EVIDENCE BRIEF

TECHNOLOGY ADOPTION ACROSS CANADA: THE ECOSYSTEM, BARRIERS AND SUCCESSES

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TECHNOLOGY ADOPTION ACROSS CANADA: THE ECOSYSTEM, BARRIERS AND SUCCESSES

Key messages

- Canada has been historically slow at innovation in health care

- Both healthcare providers and healthcare users in Canada see value in virtual solutions that support healthcare needs and are receptive to using them if accessible

- The COVID-19 pandemic has both changed how virtual health care is received and highlighted the need for virtual solutions to support our healthcare system

- New Brunswick has made positive progress at establishing ways to better incorporate innovations in healthcare and there are opportunities for change

Introduction

Canada's population is aging, with the proportion of those 65 and older representing 21% of the total population by 2028, an increase from 16.9% in 2018. Meeting the healthcare needs of this cohort can be expensive. The average health care cost for older adults is $12,000 per year, compared to $2700 for those who are younger, translating into an increase in $93 billion over the next 10 years[1]. Efforts to increase the health and wellbeing of these older adults is of importance. A decrease in reliance on the healthcare system or an increase in efforts to assist aging in place, could assist in decreasing healthcare expenses. One such strategy would be the expansion of use of healthcare technologies in the aging process.

Expanding the use of technology in healthcare has proven to be slow in Canada. Efforts are often made to measure whether an intervention has a positive influence on the overall health care system. The most common entry point for a person to access the healthcare system is through primary care, usually in the form of a family physician, but may also be through other professionals, such as nurse practitioners. As such, many studies evaluate the effectiveness of a health care system on metrics related to primary care. A recent survey conducted by the Commonwealth Fund found Canadian primary care physicians were ranked last in offering patients the ability to communicate electronically via email or secure website about a medical question. For example, 22% of Canadian physicians were offering these virtual options, compared to 91% of Sweden's respondents. Online appointment scheduling, prescription requests, and the ability to view test results and patient visit summaries were offered by only 1% of Canadian physicians compared to 58% of Swedish physicians doing so regularly[2]. Incorporating technology into health care could translate into lives saved, due to increased access to services, increased communication between patients and health care providers, as well as between health care providers, resulting in better coordinated care. The increased efficiency in the health care system could

also save billions of dollars[3]. Canada is among the top 11 of 44 countries as reported in OECD findings for health care spending. However, this has not necessarily translated into better access to care. On average, 20.6% of all OECD countries reported forgoing care due to limited availability. Canada reported 19% of its population being in this situation[4].

Other sectors have been successful in the adoption of technology. Education, banking and finances, media and aviation have all harnessed the opportunities to improve services with the use of technology. Incorporating technology was not done overnight in these sectors. Coordination was necessary on many levels, but nonetheless it's integration into these systems is by far stronger than has occurred in healthcare [3]. Incorporating technological innovation into healthcare will require a shift in current culture, and a system receptive and sensitive to changes. Changes to current cultures, habits and attitudes will need to occur in a variety of stakeholder groups. First and foremost is the institution of health care itself. It was created in the pre-digital era and holds fast its long-established norms. It tends to remain static and resistant to change[3]. Health systems are 'data rich and information poor', leaving an untapped potential. The fragmentation of healthcare systems and siloed mentalities make it difficult to reform[3]. A digital transformation will require leadership and policy action. This leadership will allow for a complex, system-wide shift to occur, resulting in an effective, efficient and people-centered health care system[3].

For the purpose of this report, health technology and innovation will be defined with the all-encompassing definition of digital health in mind[5]. Digital health is "the electronic collection and compilation of health data, decision support tools and analytics with the use of audio, video and other technologies to deliver preventive, diagnostic and treatment services that promote patient and population health" [6 p.2] . It is an umbrella term and further definitions of terminology and technologies related to health care can be found in Appendix A and B, respectively.

Methods

A search of relevant literature was undertaken from government websites, grey literature, and peer reviewed research articles. A total of 73 articles were identified. A variety of search engines and electronic databases were used, including CINAHL, Cochrane Library, PubMed and Google Scholar. Search terms included innovation, health technology, virtual care, digital health, health technology procurement, health technology policy, older adults, aging, seniors, adoption, scale and spread of technology healthcare.

Overview of Canada's healthcare system and the incorporation of technology
Adoption, Spread and Scale

Canada's healthcare system has been described not as a single system, but as 14 separate systems, creating a constrained policy context[7]. The federal, provincial, and territorial systems have been described as "mega silos", each having smaller silos that do not necessarily communicate with each other[8]. This lack of alignment and integration leads to challenges in the scale and spread of innovation across the country[7]. Indeed, former health minister, the Hon. Monique Bégin, has described Canada as a country of 'perpetual pilot projects"[9]. Pilot projects are necessary and encouraged for research and development. Identifying nuances are important and re-evaluating challenges before they are unleashed on a wider scale is necessary. However, there needs to be the right infrastructure in place for technologies to be further developed and adopted[8].

Adoption and the subsequent scale and spread are the last hurdles for any technology to become a part of everyday practice in the current health care system or in one's own

personal daily routine. Adoption may not come to fruition for a variety of reasons. The purpose of the technology may not be appropriate for the intended population, the end-user may not be able to maneuver its components, or the monetary constraints imposed, either by purchasing the technological tool itself or the software/internet associated costs, may limit the ability of a patient to afford it. One other reason may be that service design has not been considered when developing the technology. Service design is not specifically about the technology but related to the results the technology may bring to change in service process and provision[10]. It is most successful when it results in achieving the quadruple aim in healthcare, which is to: (1) improve patient and caregiver experience; (2) improve the health of populations (3) reduce healthcare expenditures (4) improve the clinical/professional experience[11]. Service design is then described as using the technology as an instrument to achieve these goals[10].

Adoption can occur as a result of a "technology-push" or from a "demand-pull" of those who will use it or benefit from it. For instance, a technology push is when a technology developer comes to an intended stakeholder group after the technology has been developed and a negotiation ensues with a decision maker who will likely not interact with the product regularly[10]. When clinicians/patients or other stakeholders identify a need and seek to identify an already-developed solution, this can be described as a "demand-pull" scenario. The latter situation may result in better adoption, as they have already identified a challenge and are looking to adopt service changes to solve the challenge they have identified as needing to be addressed[10]. Either scenario, however, may still not achieve the most desired outcome and could benefit from a systematic process to ensure the correct tool is being incorporated into the proper situation[10].

This leads to the notion of "scale and spread", two terms that are often used interchangeably but are different concepts. Both are involved in increasing use of a strategy that is noted to be beneficial in some way. Where they differ is in their implementation. For

instance, spread can be seen as the horizontal dispersion of best practices. It is most likely facilitated at a local level, recognizing contextual nuances and leveraging local energy to assist in the diffusion of the process or tool of interest[12]. In this sense, it's proliferation is "smaller". Scale (or scale up) can be described as simpler in its implementation and thus can be "larger". Vertical and more authoritative means are sufficient by using the alteration of policies, funding strategies and regulations to implement and support the best practice in question by providing structural support required to develop it and most importantly, sustain its existence[12]. So choosing strategies to spread or scale depend on the complexity of the desired change. Innovations that require high-adaptability or a deeper understanding of local and contextual issues will need strategies of spread. These require a longer period for change to occur with momentum building over time. Innovations that can occur in a linear manner, with few core components and low need for adaptability are more amenable to strategies of scale. This allows top-down authoritative actions to result in a change in practice. It is important to note both require engagement with all relevant stakeholders for them to be truly effective[12].

Adoption Readiness in Healthcare

With new technological innovation in some sectors of the health care system comes potential consequences for other sectors. With the advent of virtual primary care, for example, comes potential additional strain on emergency room services; when primary care, physicians need to physically examine or manipulate a patient, but cannot, they may recommend they access urgent care, which leads to an increase in low acuity patients at the emergency room and increased wait times.

In Canada, steps have begun to address some of these challenges through engagement. The Advisory Panel on Healthcare Innovation met with stakeholders across the country, including many citizens, on how best to move forward in incorporating health

innovation into the current system. Among its most prominent findings were that stakeholders are making changes to ensure budgets and services are being integrated in a way to best suit patient's needs, but siloed bodies are impeding patient-centered care. It also found, given Canada's huge landmass and widely dispersed population, gains in telehealth should continue and indeed should lead the world in virtual care[13]. This would not only help address issues in healthcare access but would serve to assist in addressing economical inefficiencies in healthcare, as well as lowering costs incurred for travel for all parties involved, thus potentially having a positive impact on the environment. Patients could decrease the need to take time away from work to travel to a location to access a healthcare service, and healthcare professionals could reach a wider patient population through digital health mediums[14]. Physicians are being underutilized in the current mode of funding and organization of healthcare. Related to this, multi-disciplinary teams should continue to expand to provide a more holistic form of care for the patient, using all available healthcare professionals to their full capacity. Funding reforms could lead to better scaling and spreading of innovation[13]. This appears to be supported by physicians as well.

Physicians have poised themselves to anticipate the incorporation of more digital services. The Canadian Medical Association held a health summit to discuss virtual care and released a discussion paper looking at challenges into making virtual care mainstream in Canada[6]. Subsequently, a virtual task force was established by the Canadian Medical Association (CMA), the College of Family Physicians of Canada and the Royal College of Physicians and Surgeons. They received input from patients, families, and caregivers to discuss challenges and make recommendations in expanding the role of virtual care in Canada[15]. They followed this report a month later with a virtual playbook for physicians, outlining how physicians across the country might better incorporate virtual care into their practices[16].

Currently, the slow pace of reform in physician payment models means most innovation involving physicians providing virtual care is developing in the private, non-insured sector, outside of provincial medicare plans[15]. The 3 main bodies that represent physicians agree those jurisdictions that employ alternate payment models can integrate virtual care and other technologies seamlessly. The challenge is in the fee for service payment model, which is a long-standing pillar in Canada's health care system. They also realize modifications to renovating this payment model is a long-term process and one which may be met with resistance. They recommend developing fee schedules that result in equal payments regardless of if they are in person or done digitally. They also recommend the various bodies that oversee health system change to further develop the incorporation of virtual care and to support physicians in being able to participate in these improvements[15].

Barriers to change

Barriers to adoption of technology innovation into healthcare in Canada is multifactorial. Some of these have been discussed, such as the fragmentation in the system and lack of using all healthcare professionals to their full potential. Others include inadequately using the data that is available in Canada's volume of information that is collected; lack of deployment of digital technology; an inadequate understanding and optimization of innovation and a risk-averse culture[13]. Having a risk-averse culture in health care is viewed as necessary when lives are at risk and mistakes can be fatal[13]. However, lack of action can be equally detrimental. Canada's current procurement system usually involves acquiring and adopting technologies that are most cost-effective and not necessarily value driven. It is generally an administrative endeavour involving blind, competitive bidding to ensure fairness[7]. However, by definition, innovative technologies are pioneers in their realms and may not have comparators by which to be judged upon. Policies that focus on short-term cost savings without proven long term results that may be realized by these innovations[7] has led to Canada being behind in the global market of procurement policy

innovation, ranking 68 out of 137 in the Global Competitiveness Index of Government of Procurement of Advanced Technology[17].

Changes are starting in procurement strategies. The development of value-based healthcare initiatives has begun to gain favor among some decision makers. These focus heavily on patient outcomes relative to the cost of those outcomes[18.] This means long-term outcomes are of importance, rather than short-term gains, with evaluations of healthcare products and services based on healthcare outcomes and not just on the cost of the service or product[18,19]. After the development of the Digital First Strategy in Ontario [20 1], a new form of value-based healthcare was developed with the Innovative Procurement Systems (IPS). Here, the procuring organization focuses on understanding a problem, the stakeholders impacted and the healthcare outcome to be achieved, rather than the cost alone. These do carry higher risk than traditional procurement strategies, as the solution is not known at the outset. The challenge is identified, there is strong collaboration between procurement experts, vendors, clinicians and, if applicable, patients and with time, a solution is identified. Despite the potential for more time and funding required to develop the solution, the result is a more robust, clinically relevant and cost-effective product or service. Those who will need to change their clinical practices may also have more buy-in due to their heavy involvement in developing the solution[19]. In the current system, IPS strategies likely exist in a small space, where they may only be applicable in approximately 5% of procurements, simply due to being resource intensive and incurring more risk. However, with increasing use, it may become a more streamlined process, allowing it to become a standard in procurement strategies[19]. To better integrate this form of procurement to align innovation efforts, it has been suggested that a system-level definition of innovation is needed, organizational roles need to be identified and a greater focus on patient experience needs to be considered and funding strategies must evolve in order to accommodate the adoption of a new innovation into the healthcare system[18].

Covid-19 catalyzed a shift

The arrival of COVID-19 necessitated the need to begin a shift in providing more virtual healthcare services. Virtual care can be an e-visit between the patient and their regular care provider, or it can be a contact between a new patient and provider, as in a virtual walk-in clinic. The uptake of these services initially inspired by infection control for the public can assist those who have immune-compromised systems who do not wish to expose themselves to other potential illnesses, as well as can be beneficial for those who may have mobility challenges that prevents them from leaving their home easily. It can also be useful for those who have a contagious illness, thus decreasing the risk of spread to others[21].

Prior to the arrival of COVID-19, there was an interest among Canadians to increase the use of digital health mediums for various aspects of their health. They were interested in accessing their own medical records, such as lab results or having access to e-visits. With the increased use nationally of EHRs, many Canadians were able to access their records, however the ability to access an e-visit was trending downward, meaning fewer Canadians were able to do so (Canada Health Infoway, 2018). By accessing various services digitally, both the patient and health care system benefited. Patients reported saving time, money and being better able to manage their health through the use of digital health services. Furthermore, they reported they did not need to seek additional care in the form of walk-in or emergency department visits, among other services[22]. As a result of the COVID-19 pandemic, more have realized the positive impacts the adoption of such services can have. The Canadian Medical Association, however, does have guidelines advising physicians on services that might not be best delivered through digital services. Such things that may require physical examination and include new and significant emergency symptoms, ear pain, abdominal pain, musculoskeletal injuries and congestive heart failure[16].

Digital health technology's place in New Brunswick

In New Brunswick, efforts prior to COVID-19 had begun to address the need for digital innovation. Digital New Brunswick was put forth in 2018 as a strategy to streamline GNB services and make New Brunswick the first digital society in North America[23,24]. This strategy was created in consultation with employees of various GNB departments, school districts, health authorities, private sector representatives, students and citizens of New Brunswick. The result was more than just a technology plan, it was a strategy aimed at transforming the way technology is incorporated into GNB services[23,24]. The goal was aimed at addressing 7 main areas, including business and technology modernization, enterprise risk management, increasing cyber-security and increasing skills of the people using the technology [24]. Areas of challenge included how information currently tends to be siloed from other departments, creating inefficiencies in communication. Duplication occurs as departments tend to create services according to their own mandates, not as a whole system. Information systems are outdated and need to be updated, there is low availability of online services, improvements in cybersecurity need to occur, and finally, digital literacy needs to be increased among employees and New Brunswickers in general[24].

These challenges echo those identified in the healthcare technology sector as well. The Digital New Brunswick strategy has components of the health care system, but much is yet to be developed in policy for healthcare technology incorporation in New Brunswick. The government had already begun efforts to incorporate elements of the EHR into the system, which has been receiving information since 2010. This system allows authorized health care professionals to easily access a patient's clinically relevant information. Included are demographics, lab test results and diagnostic imaging reports and pharmaceutical summaries. It has proven useful in improving communication among health care professionals when assisting any given patient[25].

The 2018-2019 annual health report indicates the government is committed to developing a dependable public health care system, looking to improve access to health care and build a safe, sustainable system[26]. Specific mention for technology expansion in the health system is not indicated in this report, however with the arrival of COVID-19, changes have begun. Effective March 24, 2020, physicians were granted the ability to bill for virtual consultations done over the phone or with secure digital media[27], and these were extended in July of 2020[28]. Most recently, CanHealth announced a partnership with Horizon Health in an effort to adopt innovative health care solutions as identified by user-defined needs[29]. CanHealth is an initiative originally launched in Ontario that aims to bring together leading health care organizations with companies across Canada. The Network works to bring new solutions and assist businesses in scaling these solutions nationally and internationally. They assist in removing barriers by demonstrating the value of a company's technology; fast-track procurement using existing guidelines and create an integrated marketplace to allow for scale to occur rapidly[30]. This is an exciting opportunity for New Brunswick, allowing local issues to be addressed in a transparent way and bring them to marketplace[29].

Indeed, prior to the pandemic, New Brunswickers were already having issues with accessing timely health care services. A survey done in 2017 showed 70,000 New Brunswickers, or approximately 10% of the population, were using the emergency department as their regular point of care. Of those, 55,000 described themselves as having a family physician. Thus, lack of a family physician is not necessarily a reason people access the emergency department as their first point of contact [31]. The most common reason cited by these people was that they were unable to access their own family physician in a timely manner. This undue stress on an already over-burdened emergency department leads to increased costs, an increase in ER wait times and challenges in continuity of care. A goal of increasing access to the physician they have rather than adding more physicians might prove more effective[31].

Using technology may be a way to increase accessibility, and New Brunswickers seem ready to welcome this additional service model. In a recent phone survey, it was found 77% of New Brunswickers supported the continued use of virtual care after COVID-19 measures are removed, and 4 out of 10 had used virtual care during the pandemic, with an overwhelming 90% satisfaction rate[32].

Considerations

It is evident that the success and challenges to the incorporation of technology into healthcare and the health and well-being of older New Brunswickers is multi-factorial. In moving forward, careful consideration should be taken to ensure the same challenges identified in the broader development of technology are respected when developing policies for digital health technologies in New Brunswick. In addition, the anticipated risks, and consequences of implementing technological interventions or practices should be addressed at the outset to avoid issues such as patients being redirected to the emergency room to receive in person consults and care. Special care should be taken to ensure equity of services and access remains for all, including vulnerable populations who may not have access to the internet or computer and/or smart devices, those who may not have access to reliable internet, such as exists in rural locations and for those whose digital literacy may be lower[15]. Given health care is a unique and complex sector, considerations specific to technology expansion should be taken, but an opportunity is currently present: developing responsive policies aimed at incorporating technological advancements will serve the patients, health care professionals and the New Brunswick health care system as a whole.

Appendix A: Terminology

TERMINOLOGY	Description
Innovation	The Organization of Economic Cooperation and Development (OECD) has recently defined innovation as the implementation of a new or significantly improved goods or service. It may also be a new or significantly improved process, borrowed from another industry; a new marketing or communication method or a new organizational method. It is implemented either in the business industry, workplace organization or in external relations[33]. Health technology is discussed in similar terms as defined by the WHO. It is "the application of organized knowledge and skills in the form of devices, medicines, vaccines, procedures and systems developed to solve a health problem and improve quality of lives"[34]. Both describe improvements in a given sector using either new solutions or pre-existing solutions that are applied in a new environment.
Digital Health	Digital health is "the electronic collection and compilation of health data, decision support tools and analytics with the use of audio, video and other technologies to deliver preventive, diagnostic and treatment services that promote patient and population health"[6]. It is an umbrella term where the terms described below are components of digital health.
eHealth	eHealth is defined as "cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research"[35]. This includes numerous health care tools that incorporate technology. Electronic health records, virtual care (including telehealth, which is made up of teleradiology and remote patient monitoring, among others), mHealth, eLearning, social media, health analytics and big data, and legal frameworks that address privacy concerns, access to one's health record, and policies or legislation

	that defines medical jurisdiction, liability or reimbursement[36] are components of eHealth, and of the broader term "digital health".
Electronic health records (EHRs)	Electronic health records (EHRs) are real-time, patient centered health documents that provide information pertaining to the person's health. They will provide information to authorized persons regarding the persons current status, medical history, diagnosis and treatment and test results[36]. In New Brunswick, the electronic health record started with the vision of "one patient, one record"[25]. It has one point of access available at any time for authorized individuals and contains the individual's clinical data repository, the NB Drug Information System, Diagnostic Imaging Repository, and electronic medical record which is installed at the physicians office. This centralized access point can improve patient care by accessing relevant information in a rapid, comprehensive manner[36].
Virtual Care	Virtual care, also described as telehealth in some areas, can be described as any interaction using any form of communication or information technology with a patient or anyone in their circle of care. It occurs remotely as a means of reducing or replacing in-person interactions with the goal of maximizing quality and effectiveness of patient care[15,37].
mHealth	mHealth (or "mobile health") is a component of eHealth and involves the provision of health services and information via mobile technologies, or portable devices such as mobile phones, tablet computers and Personal Digital Assistants (PDAs)[36]. It can be used for diagnosis and management of health, as well as promoting positive aspects of general health, well-being and fitness[38]. It has been used in a variety of settings, from health call centers, emergency number services, to hospitals and community/home settings. It has allowed a variety of members in the healthcare circle, professionals, patients and caregivers, to actively participate in both the development, consumption, and provision of healthcare services[36].
eLearning	eLearning is the use of digital health technologies to advance knowledge in the form of training and education for various health care team members. It can be used to make health sciences learning available to a broader

	audience as it can break down physical geographical barriers. It can improve universal access to health care by improving the knowledge and skills of current health care members, as well as increase the demand to supply new health care workers to any given field[36]. It can also be used to improve current health care workers' understanding of how digital health can make positive contributions to the overall health care system and how to better identify reliable, relevant and accredited forms of online information sources[36].
Digital Health Literacy	Related to eLearning is the notion of digital health literacy. Those who are at risk of decreased health literacy are at equal and perhaps greater risk of being vulnerable due to lower digital health literacy[39.] Health literacy is the ability to access, process and comprehend basic health information and services. Limitations in this ability can lead to decreased health outcomes[39]. Digital health literacy is equally defined as being able to appraise digital forms of health information to assist in making health-related decisions. It thus incorporates health literacy but adds the additional skills of being able to access and use computers and related technologies[40]. The need to increase digital health literacy is necessary to ensure positive health outcomes for the individual and population as a whole are achieved. Improving digital health literacy and health care professionals' knowledge on how to use digital health technologies could lead to building capacity and sustainability into eHealth[36].
Social Media	Social media has removed some barriers to health information by providing a space for informal, at times anonymous, exchanges between individuals with other individuals, or with physicians and other health care providers[36]. It can be in the form of social networking sites, blogs, online communities or discussion forums, all of which may or may not be anonymoous[41]. In Canada, as of January 2020, there were 35.32 million internet users, and 25 million, or 67%, were users of some platform of social media[42]. It was equally found that as of April, 2020, most social media was accessed by those between the ages of 18-24. The most common platform was Facebook, and a total of 76% of those surveyed over 55% indicated they had a Facebook account and 72% of these reported to use it at least once monthly[43]. From there, social media usage declines markedly in those 55 and older, with the next most common platform (messaging apps) being used by 51% of the total group. Youtube was next most common and only 43% of those 55 and older used this medium[43]. Social media has the potential to inform those seeking information at a time of need and empower them with resources and knowledge. It can be a source of factual information, of peer support or as a means of finding

	information to help a loved one[41]. During times of the pandemic, social media can be informative and assist in public health measures in messaging about masks, proper hand washing and physical distancing measures [41]. However, it is also poorly regulated, privacy is not always ensured and care must be taken to ensure information is accurate and reliable[41,44].
Digital behavior change interventions (DBCIs)	Digital behavior change interventions (DBCIs) are a subset of eHealth, defined as "a product or service that uses computer technology to promote behavior change," which can be delivered through computer programs, websites, mobile phones as text message, smartphone apps, or wearable devices[45]. DCBIs have the potential to affect positive changes in healthcare professionals, patients and or the general public alike, but can equally be detrimental should the information provided be incorrect, unsecure, undermine behaviors or be used when other interventions are more effective[45]. They can be delivered via mHealth tools, or other digital formats[45].
Health analytics/big data	Health analytics and big data has been used in Canada since the development of Medicare. Statistics gathered with hospital admissions and physician billing claims were used to advise decision makers on population health issues. In the 1970s and 80s, household surveys were developed to further compliment this information. Today, electronic medical records, social media, and genetic databases are all able to contribute to this form of eHealth information[37]. Big data and health analytics are broad terms used to describe data sets that are larger and require systems to process that operate at a higher capacity than is typical. They generally require distributed databases and advanced methods of analysis[36]. Big data has been described as having 3 components: volume, velocity and variety. Volume is the amount of information about an encounter and its characteristics. Velocity refers to the speed information can be generated and gathered and variety is the type of both structured and unstructured data that is obtained in the healthcare system[37]. Health analytics are often used when discussing big data and refers to the computational techniques used to analyze the data. Big data has been used in preventative medicine, public health, artificial intelligence and others[37].

The "internet of things" (IoT)	This is used to describe the collective of "wearables" or "smart" devices that collect and generate data. These range from watches that are used to monitor patient falls or those with dementia and various movements (sleep patterns, GPS location) or to bathroom scales and pedometers. The term intelligent clothing has also been used to describe clothing that has a sensor to monitor various bodily systems, such as measuring volumes of blood in oxygen or one's heart function[37].
Wearables	Wearable, non-implanted monitoring devices have been used by many health enthusiasts and are now being adopted by health practitioners to assist in gathering information outside the clinic setting. They can be classified into one of 3 categories: mechanical, physiological and biomedical. They can monitor a range of health conditions, providing information on glucose levels, gait disturbances and even neo-natal data on heart rate. They can be in the form of watches, patches, shoe implants, among other configurations[46].

Appendix B: Technology

TECHNOLOGY	Description
Health Apps	These generally fall under the category of mHealth techonology and are used in promoting physical fitness and healthy living; facilitating remote monitoring; used in health information or as diagnostic aids[37].
Robotics	This is used to describe "a machine that can carry out a complex series of actions automatically, especially one programmable by a computer" [37 p. 17].
3D printing	This is the process of successively laying down various thin layers with the culmination in a 3D object [37].
Nanotechnology	This is "the science and engineering involved in the design, synthesis, characterization and application of materials and devices whose smallest functional organization in at least one dimension is on the nanometer scale (one billionth of a meter)." [37 p.18]. It is generally used in pharmaceuticals and regenerative medicine[37 p.18].
Augmented Reality (AR)*	This is "a technology that superimposes a computer-generated image on a user's view of the real world, thus providing a composite view"[37 p. 19].
Virtual Reality (VR)*	"the computer-generated simulation of a three-dimensional image or environment that can be interacted with in a seemingly real or physical way by a person using special electronic equipment, such as a helmet with a screen inside or gloves fitted with sensors." [37 p. 19].
Blockchain Technology	is a term currently used to describe a financial payment system that uses a series of signatures in an electronic ledger to make transactions, such as the case in "Bitcoin". To date, this technology has been mostly reserved to the financial system, however in 2016, the US Office of the National Coordinator for Health Information

	Technology called for submissions using blockchain technology in the application of electronic health records. Estonia currently uses blockchain technology to secure EHRs for all 1.3 million of its citizens. In Canada, Peterborough, Ontario's Public Health Department with Health Space Data Systems in an effort to transmit inspection reports using blockchain technology[37.]

*Both AR and VR have been used in surgical application, medical training and even pain management (CMA, 2018, p. 19).

References

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[1] Gibbard, R (2018). Meeting the care needs of Canada's aging population. Conference Board of Canada, Ottawa. https://www.cma.ca/sites/default/files/2018-11/Conference%20Board%20of%20Canada%20-%20Meeting%20the%20Care%20Needs%20of%20Canada%27s%20Aging%20Population%20%20%281%29.PDF

[2] Doty. M., Tikkanen, R., Shah, A., & Schneider, E. (2019). "Primary Care Physicians' Role in Coordinating Medical and Health-Related Social Needs in Eleven Countries," Health Affairs,published online Dec. 10, 2019. https://www.commonwealthfund.org/sites/default/files/2019-12/PDF_2019_intl_hlt_policy_survey_primary_care_phys_CHARTPACK_12-10-2019.pdf

[3] OECD (2019), Health in the 21st Century: Putting Data to Work for Stronger Health Systems, OECD Health Policy Studies, OECDPublishing, Paris, https://doi.org/10.1787/e3b23f8e-en

[4] OECD (2019), *Health at a Glance 2019: OECD Indicators*, OECD Publishing, Paris, doi: 10.1787/4dd50c09-en.

[5] World Health Organization (2015). Frequently asked questions on Global Task Force on digital health for TB and its work. https://www.who.int/news-room/q-a-detail/tuberculosis-global-task-force-on-digital-health

[6] CMA Health Summit (2019). Virtual care in Canada: discussion paper. https://www.cma.ca/sites/default/files/pdf/News/Virtual_Care_discussionpaper_v2EN.pdf

[7] MacNeil M, Koch M, Kuspinar A, Juzwishin D, Lehoux P, Stolee P. Enabling health technology innovation in Canada: Barriers and facilitators in policy and regulatory processes.

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Health Policy. 2019 Feb;123(2):203-214. doi: 10.1016/j.healthpol.2018.09.018. Epub 2018 Oct 12. PMID: 30352755.

[8] CMAJ (2018) Canadian healthcare lacks culture of innovation. 190:E1089-90. doi: 10.1503/cmaj.109-5655

[9] CMAJ (2009). A country of perpetual pilot projects. 180 (12) 1185; DOI: https://doi.org/10.1503/cmaj.090808

[10] Shaw, J., Agarwal, P., Desveaux, L., Cornejo Palma, D., Stamenove, V., Jamieson, T...Bhattacharyya, O. (2018). Beyond "implementation": digital health innovation and service design. *Npj Digital Medicine 1(1):* 1-5. DOI: 10.1038/s41746-018-0059-8

[11] Valaitis, R.K., Wong, S.T., MacDonald, M., Martin-Misener, R., O'Mara, L., Meagher-Stewart, D., ...Savage, R. (2020) Addressing quadruple aims through primary care and public health collaboration: ten Canadian case studies. *BMC Public Health* 20: 507. https://doi.org/10.1186/s12889-020-08610-y

[12] Shaw, J., Tepper, J., & Martin, D. (2018). From pilot project to system solution: Innovation, spread and scale for health system leaders. BMJ Leader 2. DOI: 10.1136/leader-2017-000055

[13] Advisory Panel on Healthcare Innovation launches consultation and engagement activities: Guidelines for stakeholder input (2014). Ottawa: Health Canada. December 8. Available from: https://www.canada.ca/en/health-canada/services/health-care-system/advisory-panel-healthcare-innovation.html

[14] Philpott, J. & Bhattacharya, O. (2019). Canada falls behind in healthcare technology. Maclean's magazine. https://www.macleans.ca/opinion/canada-falls-behind-in-healthcare-technology/

[15] Canadian Medical Association, College of Family Physicians of Canada, and Royal College of Physicians and Surgeons of Canada, Virtual care recommendations for scaling up virtual medical services: report of the virtual care task force. 2020, Canadian Medical

Association. https://www.cma.ca/sites/default/files/pdf/virtual-care/ReportoftheVirtualCareTaskForce.pdf

[16] Canadian Medical Association . Virtual Care Playbook. 2020. Available at: https://www.cma.ca/sites/default/files/pdf/Virtual-Care-Playbook_mar2020_E.pdf

[17] The World Bank (2017). Government of procurement of advanced tech products. Accessed March 2, 2021. https://tcdata360.worldbank.org/indicators/hcc3bda79?country=CAN&indicator=606&countries=BRA&viz=line_chart&years=2007,2017

[18] Desveaux, L., Soobiah, C., Bhatia, S. & Shaw, J. (2019). Identifying and overcoming policy-level barriers to the implementation of digital health innovation: a qualitative study. *Journal of Medical Internet Research 21(12)*: DOI: 10.2196/14994.

[19] Corderre-Ball, A., Dalgarno, N., Baumhour, J., Zubani, V., Ko, I., vanWylick, R., & Fitzpatrick, M. (2020). An innovation procurement framework: a qualitative study. *Healthcare Management Forum 34(1):* 15-20. DOI: 10.1177/0840470420936718

[20] Government of Ontario (2016). Ontario Digital Service. https://www.ontario.ca/page/ontario-digital-service

[21] Hardcastle, L., Ogbogu, U. (2020). Virtual care: enhancing access or harming care? Healthcare Management Forum 33(6): 288-292. https://doi.org/10.1177/0840470420938818

[22] Canada Health Infoway (2018). Connecting patients for better health: 2018. https://www.infoway-inforoute.ca/en/component/edocman/3564-connecting-patients-for-better-health-2018/view-document?Itemid=101

[23] Government of New Brunswick (2018). Digital New Brunswick. https://www2.gnb.ca/content/gnb/en/corporate/promo/dnb.html

[24] Government of New Brunswick (2018). Digital New Brunswick: Strategy Document. https://www2.gnb.ca/content/dam/gnb/Departments/eco-bce/Promo/digitalnb/digital_new_brunswick.pdf

[25] Government of New Brunswick (2016). New Brunswick's electronic health record (EHR): an initiative of eHealthNB. https://hpspub.gnb.ca/EHR/Pages/Overview.aspx

[26] Government of New Brunswick (2019). Health: annual report 2018-2019. https://www2.gnb.ca/content/dam/gnb/Departments/h-s/pdf/en/Publications/AnnualReport_2018-2019.pdf

[27] Government of New Brunswick (2020). Department of health: Updates to temporary billing codes. https://www.vitalitenb.ca/sites/default/files/documents/medecins/updates_to_temporary_virtual_care_codes_for_consultations_march_24_2020.pdf

[28] Government of New Brunswick (2020). Department of Health: extension to temporary billing codes. https://www.vitalitenb.ca/sites/default/files/documents/medecins/2020_07_24_temporary_virtual_care_codes_extension.pdf

[29] Telegraph Journal (2021). $2.2 M program fuels development of Atlantic health-care technology.

[30] CanHealth (2020). About us. https://canhealthnetwork.ca/about-us/. Accessed September 2, 2021

[31] New Brunswick Health Council (2017). "Being Patient-Accessibility, Primary Health and Emergency Rooms. https://nbhc.ca/sites/default/files/publications-attachments/being-patient-en.pdf

[32] New Brunswick Medical Society (2020). New Brunswickers overwhelmingly support virtual health care. https://www.nbms.nb.ca/new-brunswickers-overwhelmingly-support-virtual-health-care/

[33] Bloch, C. (2007). Assessing recent developments in innovation measurement: The third edition of the *Oslo Manual*, *Science and Public Policy*, Volume 34, Issue 1, Pages 23–34, https://doi.org/10.3152/030234207X190487

[34] World Health Organization (2007). Sixtieth World Health Assembly, Geneva May 2007, WHA60.29, p. 106. https://www.who.int/healthsystems/WHA60_29.pdf?ua=1

[35] World Health Organization (2005). Fifty-eighth World Health Assembly, Geneva May 2005, WHA58.28, p. 121. https://apps.who.int/iris/bitstream/handle/10665/20378/WHA58_28-en.pdf;jsessionid=C32881C3FF17E1D075C365ADFA1ED826?sequence=1

[36] Peterson, C., Hamilton, C., & Hasvold, P. (2016). From innovation to implementation: eHealth in the WHO European region. WHO Regional Office for Europe, Copenhagen, Denmark. https://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf

[37] CMA (2018). The future technology in health and health care: a primer. Accessed January 21, 2021. https://www.cma.ca/sites/default/files/pdf/health-advocacy/activity/2018-08-15-future-technology-health-care-e.pdf

[38] Jogova, M., Shaw, J., & Jamieson, T. (2019). The Regulatory Challenge of Mobile Health: Lessons for Canada. *Healthcare policy = Politiques de sante*, *14*(3), 19–28. https://doi.org/10.12927/hcpol.2019.25795

[39] Smith, B., & Magnani, J. W. (2019). New technologies, new disparities: The intersection of electronic health and digital health literacy. *International journal of cardiology*, 292, 280–282. https://doi.org/10.1016/j.ijcard.2019.05.066

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[40] Norman, C. D., & Skinner, H. A. (2006). eHealth Literacy: Essential Skills for Consumer Health in a Networked World. *Journal of medical Internet research, 8*(2), e9. https://doi.org/10.2196/jmir.8.2.e9

[41] Zhao, Y. & Zhang, J. (2017). Consumer health information seeking in social media: a literature review. Health information and libraries journal. 34(4): 268-283. Doi: https://doi.org/10.1111/hir.12192

[42] Kemp, S. (2020). Digital 2020: Canada. https://datareportal.com/reports/digital-2020-canada

[43] Gruzd, A. & Mai, P. (2020). The state of social media in Canada 2020. Ryerson Social Media Lab, version 5. https://doi.org/10.5683/SP2/XIW8EW

[44] Sahni, H. & Sharma, H. (2020). Role of social media during the covid 19 pandemic: beneficial, destructive or reconstructive? International Journal of Academic Medicine. 6(2): 7-75. DOI: 10.4103/IJAM.IJAM_50_20

[45] Michie, S., Yardley, L., West, R., Patrick, K., & Greaves, F. (2017). Developing and Evaluating Digital Interventions to Promote Behavior Change in Health and Health Care: Recommendations Resulting From an International Workshop. *Journal of medical Internet research, 19*(6), e232. https://doi.org/10.2196/jmir.7126

[46] Dunn, J., Runge, R. & Snyder, M. (2018). Wearables and the medical revolution. Personalized Medicine 15(5): 429-448. DOI: 10.2217/pme-2018-0044Government of New Brunswick (2016). New Brunswick's Electronic Health Record (EHR), An intiative of eHealthNB. https://hpspub.gnb.ca/EHR/Pages/Overview.aspx