continued to honour the influential administrator of the original Children's Hospital. In 2017, the IWK partnered with cinema chain Cineplex to

Figure 4. Inscription at the University Avenue entrance of the IWK Health Center. Photographer: Mike Wong. 2020.

upgrade this space into a movie theatre for patients and families, and also for multimedia scientific meetings[80]. Since 2018, planning has been underway for a major expansion of the Pediatric Emergency Department, focusing on enlarged capacity, modernized spaces for mental health crises, and improved isolation for patients with contagious diseases[81].

Indeed, much has changed since Marion Morrow's personal initiative resulted in the founding of the Children's Hospital. Fortunately, pediatric outcomes are greatly improved from that era. However, even though today's pediatric care is vastly more sophisticated than a century ago, patients at the IWK are still buoyed by the ageless virtues of compassion and kindness. As it has always been, the hospital's doors are open to any child in a time of need (Figure 4).

Acknowledgements

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Humanities

Dr. Charles Miller Fisher: Important contributions to ophthalmology

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Introduction

One of the most accomplished Canadian physicians and researchers of his time, Dr. Charles Miller Fisher (CMF) is perhaps best known for his contributions to neurology and stroke medicine. By the end of his career, he had earned an impressive collection of honours and awards and left a legacy of contributions to his field of neurology as well as to ophthalmology. Some of his most famous discoveries include the thrombo-embolic theory of ischemic stroke, carotid artery disease as a cause of stroke, atrial fibrillation as a stroke substrate, lacunar infarcts, transient ischemic attacks (TIAs), and features of thalamic and cerebellar hemorrhage[1]. His dedication to clinicopathological correlation and careful observation were what led to the many discoveries he made over his lifetime and although CMF was a neurologist, he made an important mark in the field of ophthalmology. This paper explores and summarizes some of the key discoveries and contributions CMF made to the field of ophthalmology over the course of his career.

Biography

CMF was born in Waterloo, Ontario, and earned his Medical Degree from the University of Toronto in 1938 before continuing to train at Henry Ford Hospital in Detroit until 1939[2]. Shortly after completing his intern year, he joined the British Royal Navy. While participating in World War 2, CMF was imprisoned in a German Prisoner of War Camp from 1941-1944[1,2]. During his capture, he reportedly learned German, Italian, Spanish, mathematics, navigation, and music theory. After his release, he returned to medicine and continued training as a neuropathologist in Boston, Massachusetts, before returning to Montreal General Hospital. In Montreal, he developed a Neuropathology service and began to study and describe a constellation of symptoms which he later coined "TIAs." This discovery paved the way to our modern understanding of stroke as a thromboembolic phenomenon, and marked the beginning of a long and fruitful career for CMF. Even at the age of 96, he remained actively involved in research.

As a clinician, CMF was intensely curious and meticulous. This is made clear in his very detailed, and often peculiar observations. He is said to have categorized patient symptoms based on features like "patients who wrote off the paper," "mumblers," "irascible patients," and "topplers." Observations as nuanced as "the right sole was more ticklish than the left" can be found in his published work[1,3]. In addition to his role as a clinician, he left a bold mark on each of his students. One such student went on to write a paper entitled "Fisher's Rules," which highlights—among other things—the importance of closely studying one's patient at the bedside[4].

Contributions to Ophthalmology

TIA (Transient Ischemic Attack)

In 1951, CMF published the pivotal "Occlusion of the Internal Carotid Artery," where he first explores the role of the internal carotid artery in cardiovascular disease and its role in cerebral ischemic stroke[3]. The observation of a predictable collection of "premontory fleeting symptoms" affecting patients who would later go on to develop an ischemic cerebral stroke was his first and arguably most famous clinical observation. These symptoms included paresthesia, aphasia, and monocular blindness. The link between ischemic stroke and carotid artery disease challenged the then-popular "vasospasm theory," and later led to the widespread acceptance of the thrombo-embolic theory of ischemic stroke.

TIA and TMB (Transient Monocular Blindness)

The visual disturbances involved in TIAs are classically monocular and occur ipsilateral to the stenotic carotid artery. Their onset is abrupt lasting usually about one minute, which some patients describe as "like a blind pulling down" in the affected eye. In one case, a patient who developed hemiplegia famously remarked: "isn't it funny that I went blind in my wrong eye? My paralysis was on the left and my right eye went blind." The patient was initially thought to have hemianopsia, but it was later realized that these visual symptoms were likely due to carotid artery occlusion.

From the idea that ipsilateral visual disturbances can be caused by fleeting ischemia caused by ipsilateral carotid artery occlusion, the term "transient monocular blindness (TMB)" emerged[5]. As the visual features of

TMB closely resemble hemianopsia, CMF coined TMB to distinguish it from the broader "amaurosis fugax"—an all-encompassing term for all types of visual loss, whether monocular, binocular, and regardless of the etiology. In fact, in 1989, CMF declared that he still preferred the term TMB over amaurosis fugax[6].

Observations of the Fundus Oculi in TMB

In 1959, CMF carefully outlined changes in retinal circulation in two instances of TMB (Figure 1)[7]. This was important in establishing the connection between TIAs and their corresponding vascular events, and ultimately lent further support for thromboembolic phenomena as the underlying cause of TIA. Throughout the paper, CMF entertains the alternative hypotheses that the observations could be explained by vasospasm and local areas of collapsed or constricted vessel. However, he describes features that make the presence of intravascular embolic material the most likely explanation.

Firstly, the junction between the white segment and the blood-filled arteries was always square or transverse, with no mixing of red and white segments. The diameter of these segments was always equal, further supporting the presence of an intravascular material versus a segment of arterial constriction or collapse. As the white segments moved distally along the retinal arteries as if an intravascular material was being pushed along by the column of blood proximal to it, the white segment appeared to stop momentarily at bifurcations. At one point, erythrocytes were seen passing distally across the white segment, but did so only at the outer edge. If the white segment represented an area of locally constricted vessel, the erythrocytes would be expected to pass through the center.

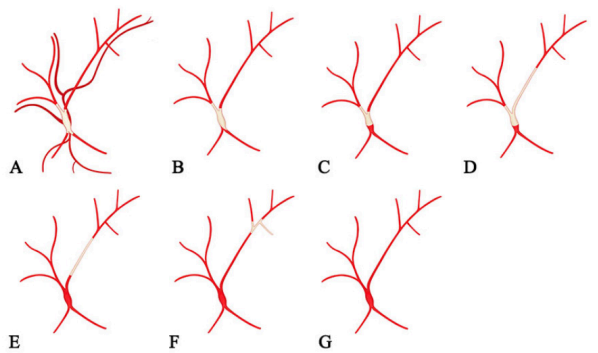

Figure 1. Changes in retinal circulation at 6 different time points in one case of TMB. This attack of monocular blindness occurred in 3 quadrants of visual field in the left eye and lasted a total of 60 minutes.

Miller-Fisher Syndrome

In 1956, CMF described a variant of Guillain-Barre Syndrome that now bears his name[8]. Miller-Fisher Syndrome was first recognized by CMF as a triad of neurological complaints that appeared to be linked to a preceding respiratory illness. Classically, ophthalmoplegia, ataxia, and areflexia characterize this condition. It therefore somewhat resembles several other diagnoses with similar presentations including vascular disease, Wernicke's Encephalopathy, and brainstem tumors.

In "An unusual variant of acute idiopathic polyneuritis," CMF describes 3 cases of stereotyped, transient neurological symptoms that were all preceded by a respiratory complaint. Within 3-4 days of onset of neurological symptoms, 2 of these patients developed external ophthalmoplegia with the eyes fixed in primary gaze. In all cases, pupils were equal and mid-dilated reacting slowly to light, and moderate ptosis was seen in 2 cases. The orbicularis oculi functioned normally, and neither visual fields, acuity, nor fundi were abnormal during the episodes. Remarkably, CMF noted restoration of ocular movements a few days after the peak of symptoms and near-full recovery after 8-12 weeks with no intervention.

CMF concluded that vascular disease was likely not the cause of these transient neurological symptoms. Although basilar artery thrombosis can cause ataxia and extensive ophthalmoplegia, it would almost certainly also damage the reticular formation and therefore have severe effects on regulation of consciousness. Another reasonable explanation for this syndrome was Wernicke's encephalopathy, which also commonly includes ataxia and ophthalmoplegia. Unlike Wernicke's Encephalopathy, however, there was no evidence of malnutrition and consciousness was never affected in these patients.

The link to polyneuritis was made after CMF recognized a rise in CSF protein in one of these cases. Furthermore, the loss of reflexes coupled with paresthesias suggested involvement of the peripheral nerves. Previously, some cases of polyneuritis were found to show a similar type of ophthalmoplegia, making CMF reason that this syndrome—now known as Miller-Fisher syndrome— was a variant of acute idiopathic polyneuritis in which involvement of the limbs is minimal and is instead characterized by ophthalmoplegia in addition to ataxia and areflexia.

One-and-a-Half Syndrome due to Ocular-Pontine Deficit

One-and-a-half syndrome was one of many important neuro-ophthalmological discoveries made

by CMF in his 1967 paper "Some Neuro-Ophthalmological Observations"[9]. One-and-a-half syndrome is a combination of a horizontal conjugate gaze palsy in one direction, and an internuclear ophthalmoplegia causing paralysis of adduction in one eye in the opposite direction. Most commonly, horizontal abduction of one eye is impaired, and complete horizontal paralysis is seen in the other[10].

CMF attributed this phenomenon to a lesion located near the pontine conjugate lateral gaze center causing the conjugate gaze palsy in the contralateral eye. This also affects the nearby MFL fibers, causing internuclear ophthalmoplegia in the ipsilateral eye (Figure 2). This discovery was anatomically important as it indicated the MLF must cross caudally in the pons near the level of the paramedian pontine reticular formation (PPRF) and Abducens nucleus, before reaching the oculomotor nucleus in the midbrain.

This condition is usually caused by a stroke or demyelinating disease such as Multiple Sclerosis affecting this area of the caudal pons, and is quite rare[10]. In particularly rare cases, such a lesion could be caused by tumors, arteriovenous malformation, and basilar artery aneurysm.

Wrong-Way Eyes

Supratentorial hemorrhage usually produces a contralateral hemiplegia and deviation of the eyes toward the side of the lesion, opposite to the paralyzed side of the body[9]. However, in "Some Neuro-Ophthalmological Observations," CMF describes cases of supratentorial hemorrhages resulting in deviation of the eyes toward the side of hemiparesis, prompting him to examine 3 cases in detail and to perform pathological correlation[9]. In each of these cases, CMF found hemorrhage in the medial thalamus on one side, ipsilateral to the direction of eye deviation, and a large pooling of blood in the third ventricle.

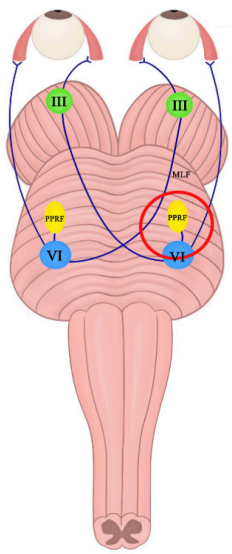

Figure 2. Brainstem schematic of one-and-a-half syndrome due to ocular-pontine deficit.

While the precise etiology of wrong-way eyes is unclear, some proposed mechanisms include compression of the mesencephalon affecting descending oculomotor pathways originating in the contralateral hemisphere[11]. The compression of the mesencephalon from hemorrhage and cerebral edema at this level are thought to involve the descending oculomotor fibers as they decussate[12].

Prognostically, the finding of wrong-way eyes in the context of prethalamic hemorrhage is typically a marker of poor outcome, as it usually indicates compression of the brainstem[12]. This clinical sign should prompt urgent surgical decompression.

Preservation of Pupillary Reflex in Miosis due to Pontine Injury

Prior to "Some Neuro-Ophthalmological Observations," intrapontine hemorrhage and devastating pontine infarcts were often diagnosed clinically as miotic pupils that were unreactive to light[9]. The strongly miotic pupils could be explained by insults to the descending sympathetic pathways involving pupillary dilation, but how these lesions impaired their inability to react to light was still unclear.

Hoping to explain this phenomenon, CMF examined 6 patients with extreme miosis: 2 of which suffered pontine infarction, and the other 4 pontine hemorrhage. In each of these patients, their pupillary response to light was measured and recorded using a hand lens for magnification. In all patients, a small reaction to light was observed. CMF concluded that the degree of miosis seen in such lesions likely made any reaction to light exceedingly difficult to observe.

Localizing Value of Scintillations and Vertical Nystagmus

Scintillations

Visual scintillations may be experienced by patients with ocular migraines but can also be caused by cerebral ischemia or hemorrhage[9]. While cerebral lesions were thought to probably involve cortical areas responsible for vision, it was unclear where precisely lesions producing scintillations arose. Three cases of scintillations were observed showing thrombosis of the vertebral arteries, basilar arteries, and PCA. Ischemia was present in the pons and occipital lobes. In all cases, injury to the MCA or temporal lobes was not observed.

Based upon the pattern of vascular involvement and cerebral injury, CMF concluded that scintillations

caused by hemorrhage or infarct may indicate damage to the calcarine sulcus or primary visual cortex, and the optic radiations are probably not involved.

Vertical nystagmus

Before 1967, it was widely held that vertical nystagmus is an indication of lesion involving either the upper or lower portions of the brainstem[9]. In the case of upper brainstem lesions, the thought was that vertical nystagmus may represent weakness of vertical gaze. However, in "Some Neuro-Ophthalmological Observations," CMF remarked having never encountered vertical nystagmus in patients who experienced thalamic-subthalamic hemorrhage involving paresis of conjugate vertical gaze. Examination of other cases of upper brainstem lesions also failed to detect any cases of vertical nystagmus. However, in cases of brainstem lesions involving the lower pons or upper medulla, vertical nystagmus was often found. While not entirely clear what the mechanism was, CMF concluded that vertical nystagmus may be an indication of brainstem damage of the pontomedullary junction, and not the upper brainstem.

Ocular Bobbing in Pontine Lesions

Ocular bobbing (OB) is a clinical sign characterized by rapid conjugate downward movement of the eyes, followed by a slow, conjugate return to primary gaze[13]. This sign is commonly seen in cases of extensive pontine damage by hemorrhage or infarction and is therefore a poor prognostic indicator.

In "Ocular Bobbing" (1954), CMF explores 3 cases of unresponsive patients who showed signs of OB and were later determined to have suffered pontine infarction or hemorrhage. Typical cases of OB were described as rapid, conjugate downward movement of the eyes to a range 1/4 to 1/3 total voluntary range, followed by a slower upward return to primary gaze. This pattern of ocular movements did not appear to be related to breathing or blinking, and the underlying mechanism was not known. However, due to the absence of horizontal eye movements, CMF postulated that OB is merely roving of the eyes without the horizontal component, making the vertical movements more obvious.

Indeed, OB is currently thought to be the result of damage to the paramedian pontine reticular formation which is responsible for eye movement along the horizontal plane, while sparing the vertical gaze center[14]. This mechanism is further supported by the observation that pupils remain equal and reactive to light, which suggests that the midbrain is not involved in the pathophysiology of the clinical sign. Ultimately, OB may be a clinically useful sign in the unresponsive patient as it indicates serious pontine disease and signifies a poor prognosis.

Oval Pupils

In 1980, CMF described a form of irregularly shaped pupils that previously had not been well-characterized. While square, slit, and pear-shaped pupillary deformations had previously been described, as well as pupillary irregularities seen in neurosyphilis, oval shaped pupils had not[15].

In "Oval Pupils," CMF describes 17 cases of oval pupils and their associated neurological pathologies. In 16 of all 17 cases, patients had suffered severe cerebrovascular events, including hypertensive cerebral hemorrhage, ruptured saccular aneurysm, epidural hemorrhage, bilateral cerebral infarction, brainstem stroke, and cerebral anoxia. The 17th patient did not have any vascular disease but was found to have an isolated acute oculomotor palsy.

Given the number of cases related to disastrous cerebral hemorrhage or ischemia, oval pupils seemed to be associated with acute intracranial vascular events. In all cases, damage to the oculomotor nerve nucleus was present, suggesting midbrain involvement as the underlying pathology in oval pupils. CMF proposed damage to the oculomotor and pupillomotor nerve as a possible mechanism, causing paralysis of the pupillary sphincter along one axis and thereby producing an elliptical pupil. Direction of the axis was varied across cases and did not appear to be related to the pathological process or mechanism of damage.

In most cases, oval pupils were a transient stage preceded by an acute pathological process, and complete restoration of round pupils was seen in all cases. CMF concluded that an oval pupil represents a temporary stage leading to oculomotor nerve paralysis, or in rarer cases, recovery to full symmetrical nerve function.

Conclusion

Looking at all the discoveries and contributions made by CMF over the course of his career, it is difficult to fathom that they were all made by one man in one lifetime. Beyond his excellence in academia and research, he was a memorable teacher and an incredibly interesting individual. Although CMF dedicated his life to neurology and played an important role in our modern understanding of stroke medicine, to limit his achievements there would be to sell them short. The discoveries made by CMF in both neurology and ophthalmology strengthened the connection between these two fields, and ultimately led to a more complete understanding of neuro-ophthalmology. Dr. Charles

Miller Fisher is undeniably a giant in neurology, but the impact he made on the field of ophthalmology is perhaps a better kept secret that deserves to be uncovered.

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COMMENTARY

Longitudinal rotating pathology elective: Reflections on a pilot project in pathology at Dalhousie

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Abstract

A new half-year longitudinal rotating pathology elective was offered to second-year Dalhousie medical students. The elective ran from January 2018 to April 2018 and again from January 2019 to April 2019. From both the student and preceptor perspective, the rotating elective provided a well-rounded experience in pathology, and is an excellent student introduction to residency programs and career options.

Background

First and second year medical students at Dalhousie University participate in clinical electives for a half-day per week as part of the pre-clerkship curriculum, with the goals of exploring an area of interest, gaining exposure to the clinical work environment, seeking out career options, and identifying potential clinician mentors. First year (Med1) students participate in one half-year elective, while second year (Med2) students have the option of a single full-year elective, or two half-year electives. Students typically organize these electives independently by approaching a physician or other healthcare professional as a preceptor with a specific proposal. In Med1, there is an opportunity in the Dalhousie electives catalogue to participate in an organized "rotating elective" where students are placed with clinicians in a variety of specialties. In past years the rotating elective has included Psychiatry, Family Medicine, Surgery, Internal Medicine, Pediatrics, and Obstetrics and Gynecology, each for two weeks at a time.

In 2018, two Halifax-based pathologists, Dr. Thomas Arnason and Dr. Ashley Stueck, organized a new half-year rotating elective for Med2 students based in Halifax, focused entirely on pathology and laboratory medicine. The elective was structured with a schedule where participating students spent their half-day with a different pathology and laboratory medicine preceptor each week. Preceptors included hematopathologists, microbiologists, clinical chemists, a neuropathologist, and anatomical pathologists with subspecialty interest in the gastrointestinal tract, liver, skin, breast, gynecologic tract, heart, lungs, and forensics. Teaching sites included pediatric and adult hospitals, as well as the provincial medical examiner's office. The goal was to increase student exposure to pathology before clerkship and to allow students to explore the broad range of residency and career options within pathology. Two second year medical students participated in 2018 and three in 2019.

Structured "rotating electives" are uncommon in the pre-clerkship years at Dalhousie, and this "rotating pathology elective" appears to be unique in Canada. We asked the students and lead preceptors to reflect on the experience and describe the challenges, opportunities, and impact of this type of structure for a second-year medical school elective. The student and preceptor perspective based on this experience might be helpful in planning similar rotating electives in other specialties at Dalhousie, or similar pathology electives outside of Halifax.

The student perspective

What personal or professional growth did you experience?

Patrick Holland noted a new appreciation for the breadth, volume, and importance of the work done in the laboratory behind the scenes: "When you send off a sample and a requisition, you don't really ever think about the amount of processing and evaluation that goes into that tissue, and all the people who are involved in that test, before you get the end result." Deji Ologbenla experienced a different dimension of patient care and observed how sample accession personnel, laboratory technologists, biochemists, pathologists and many other professionals all contribute to healthcare delivery without any patient contact. "Though pathologists and laboratory personnel do not have direct contact with patients, their work impacts patient care as they often come up with diagnostic as well as prognostic findings that guide patient management."

Did the elective narrow your career goals?

Students felt that pathologist preceptors and residents were candid in discussing the reasons why they chose their career paths and the experiences that led them to where they are now. Pathologist mentors discussed the job forecast within the lab medicine subspecialties and work-life balance in residency and as staff. For Carley Bekkers, who started the elective with a potential interest in a pathology career, the elective helped solidify that choice: "During the elective, I had

the opportunity to discuss what a career in Pathology is like with staff and residents. Having these conversations helped me in coming to the realization that Pathology fits with what I am looking for in terms of a lifestyle and day-to-day job". In contrast to other electives, students felt that this elective offered exposure to a greater variety of professional perspectives and opinions. Carley Bekkers noted: "Before the elective, I was specifically interested in forensic pathology, but I was pleasantly surprised at how much I enjoyed the other sub-specialties I was exposed to, particularly Pediatric Pathology, Neuropathology, and Hematopathology." Student participants felt that the elective helped them understand the difference between pathology residency specialties that they can apply to across Canada, and what careers are possible with those residencies.

Those considering pathology as a career felt that the timing of this elective was excellent, because it immediately precedes the core 3rd year clerkship. Aleksandra Kajetanowicz wanted a chance to learn more about pathology as an option for residency before the start of core clerkship: "After Med2, the next opportunity to spend time in pathology isn't until Med4 electives, and unfortunately students need to start applying for these electives mid-way through Med3. Without a pre-clerkship elective, you would be applying blindly to electives and hoping you enjoyed the work". Aleksandra found that during the pathology elective she got to understand the day-to-day work of a pathologist and found it appealing: "I was pleased to learn that I enjoyed the lab environment, and during the rotating elective I started to seriously consider pathology as a career choice." Now in clerkship, Aleksandra has been able to experience more blocks in clinical medicine and reflect back on the pathology elective: "It was difficult to admit to myself that patient interactions, although extremely rewarding, were also at times exhausting. I am very happy to have the experience of the rotating pathology elective to look back on and can now plan to do more electives in pathology after core clerkship. I hope to pursue a career in pathology and am looking forward to sorting out whether general, anatomical, or hematopathology is the best fit for me."

Patrick Holland started the elective curious about a career in pathology. He enjoyed the experience, but learned that is probably more suited to a career in family or internal medicine: "The pathologists were fantastic and I really enjoyed some of the daily activities like Gross Rounds, however I found that by the end of the 12 weeks I was missing seeing patients and talking to them about their issues." Deji Ologbenla has always been interested in pediatrics but also finds the idea of pathology fascinating, which led him to pursue the longitudinal pathology elective. He particularly appreciated his experience shadowing a pediatric pathologist: "As I have a very keen interest in pediatrics, it was exciting to spend time with a pediatric pathologist at the IWK who showed me that it was possible to be a pathologist and still channel your passion for helping children." The neuropathology component of the elective was also very well received and helped guide Deji towards exploring a neurology rotation in clerkship: "I really enjoyed the neuropathology week where we got to participate in a couple of brain autopsies. It involved a lot of dissection and understanding of neuroanatomy and this experience contributed to my decision to do a rotation in neurology at the Halifax infirmary during clerkship." Deji is hopeful his clerkship experience in Med3 followed by a fully-fledged elective in pediatric pathology early in Med 4 will shed more light and help clarify his path post medical school.

Did the elective influence how you will practice in the future?

Participants felt that the elective would influence their future practice regardless of whether or not they ultimately pursue a career in pathology. Carley Bekkers noted that her experience learning about the laboratory test cycle will help her approach to clinical care and reduce her risk of errors in clerkship and residency: "In rotating through clinical pathology labs, we discussed pre-analytical, analytical and post-analytical phases of lab testing and identified where errors in these phases could occur. I found this to be particularly valuable as no matter what specialty medical students pursue, having knowledge of how sample testing is done and how medical students, residents, and staff clinicians can reduce pre- and post-analytical errors is critically important to providing safe care for our patients". Deji Ologbenla suspects that the experience in the lab will encourage him to form collaborative relationships with pathologists and he hopes that he can become involved in the fast growing field of molecular medicine in his future practice: "Whichever path I take, I will form collaborative relationships with pathologists and try as much as possible to tap into the breadth of knowledge they possess. I also think molecular pathology is the future in diagnostic and prognostic medicine and will find ways to incorporate it into my practice."

What challenges does the elective present to participating students?

While the multiple preceptor / multiple subspecialty format provided a wide breadth of experiences, it created challenges in terms of building skills and assessing progress from week to week. Carley Bekkers noted that when you switch preceptors each week, "it does not necessarily provide the opportunity to work on new skills acquired, for example, recognizing and

recalling the histological features of a specific tissue or organ. Having a limited time with each preceptor makes it challenging to assess the progress you make in the elective." Another downside to the multiple preceptor format of the elective is that there was less opportunity to build a strong relationship with an individual preceptor. However, this was mitigated by working three times with Drs. Stueck and Arnason at the beginning, mid-point, and end of the elective for evaluations and feedback. Deji thought he sometimes struggled with orienting himself to surgical specimens and the rationale for deciding to section them in a specific way for histology: "It was sometimes difficult to wrap my head around why a transverse cut was needed somewhere, and a longitudinal cut elsewhere as I got myself oriented to specimens during gross rounds". To mitigate this, we have suggested an orientation to gross pathology with a resident to help students in the elective understand the basics of gross pathology.

The preceptor perspective

How did preceptors respond to teaching second year students?

All of the preceptors had previously taught medical students, but the majority of the medical student electives in the pathology department are fourth year MD program electives. Pathology electives prior to fourth year are less common, and pathology is not part of the core clerkship curriculum. Preceptors responded to the concept of the elective very positively and it was relatively easy to recruit the group of 14 preceptors each year. According to Dr. Arnason "I thought the elective was a good team building exercise for the department, as we had preceptors participate from all different disciplines". Dr. Stueck noted "The preceptors frequently remarked that this elective presented a valuable and unique method of interaction with Med2 students and felt it would be favourable for recruitment to the pathology and laboratory medicine specialties."

Any approaches to teaching which were more or less effective?

Dr. Arnason's impression was that students seem to be more interested in participating in the pathologists' actual daily work rather than review teaching cases: "I think there is a temptation in teaching anatomical pathology to stop doing your work and start teaching a lesson in basic histology with an archived set of histology slides. However, my experience is that the junior medical students prefer to observe me doing my actual anatomical pathology cases for the day, with pauses to explain the clinical question on the requisition, the microscopy, and how I will write up the report for the case. Similarly, they don't mind at all if we are interrupted to do a frozen section. I think that this type of elective should place more emphasis on teaching medical students what it is like to have the job of a pathologist, rather than focusing on basic histology and microscopy skills." Dr. Stueck concurred: "For small group sessions, particularly when only a single interaction with the students is planned, pathologists tend to concentrate on archival teaching material that highlights histology of either very common or extraordinary cases. This approach may be better suited to pathology residents. For medical students, discussion of challenges and interpretation of current cases, including pre-analytic factors such as what was sampled and why and what medium the tissue was placed in and for what duration, and analytic factors such as gross features and how the specimen was grossed, seem to be more relevant and of interest."

In anatomical pathology, a focus on gross pathology and autopsy seemed to work well. Dr. Stueck observed: "The inclusion of autopsy pathology has been well-received and is well-timed for the Med2 students pre-clerkship. It is important for the students to understand what an autopsy entails, the choices available to the patient's family, and the timeline of the procedure, particularly as the students will likely be involved in speaking to families about, and consenting for, autopsy during clerkship." Dr Arnason added: "I think the Med2 students tend to have strong skills in anatomy and can recognize that an abnormality is present in gross specimens, so autopsies, brain-cutting, and gross rounds are easy for them to understand and learn from. I think histopathology has a steeper learning curve, but it's important they get that experience to see if the job is right for them".

What challenges does the elective present to the organizers and preceptors?

The main challenge from the faculty point of view was the complexity of developing and coordinating a schedule with multiple faculty preceptors that matches student availability – according to Dr. Arnason, "organizing this requires a lot of emails, phone calls, and hallway conversations." The elective coordinators knew that student evaluations would be a concern, they ensured that these evaluations would be completed by scheduling the students with two elective coordinators (Drs. Stueck and Arnason) at the beginning, midpoint, and end of rotation. Soliciting feedback from faculty about the students was relatively simple, mainly through a few short e-mails and conversations. While there was useful verbal feedback about the program and faculty from the students, it seemed unreasonable to ask for written individual preceptor evaluations for such a short experience with each preceptor. Lack of

a written faculty evaluation could be perceived as a weakness of the program by some faculty. To help make up for this, at the end of the rotation, Dr. Arnason sent written thank you letters to all participating faculty.

As most preceptors had a single experience with the students, Dr. Stueck notes that "It is somewhat challenging for preceptors to form a relationship with the students and they lack the ability to observe skill and knowledge acquisition and application over time." Again, this is somewhat mitigated by recurrent exposure to the two main preceptors (Drs. Stueck and Arnason). This could be improved by repeat exposure to more preceptors, but the downside would be reduced variety. Dr. Stueck thinks "We must keep in mind the goal of this elective, which is broad exposure to pathology and laboratory medicine, rather than specific skill acquisition, and communicate this well to our preceptors and students before and during the elective."

Any suggestions for pathology preceptors looking to establish something similar at other institutions?

According to Dr. Arnason, one of the keys to the success of this type of elective is a department-wide, team-based approach to teaching, in order to provide an elective that is representative of all disciplines in lab medicine: "We used to do one-on-one electives with a single preceptor for 14 weeks which is a sometimes onerously large time commitment for individual pathologist preceptors and offers the student a relatively limited range of experiences in highly subspecialized academic centers. Having a team of preceptors in different fields of lab medicine improves the diversity of the student experience and it lightens the workload for each individual pathologist involved."

Discussion

In the Dalhousie medical school curriculum, the main exposure to pathology is in the first and second year through lectures, laboratories, and tutorial cases. There is no option to do a pathology rotation in the third-year core year of clerkship. This is typical of most Canadian medical schools. Without a core clerkship rotation and without well-established elective opportunities for medical students, there is a theoretical risk that that medical students with an aptitude and interest in pathology may fail to pursue residency and a career in the specialty due to a lack of exposure to the clinical practice and a lack of mentorship.

In the same year that this faculty-driven, rotating elective in pathology began, there was a new medical student-driven elective at the end of Med2 which also included pathology. The elective, called "PREP" (Pre-clerkship Residency Exploration Program), is reviewed on the Dalhousie University website[1]. The PREP elective provided the 40 participating Med2 students with a brief clinical experience in 14 different medical specialties. In the two weeks, each student spent one day in pathology: a half day pathology preceptorship and a half day pathology skills lab. The PREP elective provides a larger number of students with a much shorter duration clinical experience in pathology. The experience was not standardized, and each small group of students were exposed to different preceptors from different laboratory medicine specialties. While the PREP elective might be enough to spark an interest or rule out pathology as a career choice, the longitudinal rotating elective provides a more well-rounded experience and may better assist students with a career decision, particularly if they are already seriously considering pathology.

Increasing medical student interest and exposure to laboratory medicine careers is a long-term goal for the longitudinal rotating and PREP electives. Whether these electives are influential will take years to evaluate, and may be difficult to assess, since so many variables affect career decisions. However, we think there is value in the experience regardless of recruitment outcomes. The elective provides a hands-on opportunity to learn about laboratory tests, which is useful regardless of whether or not participating students eventually pursue or rule out pathology as a career choice.

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