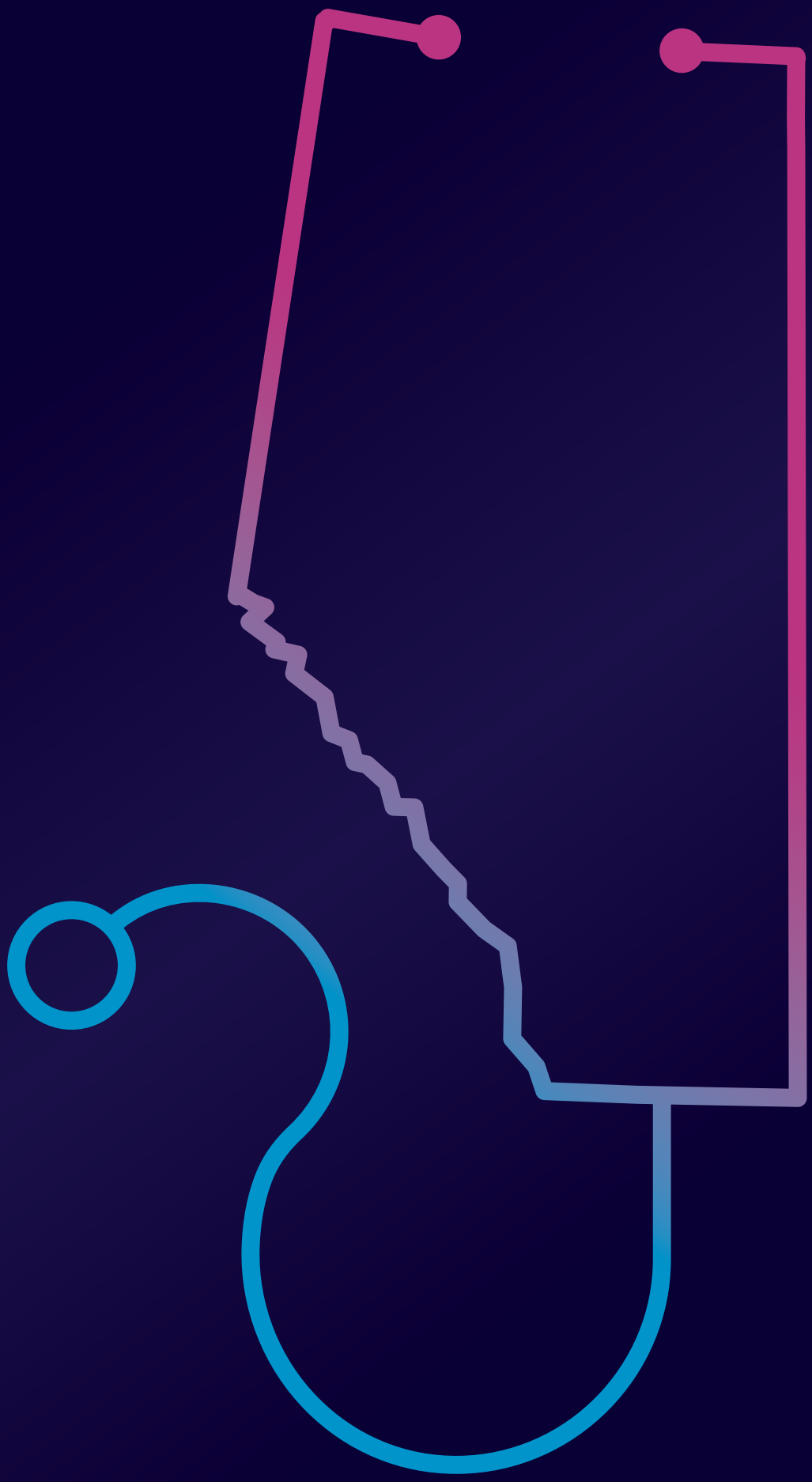

From Concept to Care

Health Technology Talent in Alberta

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Information and Communications Technology Council

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Preface

The Information and Communications Technology Council (ICTC) is a not-for-profit, national centre of expertise for strengthening Canada's digital advantage in a global economy. Through trusted research, practical policy advice, and creative capacity-building programs, ICTC fosters globally competitive Canadian industries enabled by innovative and diverse digital talent. In partnership with an expansive network of industry leaders, academic partners, and policymakers from across Canada, ICTC has empowered a robust and inclusive digital economy for over 30 years.

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Executive Summary

Digital health technologies like virtual care platforms and electronic health records have become much more familiar to Albertans and Canadians as a result of the COVID-19 pandemic. Over the past five years, Alberta has adopted technologies to manage emergency distance care while rolling out its electronic health record (EHR) unification project, Connect Care. At the same time, structural barriers to equitable access to technology-enabled health care persist, such as inadequate or unaffordable broadband infrastructure in remote and rural communities. In addition, the province's health care system has faced unprecedented pressure, including a shortage of primary care providers and an increase in continuing care needs.

Alberta's health care workforce plans include increasing the number of medical school seats in the province and streamlining international credential recognition, policies which can be monitored for effectiveness over the coming decades. One key pillar of the province's health care workforce plan is innovation. This includes finding opportunities to use health technology to improve the quality and accessibility of care and alleviate pressure on the medical system. Time-saving and task-saving health technologies can redistribute tasks more efficiently between health care workers, triage patient issues, improve health information continuity, and offer precise diagnostics, among numerous other applications.

While health care providers are now more accustomed to health technologies than they may have been prior to the pandemic, issues with adopting new solutions still exist. Change management and interoperability are complex aspects that need to be addressed within a large health care system. Furthermore, it is not a simple task for health care practitioners to find professional development time to acquire new digital health competencies, whether they are continuing care aides, allied health professionals, nurses, or physicians. Essential transferable digital health competencies include virtual care skills and health information management skills such as documentation in an era of EHRs, data analysis, informational continuity, and data privacy and security. Adopting such skills is not only about education but also about creating appropriate facilitating conditions, such as remuneration methods that adequately incentivize responsible digital adoption.

Alberta also has a strong health technology business ecosystem, with many companies connected to hubs at post-secondary institutions and local accelerators. Companies are piloting solutions in precision health and AI, remote patient monitoring, virtual care, and beyond. Many health technology companies based

in Alberta foster student talent through work-integrated learning (WIL) programs but face challenges finding mid-senior level business and technology talent. It can be hard to find seasoned entrepreneurs or market and regulatory experts in the health care domain. Alberta-based companies may find themselves competing both with the public sector (for workers with clinical experience) and with national or international technology and health technology companies (for workers with technical or business experience). For these roles, many businesses seek workers outside of Alberta and sometimes outside of Canada.

Health care innovation in Alberta is an integrated system: workforce development for both health technology companies and health practitioners relies on encouraging greater interdisciplinarity in post-secondary education. Several Alberta programs seek to address this gap by piloting health technology competitions and other programs that bring health care, technology, and business students together. In addition, retention and development of mid-senior talent in health technology depends on a critical mass of opportunities for those workers to stay in the province. These opportunities are typically supported by provincial initiatives like innovative public procurement, grant funding, and collaborative research and development.

Introduction

Jurisdictions across Canada, including Alberta, are experiencing health care workforce supply challenges, which are part of a global trend exacerbated by the COVID-19 pandemic.[1] National health spending grew significantly in 2020 and 2021 (13.2% and 7.8%, respectively), a pattern echoed to a lesser extent in Alberta, where health expenditures grew by 6.1% and 4.3% in the same years.[2] The acute crisis is over, but its impact on health care worker burnout remains, and Alberta is now facing a growing demand for continuing care to support its rapidly aging population.[3]

The pandemic also prompted significant changes in the way health care is delivered. Consumer and professional health technologies have become much more common across Canada.[4] Health technologies, such as virtual care platforms, electronic health records, home monitoring devices, precision health techniques, and other solutions, have the potential to alleviate some of the health care system's current burden. While the pandemic prompted the emergency adoption of tools like videoconferencing for clinical calls, health care systems now have an opportunity to capitalize on patient and clinician familiarity with health technologies and build purposeful and sustainable systems that improve quality of care and save time for health care practitioners.

Drawing from 39 in-depth interviews with health care companies, service providers, and policymakers, as well as a practitioner survey and an ecosystem scan,[5] this study asks how labour market demand intersects with health technology in Alberta. It examines the state of labour demand in health care in the province, as well as the digital health-related skills that health care practitioners increasingly require in their roles. It also describes the province's health care technology business ecosystem, who is being hired, and which roles are difficult to fill. It closes with commentary from health care experts about workforce development, including the role of post-secondaries, interdisciplinary health technology programs, and work-integrated learning.

Section I defines health technology and offers examples of health technologies that are already improving the quality of care, continuity of care, and access to care in Alberta. It closes with a case study that highlights the impact of a digital health application on patient wait times.

[1] Alberta Health, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy.
[2] Canadian Institute for Health Information, "National health expenditure trends, 2023 — Snapshot," November 2, 2023, https://www.cihi.ca/en/national-health-expenditure-trends-2023-snapshot.
[3] Alberta Health, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy.
[4] Lili Liu and Antonio Miguel-Cruz, "Technology Adoption and Diffusion in Healthcare at Onset of COVID-19 and Beyond," *Healthcare Management Forum* 35, no. 3 (May 1, 2022): 161–67, https://doi.org/10.1177/08404704211058842.
[5] See Appendix A for details.

Section II outlines the status of Alberta's health care practitioner labour force. It highlights examples of digital health competency frameworks before turning to an overview of the central transferable digital health skills practitioners need, according to research contributors.

Section III characterizes the health technology business ecosystem in Alberta, as well as technology workers in the health care sector. It describes in-demand roles and skills and focuses on hard-to-find talent and acquisition challenges.

Finally, **Section IV** offers conclusions related to workforce development, both for health care practitioners and for technology and business workers in health care domains.

SECTION I

What Is Health Technology?

According to the World Health Organization, health technology is "the application of organized knowledge and skills in the form of devices, vaccines, procedures, and systems developed to solve a health problem and improve quality of life."[6] In Canada, Health Canada regulates both medical treatments and digital health technologies, the latter of which includes software as a medical device (SaMD), telemedicine applications, mobile medical apps, and artificial intelligence for medical applications.[7]

Health technology also includes preventive, holistic, and mental health care tools, such as wearable activity and nutrition trackers, that users may employ to improve their quality of life outside of direct intervention from a health care practitioner. As Figure 1 shows, individuals interact with health technologies in their daily lives as well as in the health care system.

The infrastructure around health data also involves many health technologies. Consider, for example, all the technologies involved when a patient has a medical image taken and digitally stored, protected by privacy and cybersecurity systems, used to diagnose a condition, and de-identified for reference in medical research or training of future practitioners. The patient might also access their case notes through a virtual portal that requires secure identity confirmation.

Finally, research and training organizations may use a wide variety of technologies, such as a virtual-reality-enabled training tool for medical practitioners or an AI-enabled precision health tool. In short, from a smartwatch to the technologies that help a hospital manage its personnel files, a huge array of technologies interact to support health care.

[6] World Health Organization, "Health Products Policy and Standards," accessed February 1, 2024, https://www.who.int/teams/health-product-policy-and-standards/assistive-and-medical-technology/medical-devices.
[7] Health Canada, "Notice: Health Canada's Approach to Digital Health Technologies," April 10, 2018, https://www.canada.ca/en/health-canada/services/drugs-health-products/medical-devices/activities/announcements/notice-digital-health-technologies.html.

Figure 1: *Examples of Digital Health Technologies*

Most of these examples fall within a category of health technology known as "digital health." ICTC's analysis of health technology and the labour market in Alberta primarily focuses on digital health. This includes products or services leveraging digital technology as a significant part of their production or service offering but excludes manufacturing of medical cannabis, pharmaceuticals, and nutraceuticals. It also excludes the manufacturing of medical equipment and devices without significant involvement of digital technologies or precision health, such as the manufacture of personal protective equipment like surgical masks or hand sanitizer.

Digital health companies are an as-yet underexplored group within Alberta, whereas research characterizing the province's life sciences and pharmaceuticals industries has been done by organizations like BioAlberta. BioAlberta estimates that bio-health employment in Alberta will include approximately 11,300 workers by 2025.[8] BioAlberta's bio-health sub-sector "encompasses the invention, development, manufacturing, commercialization, and use of products that improve therapeutics, diagnostics, prevention and health administration, as well as the development and production of nutraceuticals and applications of medical cannabis."[9] Similarly, export development and investment attraction organization Edmonton Global counts 284 life sciences companies in the capital region alone.[10]

[8] BioAlberta, "BioAlberta LMI Study – Summary Report," *Prism Economics & Analysis and DPM Research,* September 2023, https://bioalberta.com/wp-content/uploads/2023/09/BioAlberta-LMI-Summary-Report.pdf.
[9] Ibid., p. 7
[10] Edmonton Global, "Health and Life Sciences," accessed March 28, 2024, https://edmontonglobal.ca/sectors/health-and-life-sciences/#ecosystem.

Why Do We Need Health Technology?

There are numerous applications of health technology: including developing new therapies and mobilizing consumer health technology for preventative care. The following examples are illustrative, but by no means exhaustive.

OPPORTUNITY #1

Expanding Access to Care

Health service provision in Alberta is challenged by its vast geography and low population outside of urban centres. Further complicating this challenge is a province-wide shortage of health workers. This is particularly felt in rural areas, where the shortage of workers has led to intermittent closures of emergency departments, acute care beds, and other services—in some cases, closure of entire programs.[11] In addition, health specialists tend to be concentrated in urban areas, making it difficult for rural patients to get in-person appointments without travel. One study looking at access to orthopedic surgeons and physiotherapists among people with osteoarthritis in Alberta found that the median travel time to reach an orthopedic surgeon was 11 times higher in rural, remote areas than in metropolitan areas and 26 times higher than in urban areas. The median travel time to reach a physiotherapist is also two times higher in rural, remote areas than in metropolitan areas and five times higher than in urban areas.[12] While travel costs can sometimes be reimbursed, hidden costs still apply:

> “ Telehealth appointments are hugely important, especially with the clients that I work with in rural places... There are areas that are fly-in or are very remote. To be able to support your health without having to leave your community is very important. It saves on out-of-pocket costs for clients: transportation costs, the need to take time off of work or school, childcare, those kind of hidden, indirect costs.
>
> *— Public Health Practitioner, Interviewee*

Many Albertans also experience barriers to accessing allied and other health services that can be provided virtually. For example, an interviewee working in mental health provision commented that virtual counselling was essential to serving isolated communities in the province. Of course, many health questions still require in-person appointments, but telehealth can triage many appointments away from settings requiring travel.

[11] Alberta Medical Association, “Rural Health Care,” April 21, 2023, https://www.albertadoctors.org/make-a-difference/initiatives/handle-with-care/rural-health-care.
[12] Xiaoxiao Liu et al., “Rural–Urban Disparities in Realized Spatial Access to General Practitioners, Orthopedic Surgeons, and Physiotherapists among People with Osteoarthritis in Alberta, Canada,” *International Journal of Environmental Research and Public Health* 19, no. 13 (January 2022): 7706, https://doi.org/10.3390/ijerph19137706.

Telehealth, Virtual Care, and Remote Patient- and Self-Monitoring

Telehealth uses communications technologies and medical technologies to deliver health services at a distance. Telehealth can include virtual consultations by phone or a videoconferencing service, or it can utilize remote patient monitoring (e.g., blood sugar, heart rate, and other indicators collected by devices).[13] **Virtual care** is often used synonymously with telehealth but typically refers more broadly to self-monitoring tools and personal health tools, as well as telehealth's more limited scope of clinical care delivered at a distance.[14]

Remote patient or home health monitoring is a type of virtual care in the early stages of adoption. Alberta Health Services' (AHS) Complex Care Hub pilot program gives patients hospital-level care from their homes through a virtual inpatient unit that provides users with a kit for monitoring blood pressure, oxygen saturation, temperature, and other vital signs remotely, uploading data to a physician web portal.[15] According to research contributors, remote patient monitoring is relatively new, and health systems should pay more attention to how they integrate it effectively into existing clinical workflows. For example, one interviewee raised the question of whether clinicians were expected to respond to questions from patients with self-monitoring devices in their homes at all hours of the day.

ADOPTION

The COVID-19 pandemic accelerated telehealth service provision throughout Alberta.[16] In the 2021 Canadian Medical Association National Physician Survey, 95% of Albertan respondents said they were currently providing virtual care options (94% telephone, 47% videoconferencing, 37% secure email/messaging, and 4% remote patient or home health monitoring).[17] Several research contributors felt that telehealth had made significant improvements to the quality of care in remote and rural Alberta, while others felt that more provincial investment was required for telehealth to reach its full potential.

Telehealth expands the possible locations from which patients can access care. It also expands the pool of practitioners who can provide care to Albertans. For example, virtual care can let a patient speak with an out-of-province specialist, so long as they are licensed by their professional organization in Alberta. To fully take advantage of virtual care's potential, several interviewees called for a national licencing system for health service providers, a recommendation that has also been made in the Canadian virtual care literature[18] and by the Competition Bureau.[19]

[13] National Institute of Biomedical Imaging and Bioengineering, "Telehealth," August 2020, https://www.nibib.nih.gov/science-education/science-topics/telehealth.
[14] Hari Eswaran et al., "Telehealth: Current Definitions and Future Trends," *The Rural Telehealth Evaluation Center (RTEC),* May 6, 2022, https://idhi.uams.edu/rtec/wp-content/uploads/sites/4/2022/05/Telehealth-Definitions-Paper-06MAY2022-1.pdf.
[15] Christine Harris, "'Virtual Hospital' Treats Patients in Comfort of Home," *Alberta Health Services,* November 17, 2022, https://www.albertahealthservices.ca/news/Page16981.aspx.
[16] Canadian Medical Association, "2021 National Survey of Canadian Physicians: Quantitative Market Research Report," *Canada Health Infoway,* August 11, 2021, https://www.infoway-inforoute.ca/en/component/edocman/3935-2021-national-survey-of-canadian-physicians/view-document?Itemid=0.
[17] Ibid.
[18] Will Falk, "The State of Virtual Care in Canada as of Wave Three of the Covid-19 Pandemic: An Early Diagnostique and Policy Recommendations," *Health Canada,* June 29, 2021, https://www.canada.ca/content/dam/hc-sc/documents/corporate/transparency_229055456/health-agreements/bilateral-agreement-pan-canadian-virtual-care-priorities-covid-19/template-wf-report-eng.pdf.
[19] Competition Bureau of Canada, "Empowering Health Care Providers in the Digital Era: Digital Health Care Market Study Report 3," November 11, 2022, https://ised-isde.canada.ca/site/competition-bureau-canada/sites/default/files/attachments/2022/04687-DHC-Market-Study-Part-3-Eng.pdf.

Telehealth and virtual care require adequate internet connectivity for widespread adoption. The 2022 Alberta Broadband Strategy noted that 67% of rural Albertans and 80% of Indigenous communities in the province lack access to reliable, high-speed internet at target speeds set out by the federal government.[20] The 2022 provincial strategy prioritizes fibre connectivity for communities close to cities, fixed wireless access, and low-Earth orbit (LEO) satellites to address this gap.[21]

Public digital literacy is another essential prerequisite for broad access to virtual care. Addressed throughout this study, public digital literacy is a two-way street that must be built through education campaigns and inclusive design. For example, one interviewee had built a digital health navigation portal that specifically sought to teach users about the variety of telehealth options available to them.

OPPORTUNITY #2

Improving Quality and Continuity of Care

High-quality health care is "safe, effective, efficient, equitable, timely, and person-centred."[22] Some health technologies are purpose-built to improve the quality of care for underserved communities or conditions. For example, Alberta-based Neuraura develops tools for precise diagnosis and management of polycystic ovarian syndrome (PCOS), a women's health condition that often goes undiagnosed.[23]

Continuity of care is a foundational concept in healthcare quality analysis. The point of referral—between a primary care provider and a specialist, for example—is often the most likely breaking point in a care plan.[24] Continuity of care emphasizes clear communication between health providers for patient safety.

In Alberta, the not-for-profit Greg's Wings was founded by the family members of Greg Price, who passed away in 2012 due to missed referrals that prevented Price from getting prompt diagnosis and care for cancer. Since then, the organization has pursued its mission of educating health practitioners and health system designers about continuity of care and patients' access to information.[25] According to a recent report by Alberta Virtual Care called *Interoperability Saves Lives,* a multi-organization working group found that the smooth and secure sharing of health data can improve patient safety, reduce costs, and contribute to equitable and timely health care services. These benefits are best achieved "through person-centric health data design."[26]

[20] Government of Alberta, "Alberta Broadband Strategy," 2022, https://www.alberta.ca/alberta-broadband-strategy.
[21] Ibid.
[22] Alberta Virtual Care Health Data Interoperability Working Group, "Interoperability Saves Lives," October 2023, https://www.albertavirtualcare.org/_files/ugd/efde1a_43101bc906434781a6d497cd576602c1.pdf, p. 12.
[23] Neuraura, "Home," accessed April 5, 2024, https://www.neuraura.com.
[24] Health Quality Council of Alberta, "Patient Perspectives on an Electronic Referral System for Alberta," January 2016, https://hqca.ca/wp-content/uploads/2021/12/E_Referral_Summary_Report_FINAL.pdf
[25] Greg's Wings, "Greg's Wings," accessed April 8, 2024, https://gregswings.ca/.
[26] Alberta Virtual Care Health Data Interoperability Working Group, "Interoperability Saves Lives," October 2023, https://www.albertavirtualcare.org/_files/ugd/efde1a_43101bc906434781a6d497cd576602c1.pdf, p. 12.

Electronic Health Records

Electronic medical records (EMRs) are used by clinicians to log data related to patient diagnosis and treatment. More holistically, **electronic health records (EHRs)** are built to share patient data across care providers to "contain information from all the clinicians involved in the patient's care."[27] EHRs enable the secure sharing of data between relevant parties, including patients themselves, and have been shown to reduce prescriber errors and free up administrative time.[28]

ADOPTION

Alberta Health Service's EHR system is called Connect Care, which launched in instalments in 2019. Connect Care is slated to connect all of Alberta's health facilities (including 106 acute care hospitals, 139 public health centres, 39 addiction facilities, and 331 long-term care and supportive living facilities)[29] by the end of 2024.[30] Patients can access their Connect Care health information through an online tool called MyAHS Connect.[31] Connect Care also offers toolkits and training for clinicians[32] and innovators,[33] addressing topics such as privacy and standards compliance.

Connecting all health services in Alberta to one EHR is no easy task. Many Albertan physicians operate as sole proprietors or within community clinics that are using their own EHR providers. Data interoperability is a priority for quality of care, and Alberta has been working to ensure that all EHRs in the province have a two-way connection.

To connect community clinic EMRs to Connect Care, Alberta has launched the Community Information Integration and Central Patient Attachment Registry (CII/CPAR) system. CII/CPAR connects EMRs to Alberta's centralized Netcare system (the province-wide database that bridges Alberta Health Services' Connect Care and other providers).[34] In 2022, the Alberta Medical Association and Alberta Health launched an acceleration grant designed to encourage adoption by compensating physicians for their time and the administrative burden of enrolling in CII/CPAR.[35] As of January 2024, 48% of physicians (65% of family physicians and 27% of eligible specialists) in Alberta had adopted the CII/CPAR.[36]

[27] Peter Garrett and Joshua Seidman, "EMR vs. EHR – What is the Difference?" *Office of the National Coordinator for Health Information Technology,* January 4, 2011, https://www.healthit.gov/buzz-blog/electronic-health-and-medical-records/emr-vs-ehr-difference.
[28] Denis Protti, "Missed Connections: The Adoption of Information Technology in Canadian Healthcare," C.D. *Howe Institute,* April 2015, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2587406, p. 2.
[29] "Alberta Health Services: Connect Care Update," (presentation, last updated February 23, 2023).
[30] Alberta Health Services, "Connect Care: Implementation Timeline," November 2023, https://www.albertahealthservices.ca/assets/info/cis/if-cis-cc-infographic-site-implementation-timeline.pdf.
[31] Alberta Health Services, "Patients and Families: Connect Care," accessed February 7, 2024, https://www.albertahealthservices.ca/cis/Page15448.aspx
[32] Alberta Health Services, "Connect Care Manual," accessed February 7, 2024, https://manual.connect-care.ca/.
[33] Alberta Health Services, "Connect Care Innovator Toolkit," 2022, https://innovators.connect-care.ca/home.
[34] Government of Alberta, "The Evolving EHR FAQs," *Alberta Netcare EHR,* accessed Feb 22, 2024, https://www.albertanetcare.ca/1373.htm
[35] Alberta Doctors, "What is CII/CPAR?" accessed February 22, 2024, https://actt.albertadoctors.org/cii-cpar/.
[36] CII/CPAR and Alberta Medical Association Accelerating Change Transformation Team, "CII/CPAR Provincial Monthly Statistics," January 22, 2024, https://actt.albertadoctors.org/media/ucsnddfy/cii-cpar-monthly-statistics.pdf.

Why is this complex interconnection of EMRs helpful? The CII/CPAR team features the following story from an Albertan Family Physician, Dr. Andie Bains:

> “A patient of mine presented to the ER with atypical chest pain. The team accessed Alberta Netcare… which is populated with information by CII/CPAR. They saw I had recently seen the patient for anemia, so they contacted me. We discussed how her angina was likely a result of the anemia. She received a transfusion at the hospital, avoiding a long wait for the procedure. **This shared information and communication among care providers created more efficient and optimal patient care.**[37]

Many research contributors were enthusiastic about the final implementations of Connect Care and CII/CPAR. One health practitioner and policymaker saw Connect Care as an opportunity to help Alberta adopt a “Learning Health System,” a US Institute of Medicine-coined concept[38] defined by the Agency for Healthcare Research and Quality as organizations that “systematically gather and apply evidence in real-time to guide care,” among other parameters.[39] However, many health care practitioners were frustrated by how Connect Care was rolled out, or faced difficulties integrating it into their workflow. The skills and facilitating conditions that support good use of EHRs are discussed in greater detail in Section II and Section IV.

OPPORTUNITY #3

Addressing Labour Shortages

Health care labour shortages are a worldwide issue.[40] As such, addressing health care shortages in any given jurisdiction demands greater innovation than simply attracting workers from other regions.[41] In Alberta, factors such as a high-stress work environment during the COVID-19 pandemic have led to a rise in “vacant clinical positions at Alberta Health Services from 9.9% in 2018 to 16.8% in 2022.”[42] Over the next three years, the predicted demand for nurses and other roles outstrips the projected number of new graduates from Albertan post-secondary health care programs.[43] Health technology tools have the potential to keep patients out of the health care system by enabling preventive care, facilitating faster virtual appointments, and reducing administrative overhead with triage tools.

[37] Alberta Doctors, “What is CII/CPAR?” accessed Feb. 22, 2024, https://actt.albertadoctors.org/cii-cpar/.
[38] LeighAnne Olsen, Dara Aisner, and J Michael McGinnis (Eds.), *The Learning Healthcare System: Workshop Summary,* Washington DC: National Academies Press, 2007.
[39] Agency for Healthcare Research and Quality, “About Learning Health Systems,” May 2019, https://www.ahrq.gov/learning-health-systems/about.html.
[40] Mark Britnell, *Human: Solving the Global Workforce Crisis in Healthcare* (Oxford University Press, 2019), https://doi.org/10.1093/oso/9780198836520.001.0001.
[41] Government of Alberta, “Health Workforce Strategy 2023,” March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy.
[42] Ibid., p. 11.
[43] Ibid., p. 17.

Health care labour shortages are disproportionately felt in rural areas. There are roughly twice as many nurses for every 1000 seniors in urban Canada than there are in rural Canada, and this disparity only grows when looking at the ratio of doctors per 1000 seniors.[44] Technology for health care can help download tasks from physicians and nurses to other types of care workers or, when necessary, to patients themselves.[45] For example, providing patients access to internet infrastructure and digital health tools for remote self-monitoring could help take some of the burden off rural and sub-acute service providers.[46] In addition, telehealth can be used in combination with in-person health in rural areas to manage human resources more efficiently and retain facilities despite labour shortages.

Artificial Intelligence and Precision Health

The cluster of tools and techniques broadly known as "artificial intelligence" (AI) has diverse and growing applications in health care. For example, in precision medicine, AI can assist health professionals in improving cancer recognition in medical imaging or in predicting the best treatment for a patient based on data from patients with similar attributes and contexts.[47]

Natural language processing (NLP) AI tools like speech recognition, translation, and analysis have applications for patient services (e.g., triaging patient inquiries in a health care mobile phone application).[48] NLP tools can also help transcribe client-practitioner sessions and populate an EHR by extracting data from unstructured physician notes, saving administrative time. One research contributor noted that Alberta Health Services was slated to begin integrating AI for improving documentation in early 2024. AI-based software has also been used to accelerate aspects of the drug discovery and development pipeline in biotechnology.[49]

AI tools for precision medicine, patient services, and other applications can help reduce the workload of health care providers, but they still require rigorous human oversight. As subsequent sections will show, precision health relies on accurate and rich patient data: attention to data quality is essential for precision health. Furthermore, some research contributors noted the importance of respecting First Nations data sovereignty in any health technologies that harvest data from province-wide EHRs.

[44] Ruolz Ariste, "Availability of Health Workforce in Urban and Rural Areas in Relation to Canadian Seniors," *The International Journal of Health Planning and Management* 34, no. 2 (November 27, 2018), https://doi.org/10.1002/hpm.2712.
[45] Mark Britnell, *Human: Solving the Global Workforce Crisis in Healthcare* (Oxford University Press, 2019), https://doi.org/10.1093/oso/9780198836520.001.0001. pp. 12-13.
[46] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy.
[47] Thomas Davenport and Ravi Kalakota, "The Potential for Artificial Intelligence in Healthcare," *Future Healthcare Journal* 6, no. 2 (June 2019): 94–98, https://doi.org/10.7861/futurehosp.6-2-94.
[48] Ibid.
[49] Rizwan Qureshi et al., "AI in Drug Discovery and Its Clinical Relevance," *Heliyon* 9, no. 7 (June 26, 2023): e17575, https://doi.org/10.1016/j.heliyon.2023.e17575.

ADOPTION

The University of Alberta is internationally recognized as a centre for reinforcement learning expertise,[50] building medical applications such as intuitive prosthetic limbs.[51] The Alberta Machine Intelligence Institute (AMII) is closely linked with the University of Alberta and is a central driving force for AI adoption and applications throughout Alberta. The University of Alberta also has cross-departmental collaborations, such as the former Precision Health Signature Area (PHSA), which used Alberta's unique advantages (including a unified EHR system) to develop and commercialize precision health tools while training future students.[52]

Research contributors in Alberta described their own precision health companies: one was developing a machine learning-powered tool to test the likelihood of prostate cancer being clinically significant, noting that their test could significantly reduce the number of unnecessary biopsies. Another was using wearable technology data to detect changes in health that might lead to preventive care, "for seniors, for instance, you could detect trends in gait analysis and predict a higher likelihood of a fall." In another example, Alberta researchers used machine learning for metabolic analysis to provide insight into pediatric Crohn's disease (pCD) pathogenesis and predict disease severity.[53] In return, these advanced analysis techniques powered by machine learning predictions support a better understanding of changes in host-microbe interactions and further enable the development of new diagnostic or therapeutic options for those suffering from pCD.[54]

[50] Catherine McIntyre, "Teaching Machine Learning at the University of Alberta," *Maclean's,* February 2, 2018, https://macleans.ca/education/ai-computer-science-alberta/.
[51] Britt Ayotte, "BLINC Lab Aims to Create More Intuitive Artificial Limbs," *Alberta Machine Intelligence Institute,* February 24, 2022, https://www.amii.ca/latest-from-amii/recommended-watching-blinc-lab/.
[52] University of Alberta Precision Health, "About: What is the Precision Health Signature Area?" accessed February 5, 2024, https://www.ualberta.ca/precision-health/about/index.html.
[53] R G Suarez Suarez et al., "Utility of Machine Learning for Serum Metabolomic Data Analysis in Pediatric Crohn Disease," *Journal of the Canadian Association of Gastroenterology* 5, no. 1 (March 1, 2022): 56–57, https://doi.org/10.1093/jcag/gwab049.175.
[54] Ibid.

CASE STUDY

Improving Wait Times in Alberta

When patients are referred by their primary care provider to a medical specialist, they often experience long and uncertain wait times. Most referrals in Alberta are still conducted by fax, and continuity of care can break down if patients have no ability to follow up or track their cases.[55] EConsult platforms seek to improve speed and accuracy in this process.

An international evaluation of wait times across peer countries shows that Canada lags peer nations.

Specialist Wait Times
Across Peer Countries

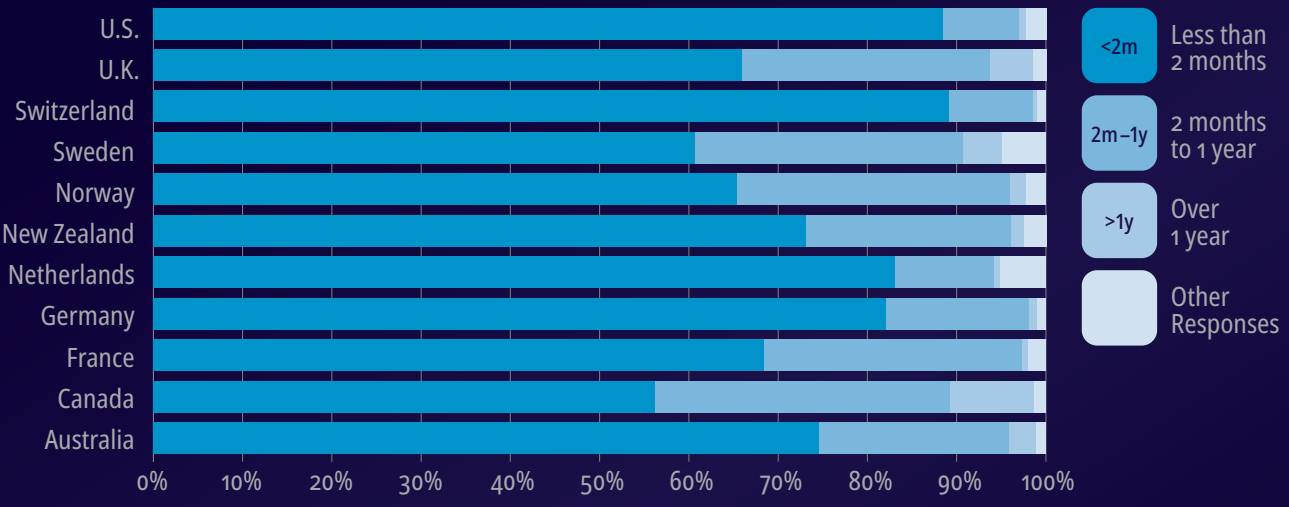


Figure 2: Data from the Commonwealth Fund Survey International Health Policy Survey 2020, CIHI Canada[56]

Not only does Canada have the fewest number of patients waiting less than two months, it has the highest number of people reporting waiting more than a year to see a specialist. Patient wait times vary by province as well; 23% of Nova Scotians report waiting more than one year to see a specialist, compared to 10% of Albertans.

[55] Health Quality Council of Alberta, "Patient Perspectives on an Electronic Referral System for Alberta," January 2016, https://hqca.ca/wp-content/uploads/2021/12/E_Referral_Summary_Report_FINAL.pdf
[56] Canadian Institute for Health Information, "Commonwealth Fund Survey, 2020," February 2021, https://www.cihi.ca/en/commonwealth-fund-survey-2020; Other responses include "Never tried to get an appointment," "Not sure," and "Declined to answer."

Specialist Wait Times
Across Provinces

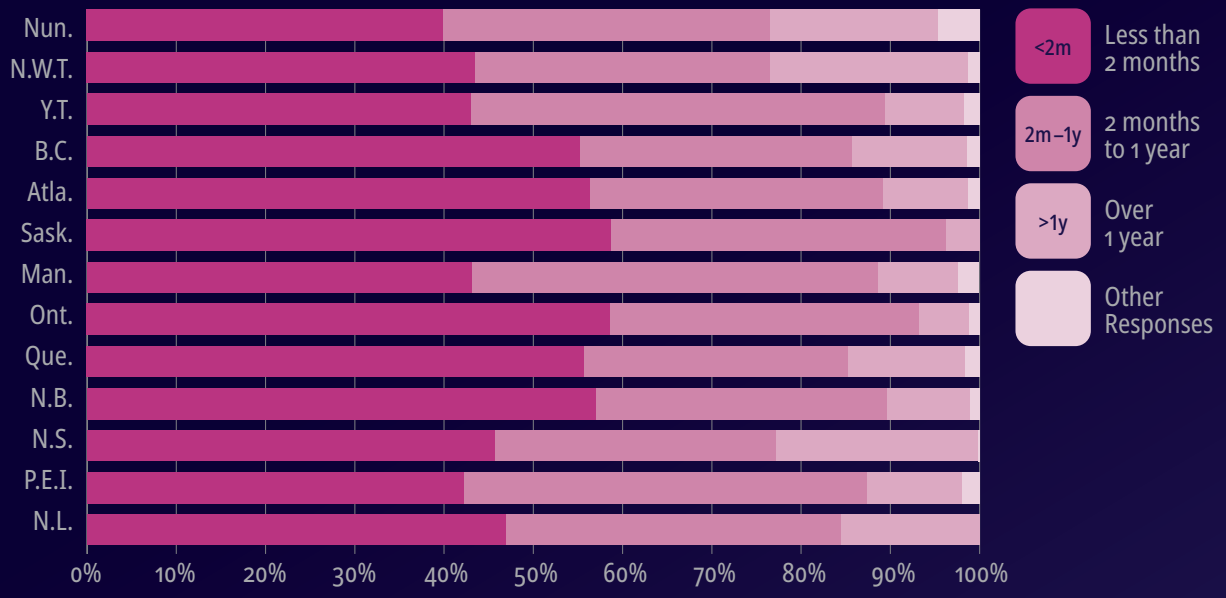


Figure 3: *Data from the Commonwealth Fund Survey International Health Policy Survey 2020, CIHI Canada*[57]

According to the Commonwealth Fund Survey and CIHI, Alberta finds itself in a similar position to other big provinces: patients experience wait times similar to those in Ontario, British Columbia, and Quebec. Albertans also fare much better than patients in some of the Atlantic provinces.

Specialist wait times can also be broken into two segments: the time from family physician referral to specialist consultation and the time from a specialist consultation to treatment.[58] When considering both the initial wait time to see a specialist and the subsequent wait time to get treatment, patients in Alberta experience slightly longer average wait times than in Ontario, Quebec, and British Columbia, and longer than the Canadian average.[59] Atlantic provinces, notably, see some of the longest wait times in Canada.[60]

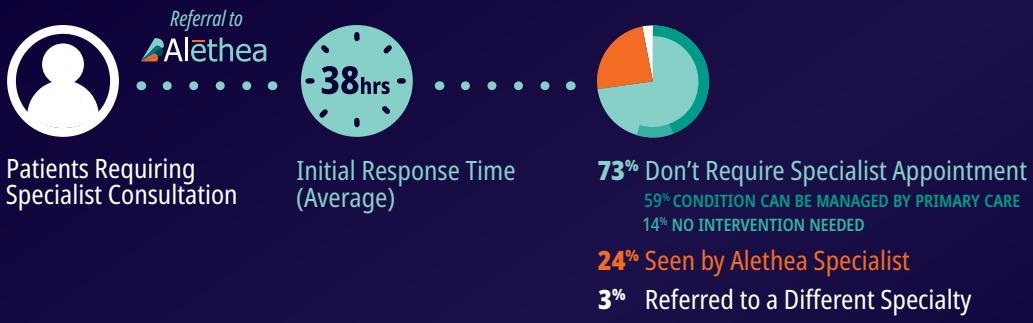
Alethea Medical, founded in 2019 in Calgary, is a platform designed to streamline the referral and specialist consultation process.[61] Rather than adding their patient to a referral waitlist, family doctors send a structured e-consult to specialist consultants affiliated with the Alethea service. Participating specialists review the patient information through the platform, allowing them to provide an initial consultation in 24–48 hours, a substantial decrease from the wait times experienced by most Albertans.

[57] Canadian Institute for Health Information, "Commonwealth Fund Survey, 2020," February 2021, https://www.cihi.ca/en/commonwealth-fund-survey-2020; Other responses include "Never tried to get an appointment," "Not sure," and "Declined to answer."
[58] Mackenzie Moir and Bacchus Barua, "Waiting Your Turn: Wait Times for Health Care in Canada," *Fraser Institute,* 2022, https://www.fraserinstitute.org/sites/default/files/waiting-your-turn-2022.pdf.
[59] In absence of Alberta, Ontario, BC, and Quebec make up the remaining majority of the Canadian populations, thus influencing the overall Canadian average.
[60] Mackenzie Moir and Bacchus Barua, "Waiting Your Turn: Wait Times for Health Care in Canada," *Fraser Institute,* 2022, https://www.fraserinstitute.org/sites/default/files/waiting-your-turn-2022.pdf.
[61] Vincent Vong, "Alethea: Light at the End of the Canal," *Alberta Doctor's Digest,* February 2021, https://add.albertadoctors.org/issues/january-february-2021/alethea-light-end-canal/.

Alethea uses three key technologies. First, its digital platform connects primary care physicians, patients, and specialists directly. Second, Alethea employs tools such as a Digital Otoscope, allowing primary care physicians to provide accurate and high-quality images to specialist consultants and attach them to the patient's EMR. Third, Alethea uses AI for workflow optimization to reduce the time required to do a consult, as well as AI for decision support for Ear, Nose, and Throat (ENT) as well as dermatology issues.[62]

Alethea shared data with ICTC from an impact assessment it had completed of its platform. It saw two major outcomes.

First, Alethea diverts individuals away from the medical specialist system when their conditions do not actually require specialist care. In a snapshot of data from Alethea's platform between June and September 2023 (over 1500 cases), approximately 73% of patients who used Alethea's platform did not actually require an appointment with a specialist. Instead, their condition had a routine diagnosis, along with simple management or treatment that could be dealt with by primary care, or their condition did not require an intervention at all. Accordingly, Alethea's specialist panel reduced the number of unnecessary referrals in Alberta's health care system and directed some patients to more appropriate care providers.[63]



Second, patients whose condition warranted specialist advice and received eConsults through Alethea's platform were better triaged (based on severity), meaning that patients with significant issues were able to see a specialist much sooner than they would be in a traditional referral system. Because eConsults can be done virtually and include patient history and imaging, specialists can review the referral quickly without taking on the administrative load of booking an appointment and seeing the patient in person. This process reduces the time it takes to see a specialist, and takes an expensive burden off of the healthcare system if patients would otherwise be visiting the emergency room to access care. Lastly, the digital nature of the platform further allows Alethea's specialist consultants to service rural and remote areas that would have otherwise required patients to make time-consuming trips into a city.[64]

Currently, Alethea operates in Alberta, and a pilot program has been rolled out for British Columbia. By directing patients away from the specialist referral backlog and allowing them to get an initial consultation within 48 hours, Alethea is trialling an Alberta-grown solution to one of Canada's most pressing medical challenges.

[62] Alethea Medical, "Alethea Platform," accessed March 27, 2024, https://www.aletheamedical.com/product.
[63] Alethea Medical, "A Summary of Patient Care Benefits Using the Alethea Platform," May 2022, https://www.aletheamedical.com/resources/a-summary-of-patient-care-benefits-using-the-alethea-platform.
[64] Ibid.

SECTION II

Health Care Practitioners and Digital Health Competencies in Alberta

Health technology can improve the quality of and access to care and address labour shortages, but what does the labour shortage in health care in Alberta look like, and how do technologies fit into health practitioners' existing workflows? Section II approaches the worker shortage in Alberta with a closer look at who health care practitioners are and what new competencies they might require to best make use of the technologies being implemented around them.

Health Workers and the Health Care Workforce Shortage in Alberta

Health workers include family physicians, specialists, nurses, allied health professionals, health aides, and other supporting or managerial roles. The Government of Alberta's 2023 Health Workforce Strategy notes that Alberta faces a deficit in its health care workforce supply. Addressing this labour shortage is crucial to the province's ability to provide critical care to its rapidly aging population. There are currently 725,000 Albertans over 65, a figure that is expected to grow to more than 1 million by 2035.[65] Demand for both acute and sub-acute continuing care is expected to increase substantially in the coming decade.[66]

The unemployment rate for all health care occupations in Alberta was 3.4% during the last census. Within this grouping, health care management occupations and professional occupations in health (a large category including physicians, nurses, and allied health professionals) experienced the tightest labour market, with

[65] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 8.
[66] Ibid.

unemployment rates of 2% each.[67] In comparison, Alberta's overall unemployment rate was about 7% before the onset of the COVID-19 pandemic and sat at 6.2% in February 2024.[68] While not the only factor, the unemployment rate is one key way of assessing labour market demand: it demonstrates that there are relatively few health professionals looking for work in their field who have not been able to find employment.

As Figure 4 illustrates, the number of physicians per 100,000 Albertans has slowly declined since 2019, with the availability of family physicians posting the largest declines. Family medicine, or primary care, has long been a patient's first point of contact with the health care system. A shortage of family physicians and general practitioners (operating via walk in clinics or telehealth) creates a bottleneck, preventing patients from accessing prompt specialist care, diagnostics, and needed referrals to other health professionals.

Physicians per 100,000 Population Alberta
Annually

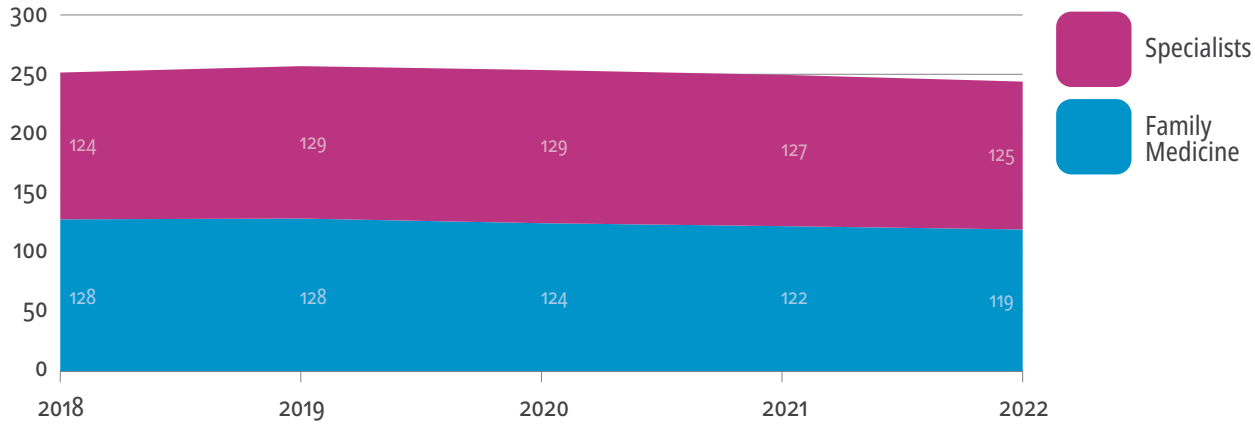


Figure 4: *Data Source, Canadian Institute for Health Information (CIHI) Supply, Distribution and Migration of Physicians in Canada, 2022 — Data Tables, Oct 2023. https://www.cihi.ca/sites/default/files/document/supply-distribution-migration-physicians-in-canada-2022-data-tables-en.xlsx*

Physicians only make up a portion of Alberta's health workforce. Figure 5 illustrates that there are more nurses (including registered nurses [RN], licensed practical nurses [LPN], psychiatric nurses, and nurse practitioners [NP]) and health care aides than physicians. In addition, allied health professionals, such as occupational therapists, physiotherapists, and related roles, comprise a significant portion of the health workforce in the province.

[67] Statistics Canada, "Table 98-10-0591-01 Class of Worker Including Job Permanency by Occupation Minor Group, Labour Force Status, Age and Gender: Canada, Provinces and Territories and Census Divisions," November 15, 2023, https://doi.org/10.25318/9810059101-eng.
[68] Government of Alberta,"Unemployment Rate," February 9, 2024, https://economicdashboard.alberta.ca/dashboard/unemployment-rate/.

Alberta Health Worker Employment
Annually vs. Provincial Population

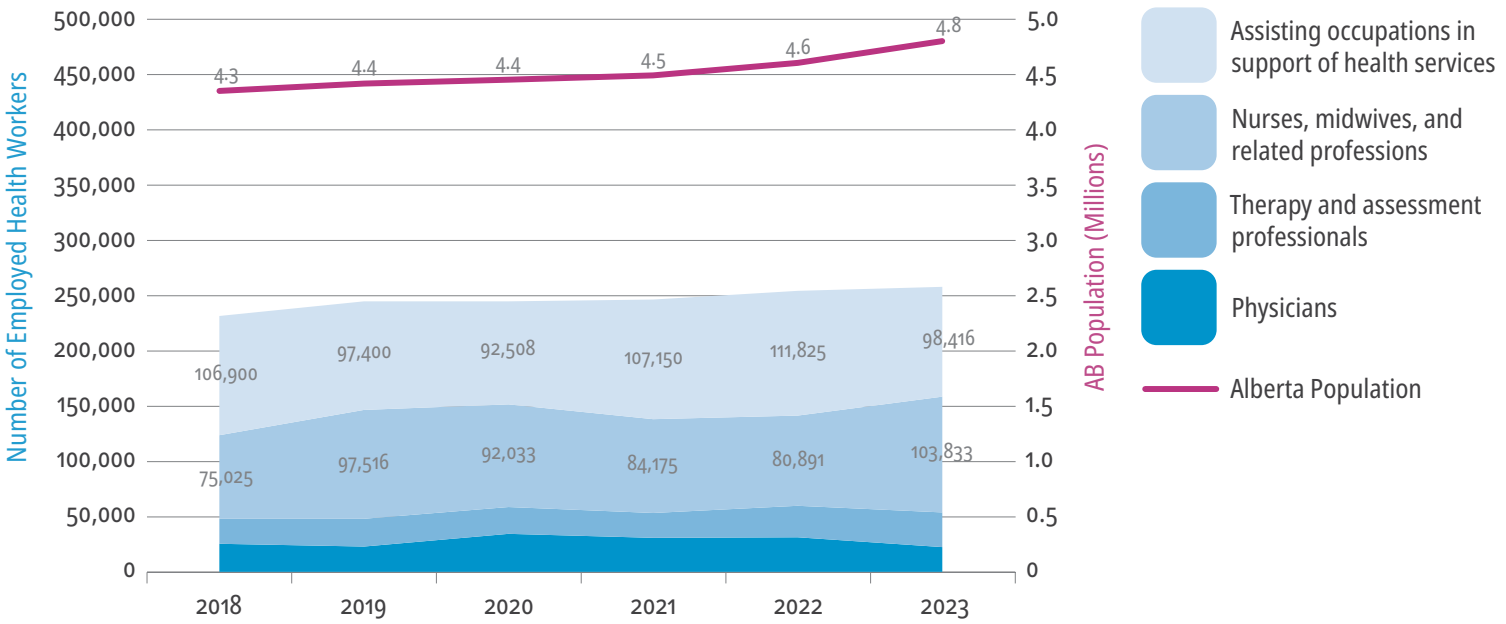


Figure 5: *Data Sources: Statistics Canada Labour Force Survey, Alberta Population Annual Q4 Estimates from https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710000901&cubeTimeFrame.startMonth=10&cubeTimeFrame.startYear=2018&cubeTimeFrame.endMonth=10&cubeTimeFrame.endYear=2023&referencePeriods=20181001%2C20231001*

Although the number of health care workers in Alberta is slowly growing, this growth is driven by occupations other than doctors. In addition, the growth in the total number of health workers is not keeping pace proportionally with the growth in the provincial population.

Today's health care worker shortage is partially driven by the lasting impact of the COVID-19 pandemic (including long working hours and stressful work conditions in the health care sector). A 2021 study by Ernst & Young on Alberta's response to COVID-19 found that between Q3 of 2020 and Q3 of 2022, registered nurses working in ICUs saw their overtime hours increase by 82%. At the same time, their voluntary termination rate more than doubled (1.3% to 3%).[69] Referencing data from Alberta Health Services (AHS), the report also found that between September 2019 and September 2021, vacancy rates (as a percentage of all positions) increased across health professions to 7.6% for RNs in ICUs, 14.8% for LPNs, 13.1% for RNs as a whole, and 9.8% for health care aides and nursing assistants.[70] In an effort to address some health care workforce gaps, in 2022, the Government of Alberta agreed to increase compensation for nurses, physicians, and health care aids.[71]

[69] Ernst & Young, "Alberta Department of Health: Alberta Health System Sustainability and Resiliency Action Plan." February 10, 2022, https://open.alberta.ca/dataset/66102fc1-1ddd-43f8-81e3-65f8d1b1747e/resource/f6170e30-a977-40d7-bbcd-01b33a5eb049/download/health-ey-health-system-sustainability-action-plan-2022-02.pdf, Table A.2.
[70] Ibid., Table A.2.
[71] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 17.

Alberta has also taken steps to attract international candidates through programs like the Alberta Clinical and Surgical Assistant Program[72] and the Fair Registration Practice Act (FRPA) to streamline international credential recognition.[73] In 2022, 34.7% of Alberta's physicians were foreign-trained (the second highest proportion in Canada, next to Saskatchewan at 49.3%).[74] This proportion is smaller for nurses: in 2022, for example, only 10.2% of registered nurses in Alberta were internationally trained.[75] Despite these programs, interviewees still described seeing clinicians struggle with international credential recognition in Alberta. For example, a health policy subject matter expert commented that they often saw internationally trained medical professionals switch roles in the health care system (e.g., from nursing to a managerial or administrative role) to avoid a lengthy licensing process.

To boost the volume of students in clinical programs, the province has committed to funding more health care-related seats at post-secondary institutions and implementing a tuition support program for health care aid students who commit to working in Alberta after graduation.[76] While graduating from an Albertan school does not guarantee that a health worker will remain in the province long-term, graduates from large Canadian universities tend to work in the province they trained in, at least in the years closely following graduation (see Figure 6).

Family Doctors by Graduating MD University:
Percent Still Practising in Province of Graduation as of 2022
Selected Canadian Universities

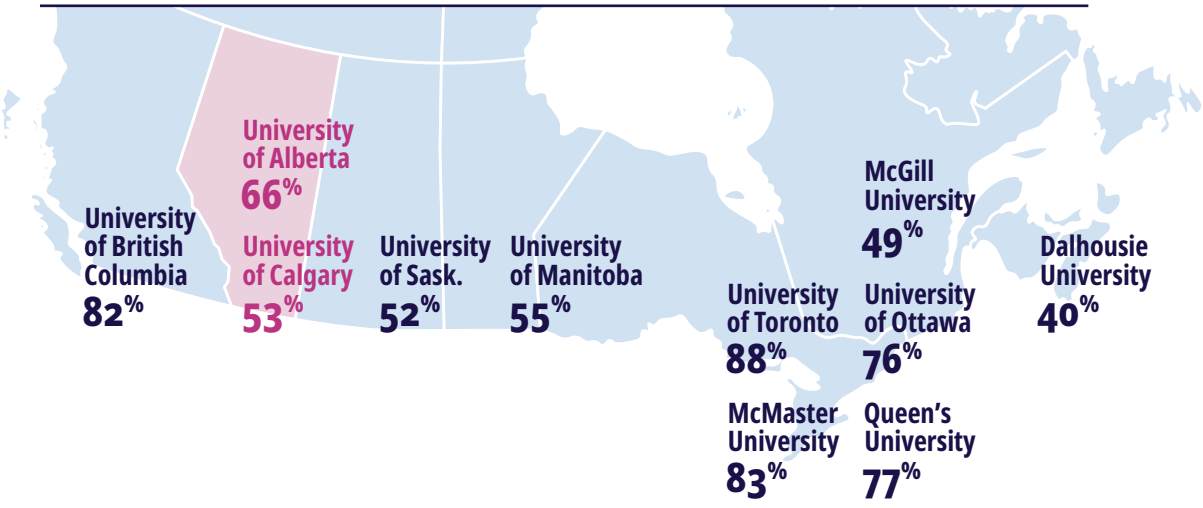


Figure 6: *Retention of Family Physicians by Selected Canadian University. Data source: Canadian Institute for Health Information) Supply, Distribution and Migration of Physicians in Canada, 2022 — Data Tables, Oct 2023, https://www.cihi.ca/sites/default/files/document/supply-distribution-migration-physicians-in-canada-2022-data-tables-en.xlsx.*

[72] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 18.
[73] Ibid.
[74] Canadian Institution for Health Information (CIHI), Supply, Distribution and Migration of Physicians in Canada, 2022 — Data Tables, October 2023, Table 19.0 Number and percentage of physicians, by physician type, place of MD graduation and jurisdiction, Canada, 2022
[75] Canadian Institute of Health Information, "The State of the Health Workforce in Canada, 2022," February 29, 2024, https://www.cihi.ca/en/the-state-of-the-health-workforce-in-canada-2022.
[76] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 21.

The shortage of health care workers is a global problem. Many jurisdictions within and outside of Canada compete for a limited pool of existing health care talent to fill immediate needs while they develop programs and strategies to boost the supply of new entrants to the field in future years. On top of this, the global demand for these workers means that Canadian jurisdictions must also focus on retaining existing workers as much as possible. Global health analyst Mark Britnell comments that doctors and nurses are "more likely to move between countries than people in any other highly regulated profession, driven by better pay and opportunities."[77] While growing the overall supply of health care workers is key, productivity-enhancing strategies within the sector and across occupations—such as the introduction of digital tools to streamline operations—can better leverage health care resources in the interim.

Digital Health Competency Frameworks: Existing Efforts to Integrate Digital Health in Medical Practice

> "My personal opinion is that everyone in the health care system needs tech skills, at a minimum, to use the system to its full potential, but then also to look for improvement opportunities.
>
> *Advisory Committee Member*

As technology increasingly permeates the health care sector, health care workers across all domains increasingly require core digital skills to complete modern-day tasks like using EHRs, applying diagnostic and treatment tools, and delivering virtual care. As such, the skill needs of health care professionals have evolved over time to include core "digital health" competencies. Several international efforts to review and standardize digital health competencies have taken place over the years, including some that have produced competency frameworks.[78] One well-respected, multi-lateral project is the Health Information Technology Competencies (HITComp) framework. Starting in 2013, HITComp was led by a consortium of EU and US public and private subject matter experts and practitioners.[79] In 2020, it was rebuilt and expanded through the EU*US eHealth Work Project, funded under the European Union's Horizon 2020 research and innovation program.[80]

The HITComp project sought to be globally applicable by identifying competencies relevant to health workers in both the US and EU, as well as jurisdictions with different job titles and job descriptions.[81] Numerous partners, including the Health Information Management Systems Society (HIMSS) and Omni Micro Systems, worked to create a database of over 1000 competencies in five domains.[82] HITComp also offers an open-access foundational curriculum for each competency area.[83]

[77] Mark Britnell, *Human: Solving the Global Workforce Crisis in Healthcare,* Oxford University Press, 2019, p. 19.
[78] Jessica Longhini, Giacomo Rossettini, and Alvisa Palese, "Digital Health Competencies Among Health Care Professionals: Systematic Review," *Journal of Medical Internet Research* 24, no. 8 (August 18, 2022): e36414, https://doi.org/10.2196/36414.
[79] HITCom and Omni Micro Systems – Omni Med Solutions, "About the Project," 2024, http://hitcomp.org/about/.
[80] "The EU*US eHealth Work Project: Project Overview: Measuring Informing, Educating, and Advancing Health." EU*US eHealth Work, n.d., accessed February 27, 2024, http://www.ehealthwork.eu/FC/Presentations/EU-US_eHealth_Work_Project_Overview-Final.pdf
[81] Interviewee from HITComp project.
[82] HITCom and Omni Micro Systems – Omni Med Solutions, "Introduction," 2024, http://hitcomp.org/introduction/.
[83] HITComp and Omni Micro Systems – Omni Med Solutions, "Education," 2024, http://hitcomp.org/education/.

HITComp Aggregate Areas of Competency

Access to Information, Protected Health Information, and Health Information Management

Administration/General Mgmt/ Governance

Business Process Design/ Workflows

Care Coordination

Clinical Decision Support and Pathways

Clinical Practice and Workflows

Coding and Terminologies

Collection of Data/Knowledge Mgmt (Library)

Communication and Change Management

Confidentiality/Protected Health Information/Records Mgmt

Data Compiling, Analysis, Modelling and Reporting

Documentation Process

Financial and Account Management

General HIT Knowledge/System Use

HIE/Interoperability/Interfaces/ Integration

Informatics Process

Information and Communications Technology/ Information Systems/IT

Issue Management and Resolution

Legal

Medications and Allergies

Order Entry

Patient Access and Engagement/PHRs

Patient-Centred Interactions/ Patient Identification

Policies and Procedures

Population Management/Public Health

Privacy and Security

Project/Program Management

Quality and Safety

Research/Biomed

Risk and Compliance

Standards and Protocols

Systems Development and Implementation

eHealth/mHealth/Telehealth

Further Resources

http://hitcomp.org/
http://www.ehealthwork.eu/

Figure 7: *HITComp Aggregate Areas of Competency, accessed March 15, 2024.*

Similar competency identification has taken place in Canada. For example, the Royal College of Physicians and Surgeons developed the CanMEDS family medicine framework; here, digital health often occurs as a sub-set of competencies within a larger set of clinical skills. Working groups for CanMEDS 2025 are expressing the need for emphasis on health informatics and digital health competencies.[84] As health care is a provincial domain, Alberta-based organizations and professional associations also produce and manage their own competency standards with digital health components.

Figure 8 illustrates the types of health technology-related competencies currently contained in Canadian and Albertan professional skill frameworks for health workers. The examples below are paraphrased from three different systems, but

[84] Brent Thomas et al., "Data-Informed Medicine in CanMEDS 2024," *Canadian Medical Education Journal* 14, no. 1, (March 21, 2023):54-57, https://doi.org/10.36834/cmej.75540..

further skill competency frameworks exist. For example, the College of Registered Nurses of Alberta (CRNA) Council has also published frameworks for specific nursing roles, such as nurse practitioners.[85]

Allied health professionals, such as physiotherapists, dentists and vision specialists, social workers, paramedics, and mental health professionals, offer essential holistic health and wellness services to Albertans, including preventive care. Alberta has 29 colleges governing allied health professions.[86] Because there are so many different allied health professions, Figure 8 does not select a single competency framework to illustrate the types of digital health competencies required for a Kinesiologist as compared with a Speech Pathologist, for example.

Role	Physicians	Nurses	Health Care Aids
Core Competencies *High level*	Medical Expertise Professional Skills Communication Skills Collaborative Skills Leadership Skills Health Care Advocacy Scholarship/Ongoing Learning	Clinical Skills Professional Skills Communication Skills Collaborative Skills Coordinative Skills Leadership Skills Health Care Advocacy Patient Education Scholarship/Ongoing Learning	Professional Skills Provision of Person-Centred Care Collaborative Care (with health team, client, family) Communication (written, verbal, active listening) Health Across the Lifespan & Cultural Competence Safety & Harm Prevention
Health Technology Competencies *Relevant examples, not exhaustive list*	Application of core clinical and biomedical sciences Continuity of care, effective handover Interpreting diagnostic tests Effectively communication using EHRs Health informatics for quality-of-care improvements Continuous professional learning & integration of best practices Professional behaviour in technology-enabled communication	Analysis and interpretation of client data Maintenance of client privacy, confidentiality, and security Maintenance of professional standards in use of social media and other information and communication technology (ICT) Use of ICT for communication Client assistance for accessing, reviewing, and evaluating information received via ICT Identification and analysis of emerging evidence and technologies that may change, enhance, or support healthcare	Communication: Demonstrate effective use of information technology appropriate for health care settings. (1) Digital literacy: Candidates must possess knowledge of computer and technology tools to be successful in a licensed health care aide (HCA) program. Candidates must be able to be able to communicate, research, and understand information; use web and email; critically evaluate how technology can affect one's behaviour; create, produce content, and effectively communicate via email, media, internet.

[85] College of Registered Nurses of Alberta, "Entry-level Competencies for Nurse Practitioners," December 2023, https://www.nurses.ab.ca/media/pibjny1j/branded-entry-level-competencies-for-nurse-practitioners.pdf.
[86] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 26-31.

Health Technology Competencies *Relevant examples, not exhaustive list*	Application of core clinical and biomedical sciences Continuity of care, effective handover Interpreting diagnostic tests Effectively communication using EHRs Health informatics for quality-of-care improvements Continuous professional learning & integration of best practices Professional behaviour in technology-enabled communication	Analysis and interpretation of client data Maintenance of client privacy, confidentiality, and security Maintenance of professional standards in use of social media and other information and communication technology (ICT) Use of ICT for communication Client assistance for accessing, reviewing, and evaluating information received via ICT Identification and analysis of emerging evidence and technologies that may change, enhance, or support healthcare	Communication: Demonstrate effective use of information technology appropriate for health care settings. (1) Digital literacy: Candidates must possess knowledge of computer and technology tools to be successful in a licensed health care aide (HCA) program. Candidates must be able to be able to communicate, research, and understand information; use web and email; critically evaluate how technology can affect one's behaviour; create, produce content, and effectively communicate via email, media, internet.
Digital Health Skill Examples from Alberta Job Postings *ICTC Job Data, Aug 2023–present*	Information Technology Computer Literacy EMR Proficiency	Information Systems Computer Literacy EMRs Mobile Devices	Awareness of Health Systems Computer Literacy EMRs
Competencies Source	Royal College of Physicians and Surgeons of Canada, CanMEDS Framework, 2015 (*2025 in progress)	College of Registered Nurses of Alberta (CRNA), Entry-level Competencies for the Practice of Registered Nurses, 2019	(1) Alberta Health, Health Workforce Planning and Accountability, Health Care Aide Competency Profile, 2018 (2) Government of Alberta, Health care aide program, 2024, https://www.alberta.ca/health-care-aide-program.

Figure 8: *Health technology-related competencies currently contained in professional skill frameworks for health workers.*

In short, digital literacy and competencies related to virtual care and health information management are crucial to all types of health care roles.

Digital Health Competency Frameworks for Unregulated Professions

Often known as health care aides, workers in assisting roles comprise a significant part of the health care workforce in Alberta. Professions falling under this category are typically unregulated. Many aide workers are based in continuing care facilities across the province.[87]

Some analyses of digital health competencies suggest that competency identification and education too often focus only on physicians, the "top" of the clinical hierarchy. However, digital health competency development focusing solely on clinicians "fails to reflect the rapid rise of chronic conditions for which lower-skilled care workers, alongside devices, technology, and algorithms, can provide substantial levels of support as well as encourage a significant degree of self-management."[88] Working closely with patients, especially elderly patients who may need more support navigating digital health solutions, means that digital health competencies are just as essential for aid roles as they are for nurses or doctors.

ICTC interviewed a Canadian app company that facilitates at-home continuing care. To deliver this service, the company engages a small number of nurses and a larger number of health care aides. Health care aides work directly with clients. They are responsible for teaching clients to use at-home monitoring devices and virtual care platforms, and they walk clients through privacy and data sharing. Aides log activity in the company's app, escalating issues to nurses and doctors in the larger health care system where needed. This is one example of using technology to fully take advantage of a pyramid-shaped health care workforce, with short-term-trained health aides making up the largest proportion.

Essential Transferable Digital Health Competency Areas

Physicians, nurses, and healthcare aides all have distinct roles and responsibilities, but they share some transferable competency areas related to digital health, as seen in Figure 8. All roles require digital literacy, effective communication using technology, and some degree of critical evaluation of data and technology. All roles will require the ability to deal with sensitive patient data and operate effectively using virtual care platforms. The same transferable competency areas are important in allied health as well. For example, allied health professionals use several EMRs and virtual health tools that are integrated with the Alberta MyHealth platform.[89] In addition, many allied health practices transitioned to offer virtual care during the COVID-19 pandemic.

[87] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 26-31.
[88] Mark Britnell, *Human: Solving the Global Workforce Crisis in Healthcare,* Oxford University Press, 2019, pp. 12-13.
[89] Alberta Medical Association, "Virtual Care," January 16, 2024, https://www.albertadoctors.org/leaders-partners/ehealth/virtual-care.

During this study, ICTC surveyed health practitioners about the skills they would like to develop related to digital health.[90] From an "all that apply" list, respondents prioritized understanding usability and user experience, as well as virtual care skills (e.g., doing high-quality distance consultations). Next, respondents saw a need for skills related to clinical informatics and health data management: system integration, data management and analysis, data privacy, and cybersecurity awareness. Nearly a quarter (23%) of respondents said they wanted to improve their baseline digital literacy.[91]

In the following section, each of these key transferable competency areas is unpacked and examined. While applications of certain skills vary by profession, research contributors highlighted these digital health skills as top of mind regardless of whether they were speaking on behalf of physicians, nurses, allied health, or health aides.

Delivering Care Virtually

Virtual care transforms clinical encounters. Health practitioners must be able to help patients access virtual care and then provide a high-quality consultation over a virtual care platform.

WHAT IS CAUSING A SKILL GAP?

In the 2021 CMA Physician Survey, 83% of Alberta respondents felt they had "the knowledge and skills to use virtual care platforms to provide care," but only 66% agreed that "virtual care enables [them] to provide quality care for [their] patients."[92] Across Canada, the number one challenge physicians experienced with virtual care was "challenges with virtually examining patients" (experienced by 80% of respondents).[93]

Research contributors did not feel that post-secondary programs were currently training practitioners in the distinct skills required for virtual care. They suspected that this was because of the novelty of the virtual care skill cluster: research on how virtual care changes clinical practice and how to train providers accordingly may need more time to disseminate into curricula.

WHAT SKILLS ARE INVOLVED?

ICTC asked research contributors in charge of hiring for virtual care roles what they looked for in applicants.

[90] ICTC conducted a primarily qualitative survey of health professionals in Alberta to gather information on what technologies health practitioners found most or least helpful, what skills they most wanted to develop, and other topics (see Appendix A for a discussion of survey participants).

[91] Note: This survey does not represent the entirety of healthcare practice in Alberta: it is a small sample of respondents (see Appendix A) and was designed mostly to elicit text/open-ended responses like a digital interview questionnaire.

[92] Canadian Medical Association, "2021 National Survey of Canadian Physicians: Quantitative Market Research Report," *Canada Health Infoway,* August 11, 2021, https://www.infoway-inforoute.ca/en/component/edocman/3935-2021-national-survey-of-canadian-physicians/view-document?Itemid=0. Q15: "Please indicate your level of agreement with the following statements regarding providing virtual care in your practice."

[93] Ibid., Q16: "What challenges have you experienced in using virtual care in your practice?"

A virtual clinic lead in Alberta described putting clinical job applicants, primarily nurses, through virtual care simulations. As a baseline, the contributor looked for candidates with digital literacy and the ability to intuitively use their platform. In addition, they looked for interpersonal and clinical skills that carried well over a screen, including whether the candidate could tell if a patient was in pain and whether they asked the right questions to build a strong patient relationship and elicit essential information about their experience.

Similarly, a mental health practitioner in Alberta described the necessity of focus and attentiveness in virtual care settings:

> "So much of communication is non-verbal. When you're online, there is a potential to miss unspoken signs. So, it requires probably even more ability to pay attention, to read signals, to communicate well, and to check in.

Health Informatics and Health Information Management

> "The practice of medicine is evolving as individual and population-level health data change how medical decisions are made. Moving forward, the medical profession will need to harness the power of data to develop learning health systems that routinely collect and analyze health data to generate knowledge to inform health decisions and/or system improvements. …To support this new paradigm of 'human and machine,' data cooperation will require new physician competencies: the collection, organization, storage, exchange, aggregation, and interpretation of health data to facilitate high-quality patient care.[94]

Health informatics (or **clinical informatics**) combines health sciences with computer and information sciences to manage health data for enhanced delivery of care. Health informatics is both a distinct profession (discussed in Section III) and a general competency area for health practitioners. Collection, storage, use, and management of health information in EHRs, data collection devices, and personal data devices are all relevant to health informatics.[95] Health informatics competencies can be applied by health practitioners, health managers and policymakers, IT professionals in health care, and researchers.

Here, health informatics competencies are broken down into several distinct categories.

[94] Brent Thomas et al., "Data-Informed Medicine in CanMEDS 2025," *Canadian Medical Education Journal* 14, no. 1 (March 21, 2023): 54–57, https://doi.org/10.36834/cmej.75440.
[95] Julianne Sweeney, "Healthcare Informatics," *Online Journal of Nursing Informatics* 21, no. 1 (February 2, 2017), https://www.himss.org/resources/healthcare-informatics.

Data Collection, Documentation, and Analysis

In a clinical encounter, health workers take notes on clients' cases. In an era of EHRs, this data feeds into a database that could be used for many applications other than simply recording an individual appointment. Health data in an EHR can be extremely helpful to patient safety, health policy, and population research—if it is structured appropriately and of high quality.

WHAT IS CAUSING A SKILL GAP?

Digital health documentation remains a key gap in many health professionals' foundational and ongoing education. Research contributors told stories about physicians adopting EHRs for the first time and interacting with them as if they were physical charts or notepads rather than databases interconnected with an entire health system:

> "We find that a lot of physicians find themselves in something like Connect Care, which is a very powerful clinical information system, but they treat it like the equivalent of an old filing cabinet or a digital filing system with a Dictaphone. They're not adhering to our minimum use norms. They're not doing fundamentally important things like medication reconciliation or problem reconciliation. They're just dictating to a blank screen.

Another health system analyst posited that part of the EHR documentation skills gap results from health workers not having adequate exposure to data analysis and outputs:

> "If you don't have a background [in data analytics], you just think that you release a magical AI into the data and suddenly you have reliable analytics. But the biggest barrier to begin with is well-structured, reliable data because if you give an algorithm bad data, it's going to give you bad predictions. Teaching students or future practitioners, even current practitioners, about reliable data entry or uniform data practice is the best first step for now.

Finally, a public health expert described the type of impact this skill gap might have down the line:

> "As it sits, at least with the clinics and patient charting that I've seen, one patient might be assessed in three different ways across three different practitioners. If you were then to pull that data and do any analytics based on it, you're going to get some questionable results.

The EHR documentation skills gap is not limited to physicians. In a recent survey of senior-level nursing students in Alberta's BScN programs, less than half of the participants were familiar with nursing informatics competencies (42%) and only 38% reported using a training version of an EHR during their programs. In clinical settings, only 40% had been permitted to document patient care electronically

under supervision.[96] Study authors commented that participants felt "overwhelmed about transitioning to the work setting" and that "participants generally hoped learning about [Nursing Informatics] would continue in the workplace and include supports and resources to build their competence."[97]

WHAT SKILLS ARE INVOLVED?

Research contributors working with health data in the aggregate (e.g., in AI and precision health applications) felt that it was essential to provide health practitioners with the skills to think about how their EHR input relates to larger systems. These research contributors felt that appropriate use of health data on the individual level included an ability to "zoom out" and "see how the role they play contributes to a better health care system."

Health data analysis skills support good documentation. Experience in analysis brings home the importance of clean, structured, and well-annotated health data. Digital health educators and policymakers described trying to teach health practitioners about how EHRs could save them time if they used them for data analysis. One commented, "We say that the EHR should be the hardest-working team member."

A health innovation expert described teaching health practitioners to use data analysis to interpret patterns or inconsistencies in a patient's health record:

> "[We teach] data for informed decision-making.... So when you're pulling EMR reports, say, if [clinicians] are seeing differences in the numbers, we try to help them understand where differences are normal and good, and where differences might reflect inconsistencies in their processes in documentation."

The same interviewee also coached physicians to use data hygiene and analysis to invest resources more efficiently across patient panels:

> "Once you have data hygiene, you can pull reports related to your patient population and understand where the team needs to invest energies. So, for example, [instead of scheduling screenings on a patient-by-patient basis, you can] use an EMR to plan all of your screening and support a systematized process... you might decide you're going to screen for 10 things [examples given: lung cancer, cervical cancer, hypertension], build the criteria into your EMR, and then every January, pull all patients born in January and check who is due for those screens based on your parameters. And you can check. Are they coming in any way, or do we need to contact them? Then in no time at all, you're caught up on your screening.
>
> *Health Innovation Expert, Interviewee*

[96] Manal Kleib et al., "Are Future Nurses Ready for Digital Health?: Informatics Competency Baseline Assessment," *Nurse Educator* 47, no. 5 (October 1, 2022): E98–104, https://doi.org/10.1097/NNE.0000000000001199.
[97] Ibid.

How Does Rich Data Contribute to Quality of Care? EHRs, Documentation, Data Richness, and Inclusive Design

Health data inputs result in what some researchers call "electronic health record phenotyping," or "the use of raw EHR data to assert characterizations about patients."[98] For example, a health care system might use a "phenotype algorithm" to assess the probability of type 2 diabetes in patients throughout a clinical dataset based on known related risk factors already entered into their EHR (e.g., age, activity, blood glucose tests, family history).[99]

It is easy to imagine the benefits of EHR phenotyping. For example, patients can be more efficiently flagged for testing and screening for high-risk conditions. However, the success of this kind of procedure rests on high-quality data being present in EHRs in the first place. Some health data researchers call this "data richness."[100] Rich data relies both on a well-designed EHR system and detailed training for its users.

Sparse, inadequately rich data can result in negative consequences for patient care. For example, an EHR that relies on the variable sex at birth might miss clinically meaningful distinctions, leading to problems if phenotype algorithms are being used to guide care plans. A patient whose sex at birth is marked "female" might be automatically flagged for routine screenings like mammograms, even if they have a double mastectomy. Data richness researchers recommend asking more nuanced questions in EHRs, such as whether an individual has ever been karyotyped, what their result was if they are receiving hormone therapy, and what types of surgeries they have had.[101] Similarly, data richness researchers point to a missing variable of time in many EHRs: patient data like blood glucose levels might change over time and create meaningful patterns for diagnosing conditions like diabetes, as well as its type and severity.[102]

EHR design can have a significant impact on data richness. Researchers point to problems when EHRs record diagnoses as billing codes, which can create one-dimensional data and/or incentivize clinicians to overuse or underuse certain codes. George Hripcsak and David Albers state that "the EHR is actually a measure of the health care process… Treating the EHR as a direct measure of the patient with noise misses the opportunity to correct the bias instead of just quantifying it."[103]

[98] George Hripcsak and David Albers, "High-Fidelity Phenotyping: Richness and Freedom from Bias," *Journal of the American Medical Informatics Association* 25, no. 3 (March 2018), pp. 289–294, https://doi.org/10.1093/jamia/ocx110.
[99] Ibid.
[100] Ibid.; Kendra Albert and Maggie Delano, "Sex Trouble: Sex/Gender Slippage, Sex Confusion, and Sex Obsession in Machine Learning Using Electronic Health Records," *Patterns* 3, no. 8 (August 12, 2022): 100534, https://doi.org/10.1016/j.patter.2022.100534.
[101] Kendra Albert and Maggie Delano, "Sex Trouble: Sex/Gender Slippage, Sex Confusion, and Sex Obsession in Machine Learning Using Electronic Health Records," *Patterns* 3, no. 8 (August 12, 2022): 100534, https://doi.org/10.1016/j.patter.2022.100534..
[102] Ibid.
[103] Ibid.

In this project, one Alberta-based physician educator said they had yet to see clinicians truly understand how their EHR use was connected to AI-powered decision support. They commented that they would like to see more clinicians who are able to interpret EHR decision support with a critical eye. First, they wanted clinicians to be aware of what decision support was, when they were encountering it "within a health information system," and what types of biases it might be subject to. And second, "What's missing?" they explained, is recognition that a person might

> "...be misled rather than guided by what you're seeing on the screen... So you see a data point, such as a particular lab result. But if you don't know the context that it came from or the question that was asked when the test was ordered, you may think that a number is abnormal when it's unequivocally not abnormal for the question that was asked."

Informational Continuity, Continuity of Care

Continuity of care is a principle intended to ensure that patients are handed from practitioner to practitioner without a gap or break in their care plan. Informational continuity supports continuity of care by ensuring that data is passed appropriately from provider to provider and EHR to EHR. Yet, referrals are typically the point at which patients are most at risk of experiencing a break in their care plans.[104]

WHAT IS CAUSING A SKILL GAP?

Informational continuity requires both a technical and a cultural solution. Health care workers can operate in informational silos. For example, a family physician, a specialist, and an allied health practitioner may be using EHR systems that are not yet integrated. In the meantime, the competency area of informational continuity helps care providers make sure their own practices bridge gaps in technology.

Interviewees felt that informational continuity was not commonly taught in health care programs. They gave examples of care providers faxing referrals and assuming they had been received or family clinics telling their clients to wait for specialist appointments without checking whether delays were real or due to administrative errors in another office.

[104] Health Quality Council of Alberta, "Patient Perspectives on an Electronic Referral System for Alberta," January 2016, https://hqca.ca/wp-content/uploads/2021/12/E_Referral_Summary_Report_FINAL.pdf.

WHAT SKILLS ARE INVOLVED?

Health care practitioners need to be able to put themselves in a patient's shoes and think about themselves as part of an integrated care plan rather than a sole care provider shipping information off to another part of the system. Interviewees described working with clinicians to teach the principle of informational continuity by encouraging them to think about the patient journey:

> "Whether patients are at emergency or they're seeing their family doc or they're seeing a specialist, they shouldn't be getting competing information, and there shouldn't be gaps in information.
>
> *Health Quality Analyst*

> "'No news is good news' would only work if the system was perfect.
>
> *Health Educator*

Health information continuity implicates all roles in health care practice. A care continuity educator also pointed out the need for training medical office assistants and workers in other roles that weren't "at the top of the clinical hierarchy but are incredibly important in care delivery, information flow, and being willing to adopt new technology."

Informational continuity can also be built into health policy. One interviewee advocated working closely with health organizations to set up service agreements between different types of providers (e.g., a specialist receiving a referral from a primary care physician). This way, they suggested, all health practitioners would understand their distinct roles in an "integrated care plan," with digital checks and balances working in concert with complementary service provision.

Patients are also a crucial part of informational continuity. Providing patients with online access to their own medical information is another way to empower the public with the information required to monitor referrals and receive updates and confirmations. However, health care workers may need the skills to be able to teach patients how to access their medical information. Training in digital literacy, health information literacy, and health information management for health workers and patients is likely to support improved informational continuity.

Safety, Privacy, and Ethics in Health Information Management

Health data is highly sensitive, personally identifying information, and care workers in Alberta are custodians of health data under the Health Information Act.[105] Aggregate health data can be immensely useful for public health measures, research, and even emergency management; however, careful standards must guide its use.[106]

[105] Government of Alberta, "Health Information Act," accessed March 19, 2024, https://www.alberta.ca/health-information-act.
[106] Jawahitha Sarabdeen, Emna Chikhaoui, and Mohamed Mazahir Mohamed Ishak, "Creating Standards for Canadian Health Data Protection during Health Emergency – An Analysis of Privacy Regulations and Laws," *Heliyon* 8, no. 5 (May 21, 2022): e09458, https://doi.org/10.1016/j.heliyon.2022.e09458.

WHAT IS CAUSING A SKILL GAP?

Many health practitioners who contributed to this study had learned about privacy and protecting patient data on a personal level. However, EHRs, virtual care, and other platforms change how health data is handled, where it goes, and what it is vulnerable to. For example, contributors voiced a desire to learn more about cybersecurity, something they hadn't seen represented in their post-secondary educations. Overall, interviewees described a disjuncture between privacy training and the digital age: health workers might not have studied considerations like data minimization (maintaining as little, and as few copies of personal data as strictly necessary) or online privacy.

WHAT SKILLS ARE INVOLVED?

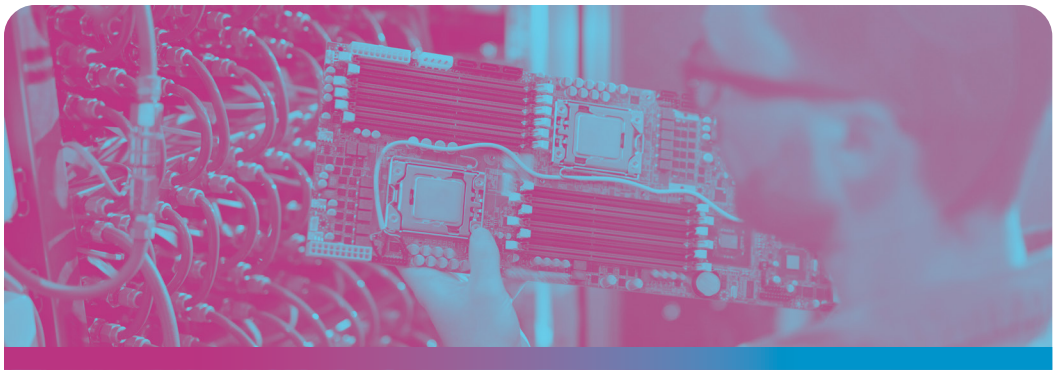
Practitioners need awareness of their organizations' privacy and security policies, as well as legislation in their region. In addition, practitioners using digital platforms need to be aware of those platforms' policies and practice data hygiene:

> "Awareness of privacy policies and good privacy hygiene… like, do you record your [virtual care] sessions or not? Where are you going to keep them? How safe is it, who has access to it, how long do they have access?
>
> *Virtual Care Provider, Interviewee*

Cybersecurity-related skills are also key to keeping patient data safe. HealthCareCan, a leader in health care cybersecurity training for Canadian health workers, suggests that education is one of the most effective methods of protecting health care systems against cyberattacks. They recommend clear, gamified, explicit training on avoiding phishing and social engineering for health care workers.[107]

Data privacy, safety, and ethics are guided by distinct principles set out by many First Nations, Metis, and Inuit governments, and there are over 50 Indigenous communities and governments in Alberta, and over 250,000 Indigenous-identifying people in Alberta.[108] For example, the First Nations Information Governance Centre (FNIGC) principles of data ownership, control, access, and possession (OCAP®)[109] guide people working with First Nations health data on principles of data sovereignty and population-level data privacy, and the Alberta FNIGC publishes its own health research led in consultation with communities across the province.[110] Health workers with Indigenous clients or working in Indigenous jurisdictions are likely to require distinct knowledge related to community data sovereignty.

[107] HealthCareCan, "Key Takeways from HealthCareCan's Summit on Cybersecurity," 2018, https://www.healthcarecan.ca/2018/03/14/key-takeaways-from-healthcarecans-summit-on-cyber-security/
[108] Alberta First Nations Information Governance Centre (AFNIGC), "Who We Are," accessed March 19, 2024, https://abfnhealth.afnigc.ca/who-we-are/; Government of Alberta, "Indigenous Community Data," accessed March 19, 2024, https://www.alberta.ca/indigenous-community-data.
[109] OCAP® is a registered trademark of the First Nations Information Governance Centre (FNIGC). Visit the FNIGC at https://fnigc.ca/ocap-training/ for more information.
[110] The Alberta First Nations Information Governance Centre, "Customize Your Report," accessed March 19, 2024, https://abfnhealth.afnigc.ca/the-report/customize-your-report/.



The Alberta Health Technology Workforce

SECTION III

WHO IS THE HEALTH TECHNOLOGY WORKFORCE IN ALBERTA?

Health technology includes digital health, life sciences, and any innovation used to improve quality of life, as outlined by the patient-centred World Health Organization definition in Section I. ICTC has primarily focused on the intersection between health care and the digital economy (namely digital health, precision health and diagnostics, medical devices involving digital technology, virtual care, and related products and services) in this study. Within this area of focus, Alberta's digital health workforce includes:

#1 Information and communication technology-related workers in health care in Alberta (for example, a database administrator employed by Alberta Health Services);

#2 Health Information Technology and Clinical Informatics professionals, whose roles sit directly at the nexus between health care and digital technology;

#3 All workers (not just technology workers) hired by Alberta-based digital health technology companies and all Albertan workers hired by other Canadian and multinational digital health firms.

Section III walks through each of these categories in turn. Each category offers one way to think about the digital health workforce, but they cannot simply be added to create a final number of digital health workers in Alberta. For one, these categories double-count some workers. For example, a software developer at a virtual care company headquartered in Alberta would be part of the third category, workers for health technology companies, and the first category, technology workers in the health care sector. Meanwhile, there are likely health technology workers not captured here. For example, an AI and precision health specialist could consult with health technology companies while primarily employed by a post-secondary

institution or an accelerator. Alternatively, a technology worker could be employed by a health technology department of a larger multinational firm but not show up in the health care sector if their employer has multiple business streams.

Technology Workers in the Health Care Sector

Technology workers are in occupations such as data science, cybersecurity, electrical engineering, web design, graphic design, software development, network technicians, and beyond. Over the past five years, the number of technology workers employed in Health Care and Social Assistance in Alberta has grown substantially, approximately doubling in the lead-up to 2020. However, it also displays significant volatility (see Figure 9, Figure 10).

Technology Employment in Health Care and Social Assistance Sector in Alberta

Three-Month Moving Average 2018 – Present

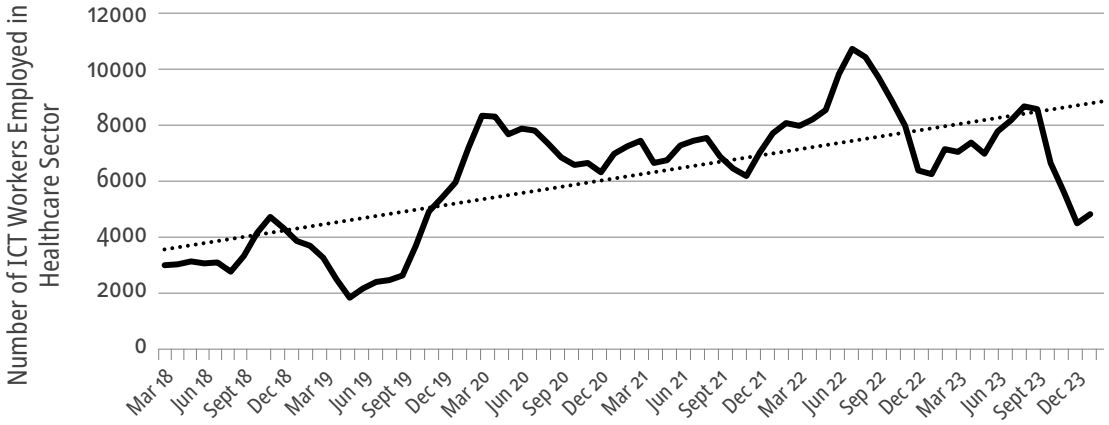


Figure 9: *Technology Workers in the Health Care and Social Assistance Sector, Alberta, March 2018 to December 2023. Statistics Canada Labour Force Survey Data, Analysis by ICTC.*

It is tempting to interpret the growth of IT workers in health in 2020 in light of the COVID-19 pandemic and the rapid adoption of telehealth and virtual care. However, the rise in the number of IT workers began before the pandemic. Research contributors suggest that many of the shifts in employment in this figure might reflect contract-based hiring connected to major IT projects at Alberta Health Services, including the Connect Care EHR implementation. As of 2023, Alberta Health Services was Alberta's largest employer, employing about 100,000 Albertans.[111] As discussed in this paper's introduction, Connect Care's rollout began in 2019. Most of the work is now complete, and final implementation is scheduled to finish in 2024.

[111] Government of Alberta, "People," accessed March 27, 2024, https://www.alberta.ca/people.

Figure 9 uses a retrospective three-month moving average (i.e., the figure for February will not be available until May). Looking forward into 2024, demand for IT workers in health care is unlikely to stop entirely once major IT infrastructure is put in place. There will be a continued need for interoperability in EHRs, e-referral and prescription tools, and other provincial priorities that have all stayed crucial post-COVID-19.[112] In January 2024, there were 5,100 workers in ICT occupations in Health Care and Social Assistance.[113] However, given the Alberta public sector's importance in hiring in health care, trends such as a reported hiring freeze for non-clinical roles in health care organizations will also impact these numbers.[114]

Clinical Informatics Professionals in Alberta

In addition to technologists, the health care sector is seeing increased demand for roles at the intersection of technology and health care. These roles require strong technical competencies, health care domain knowledge, and the ability to translate between technology professionals, health care practitioners, and subject matter experts. Clinical informatics professionals might implement and train colleagues on EHRs, design workflows, and translate knowledge between medicine and IT.

> "Clinical Informatics is that combined skill set of understanding clinical workflows and how technology interplays with that: you certainly need technical skill sets: cybersecurity, infrastructure, application management, and then it's about working with technologists and care providers to enhance the care process.
>
> *Advisory Committee Member*

In Alberta in 2021, there were about 550 health information management professionals with a median employment income of $69,500.[115] About 400 of these workers had studied health and related fields (with the next most common degree being business, management, or public administration.)[116] Health information management professionals might have titles such as Health Records Technicians, Medical Records Unit Supervisor, or Health Information Management Technicians.[117] More senior roles in health informatics could include Chief Medical Information Officers, Chief Nursing Information Officer, or Chief Operations Information Officers.

[112] For example, see future priorities for virtual care technology mapped out in: Alberta Virtual Care Working Group, "Optimizing Virtual Care in Alberta: Recommendations from the Alberta Virtual Care Working Group," 2021, https://bit.ly/Alberta-Virtual-Care-Working-Group-Recommendations.
[113] Statistics Canada, Labour Force Survey, ICT NOCS in Health Care and Social Assistance NAIC, January 2024.
[114] David Opinko, "Alberta announces healthcare hiring freeze, but will not impact clinical positions," Lethbridge News Now, February 22, 2024, https://lethbridgenewsnow.com/2024/02/22/alberta-announces-healthcare-hiring-freeze-but-will-not-impact-clinical-positions/.
[115] Statistics Canada, "Table 98-10-0586-01 Employment Income Statistics by Occupation Unit Group, Visible Minority, Highest Level of Education, Work Activity during the Reference Year, Age and Gender: Canada, Provinces and Territories," May 10, 2023, https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=9810058601.
[116] Statistics Canada, "Table 98-10-0404-01 Occupation by major field of study (detailed, 4-digit): Canada, provinces and territories," October 2023, https://doi.org/10.25318/9810040401-eng.
[117] Government of Canada, "12111 – Health information management occupations," National Occupation Classification 2021 Version 1.0, accessed March 15, 2024, https://noc.esdc.gc.ca/Structure/NocProfile?objectid=VMo%2BEti%2Fgo0GfJsPuyX0MqT7hBT3Xa3CqEEv0Nsvl-JE%3D

While health informatics titles comprise a small proportion of health roles in the province, interviewees commented that these positions could be hard to fill: strong applicants require a combination of skills in health care management, information technology, and knowledge of clinical practice.

Manager, Information and Clinical Informatics

AgeCare, Calgary

$110,000 – $130,000 /year

FIRST POSTED SEPT 2023, REPOSTED JANUARY 2024

Position combines IT, health informatics, and a strong clinical background. "This role will manage and use health care data from PointClickCare to improve the effectiveness, efficiency, and reliability of inter-professional collaborative care."

Education:
Bachelor's in Business, Computer Science, or Health Care.

Experience:
3+ Years Experience in Continuing Care, Nursing, or Allied Health.

Supervisor, Health Information Management

Alberta Health Services, Fort McMurray

$34.76 – $59.61 /hr

POSTED JANUARY 2024

Job descripiton not available.

Education:
Health Information Management program certification recognized by the Canadian Health Information Management Association/ Canadian College of Health Information.

Experience:
3–5 years in management/ supervisory role.

Clinical Informatics Specialist

Lavender, Calgary

Salary not posted

POSTED JANUARY 2024

Position "informs the technology team on opportunities to help improve the client and clinician journey at Lavender, including responsibility for configuring clinical and client outreach systems, improving interoperability... and launching new apps that support evidence-based care and high-quality telehealth psychiatry standards." Position oversees clinical systems, EMRs, ePrescribing platforms.

Education:
University degree in health care or health informatics.

Experience:
3+ Years related experience in clinical operations or clinical systems development.

Figure 10: *Sample Job Postings in Clinical Informatics: Alberta, 2023–2024*

However, health information management and health informatics are not limited to a specialized career pathway. As health informatics educators note, training in health informatics can be a good fit for health professionals who want to implement process improvement in their current roles or advance in their careers. In a previous health technology study by ICTC, IT teams in healthcare commented that informatics was easier to teach than health care, so that they often ended up migrating nurses and other health care workers to fill clinical informatics roles.[118]

[118] Mairead Matthews, Rosina Hamoni, and Maya Watson, "Digital Transformation: The Next Big Leap in Healthcare," Information and Communications Technology Council, 2023, Available at SSRN: https://ssrn.com/abstract=4501812

Health informatics training is available at multiple levels. Alberta's NorQuest College has a 16-week Health Information Management micro-credential,[119] the Southern Alberta Institution of Technology (SAIT) offers a two-year Health Information Management Diploma,[120] while the University of Victoria, BC, offers a Master's of Health Information Science.[121] Meanwhile, the Canadian College of Health Information Management oversees certifications for sub-specializations within the field.[122]

Employees of Alberta-Based Health Technology Companies

The private sector, including Alberta-based businesses, plays a growing role in health technology hiring in Alberta. Using data from research contributors and PitchBook, ICTC compiled a dataset of a sample of 190 Alberta-headquartered health technology companies.[123] Companies included a range of health technology subsectors, such as secure health data communications services like Brightsquid Secure Communications Corp., computational biology and biotechnology companies like Willow Biosciences, virtual care and remote monitoring companies like Orpyx Medical Technologies, and many more. Figure 11 shows the companies in this dataset by founding date (where information is available). A drop-off in 2021 may simply show that very new startups have not yet been included in this dataset.

Number of Digital Health Companies Founded By Year in Alberta

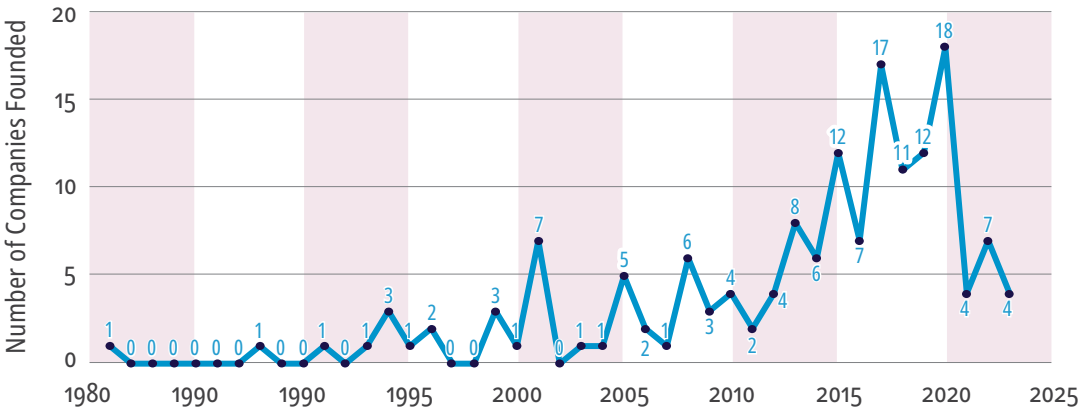


Figure 11: ICTC Alberta Health Technology Company Dataset by Year Founded.

[119] Norquest College, "Health Information Management," accessed Feb. 22, 2024, https://www.norquest.ca/programs-and-courses/programs/health-information-management/.
[120] Southern Alberta Institute of Technology, "Health Information Management," accessed April 5, 2024, https://www.sait.caprograms-and-courses/diplomas/health-information-management.
[121] University of Victoria, "Health Informatics (MSc)," accessed Feb. 22, 2024, https://www.uvic.ca/graduate/programs/graduate-programs/credential-pages/health-information-science-cred/health-informatics-msc.php.
[122] Canadian College of Health Information Management, "Certifications," accessed April 5, 2024, https://cchim.ca/certification/.
[123] See Appendix A for parameters.

Over half of the Alberta Health Technology company dataset is made up of small companies (51% have 10 or fewer employees), as illustrated in Figure 12. It is likely that many more sole proprietors or one- to two-person startups were not captured by ICTC's search because of their small size (in 2022, the Business Council of Alberta reported that 87% of the province's companies had fewer than five employees).[124] This dataset is skewed toward companies that post jobs. The Alberta-based companies in this dataset employ at least **3300 staff** overall and approximately **2500** staff in Alberta.[125]

Alberta Health Technology Companies
by Number of Employees

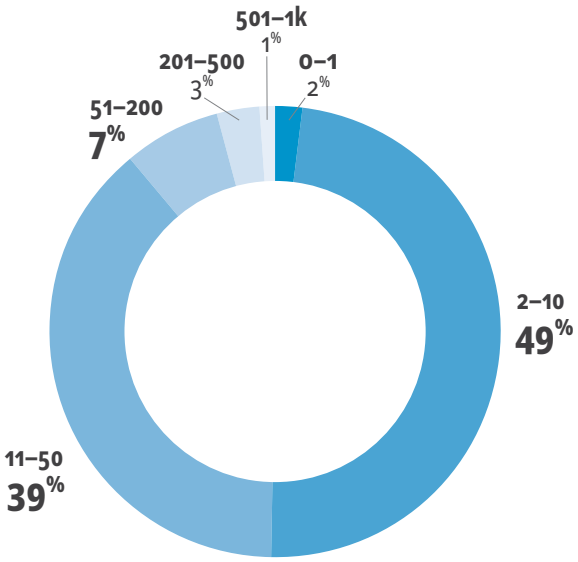


Figure 12: Alberta Health Technology Companies by Number of Employees.

Health technology companies in Alberta also do some hiring outside of the province's two major urban centres. While the vast majority of staff were in the Greater Edmonton or Greater Calgary Area, about 1% of employees were in the Lethbridge-Medicine Hat region, and the same was true for Red Deer and the Wood Buffalo-Cold Lake regions. A smaller number of team members lived in Camrose-Drumheller, Banff-Jasper-Rocky Mountain House, and Athabasca-Grand Prairie-Peace River (less than 5% of individuals in the dataset) but there were at least some health technology staff present in every economic region of Alberta.

What Does a Health Technology Team Look Like?

In-depth interviews for this study included 15 Alberta-based health technology employers.[126] Eleven employers participated in the study through a virtual focus group, and several others helped steer the study through the project advisory

[124] Business Council of Alberta, "Jobs and Job Growth in Alberta by Business Size," March 16, 2022, https://businesscouncilab.com/insights-category/analysis/jobs-and-job-growth-in-alberta-by-business-size/.
[125] This figure is a conservative estimate based on employee data from Pitchbook, Vicinity Jobs Inc. data, and manual web search.
[126] See Appendix A for methodological details.

committee. Research contributors included CEOs, COOs, Directors, Founders, and Talent Acquisition Specialists. Companies' services included precision medicine and diagnostics, digital health services (e.g., virtual care platforms, applications, and services), remote monitoring devices, and other products and services related to health technology.

In interviews, research contributors described their current team structures. The following three examples show that many health technology companies require personnel with expertise in medicine or science, business development and sales, technology, quality assurance, project management and operations, and government relations and regulatory compliance.

#1 **A digital health solutions company's product team:** This product team is made up of 10 developers, three quality assurance (QA) professionals, two project managers, and one director. This team has two international members (developers) and keeps one project manager on the West Coast, the other on the East Coast, to be in contact with clients in time zones across North America.

#2 **A precision health solutions company:** This organization has five main teams: executive, science/R&D; machine learning and data; clinical and operations; and the quality team. Their next priority will be finding talent in sales, marketing, regulation, and government relations.

#3 **A remote monitoring medical device company:** This company is a five-member start-up, including two technical co-founders, a business development lead, a CTO, and a medical innovation specialist who provides domain expertise.

Who Are Alberta-Based Health Technology Companies Hiring?

Health technology companies are commonly posting jobs for entry-level IT support and helpdesk titles, as well as medical receptionists, data entry coordinators, executive assistants, patient care coordinators, and other administrative roles.[127] However, commonly posted roles are not always the hardest to fill. Research contributors were often using word of mouth and leveraging their networks to search for workers in mid-senior roles with multidisciplinary expertise, including the following:

Business development professionals with knowledge of international health care markets, including regulatory compliance. Selling health technologies to domestic and international clients requires deeply specialized expertise, along

[127] ICTC compiled a dataset of job posting data from Alberta-based health technology companies. Data is a combination of ICTC web scraping and data from Vicinity Jobs Inc., generated March 28, 2024.

with strong business experience. Someone in a business development lead role for a health technology company must know how to scale up from Canada while meeting the compliance requirements of health care systems in more than one country. Compliance expertise is required both for market access and for design and ideation. Health care is a highly regulated space, and companies designing applications that will interface with patients or patient data must be sure they are meeting the standards of their target markets during their early design phases.

One health technology CEO described having a problem finding mature business talent and struggled with MBA or MBT (Master's of Business Technology) graduates who went through "a fantastic curriculum" but lacked enough real-world experience to understand and apply what they had learned. The problem, they said, was that recent business graduates "have been trained to think that they're company saviours."

A central challenge echoed by many companies was finding seasoned entrepreneurs, business development, or compliance specialists with mid- to late-career experience rather than recent graduates. Because many health technology companies based in Alberta are small and in the process of scaling, interviewees emphasized adaptability, creativity, and being able to work in a close, entrepreneurial environment:

> "We're a small company at the mercy of the regulatory and investment market; we need to be extremely flexible.
>
> *Employer Roundtable Participant*

Clinicians interested in transitioning to innovation and technology. Many companies conducting medical R&D or offering health services described hiring health care professionals such as registered nurses. Companies hire health care and health sciences workers for their domain knowledge (e.g., in bioinformatics and precision health) or to offer client services. However, as Section II described, health workers might need particular skills to succeed in a health technology company, such as comfort in working remotely or specialized knowledge in a company's area of care (e.g., in adult ADHD [attention deficit hyperactivity disorder]). Furthermore, companies described having to compete with health care worker salaries across Canada for professionals with licences in multiple jurisdictions.

High-calibre technology talent, sometimes with medical expertise (e.g., AI & Bioinformatics). Many interviewees were able to hire scientists in their areas of specialization (often directly out of higher education). However, they found it much harder to source technology workers with data science, AI, or other expertise. Often, this was due to salary competition for mid- to senior-career workers in the technology sector. However, some interviewees simply described low numbers of tech program graduates in Alberta with relevant skills (e.g., one interviewee said they couldn't bring to mind any UX/UI post-secondary programs in Alberta; another said they could not find any electronic engineers in Alberta). Technology roles mentioned by interviewees are summarized in Figure 13.

> We're very focused on model building, science to machine learning. There are roles that complement this work that are notoriously hard to fill, like on the data side... and then, on the deployment piece, someone with familiarity with the technology but also with the software development skills to deploy it. What's been challenging is the more senior we go... there aren't a ton of people.
>
> *AI Consulting Worker, Interviewee*

Job Title	Alberta Employment	Median Salary, Alberta
Software Developers	16,000[A]	$85,000[B]
Software Engineers	7,600[A]	$85,000[B]
Data Scientists	3,700[A]	$85,000[B]
UX Designers	n.d.	$77,000[B]
Back-end Developers	n.d.	$75,000[B]
AI Specialists (e.g., AI & Bioinformatics, Precision Medicine)	n.d.	$85,000B [ML Engineer]

Figure 13: *Data Sources: A: Statistics Canada Labour Force Survey, November 2023 available at ICTC's eTalent dashboard: https://etalentcanada.ca/locations/alberta. B: Data from Glassdoor.com, accessed March 28, 2024. N.d.: None of these occupations has a distinct Occupation Code. From the Alberta employment numbers associated with the aggregate NOC in which each of these titles belongs, it may be that there are fewer than 1000 such professionals working in Alberta (see Statistics Canada. Table 98-10-0586-01 Employment income statistics by occupation unit group, visible minority, highest level of education, work activity during the reference year, age, and gender: Canada, provinces and territories, DOI: https://doi.org/10.25318/9810058601-eng)*

Translation Skills: A Crucial Transferable Competency Area

Health technology employers, in general, named in-demand skills associated with seniority: business development expertise, client management, agility, and deep subject matter expertise. However, nearly all emphasized that their hires needed the skills to work with colleagues in other disciplines, translate information from one domain to another, and communicate in plain language with clients and the public.

Employers and educators described what this competency area looked like for a technology worker:

> It's that translation of technical things to non-technical audiences, especially when you're adopting technology. You need to communicate your progress to stakeholders, who often aren't technical and, in the health space especially, there's risk involved. So, you want to make sure everyone's comfortable with the decisions that are being made, the tools that are being used and deployed.
>
> *AI Solutions Company, Interviewee*

For a clinician, the desired competencies included the following:

> "You need to understand how to interact with scientists—the basics around it. It's less about the skill itself but more about how to become an efficient user of technology and a communicator with people who make the technologies… You need a little bit of technical knowledge, to be able to understand 10% of the technical problem but 100% of the clinician problem. You need to have someone who can translate between the two worlds.
>
> *Health Systems Innovation Consultant, Interviewee*

For a regulatory compliance professional, the desired competencies included the following:

> "It's a talent to be able to communicate to the company the importance of making everything more difficult and adding a gazillion processes… A lot of people will be pushing back and won't want to do it. This person needs to be able to have that talent to be able to communicate… in a way that doesn't generate confrontation and conflict.
>
> *Precision Health Company, Interviewee*

Talent Acquisition

Health technology talent acquisition and development in Alberta faces two overlapping challenges: first, a shortage of clinical workers, and second, a shortage of experienced technology, business development, and regulatory professionals. In some cases, private and public sector entities are competing for talent in the same pools (e.g., an RN might work either for the province or for a virtual care company, and a cybersecurity analyst might work either for a hospital or for a health technology company). Finding talent with expertise in each of these two domains only increases the difficulty of acquisition.

As discussed in Section II, health practitioner interviewees reported experiencing burnout from COVID-19, worker shortages, overtime, and policy changes (e.g., adjustments to nursing pay, as noted by one clinical research worker). A former nurse who had left to start their own company described working 12-hour shifts for 14 to 16 days for the sake of patient safety during the pandemic, without attention to morale and sustainability. Private sector employers found that they were able to hire health care practitioners exiting their previous roles, however, they were still in competition with public employers in other provinces.

The other central challenge faced by employers in this study is a "missing middle: we have either high-skilled or no-skilled—nothing in between," one health tech

CEO commented. In other words, they can find promising students with technical and/or business educations, but these hires don't yet have domain experience. They can also find experienced professionals with senior experience and the skills they need, but many companies simply can't afford them. Wage competition with larger multinational and pure technology companies makes hiring and retaining experienced staff challenging.

Many Alberta-based companies felt they were in competition with the technology sector and larger employers when looking for experienced technology talent in Alberta. Remote work and a global talent marketplace contributed to this phenomenon, and startups found it to be a particular challenge:

> "For my world, which is in digital health, I would say top developers [are difficult to hire], and the reason that that's happening is some of the giants are opening shop more in Canada... When you're trying to offer a competitive salary, no one can compete with big tech realistically, and they'll handpick people right out of university.
>
> *Director at Healthtech Company, Interviewee*

> "The high-skill people ask for so much, and they don't like their salaries. Low-skill people are also expecting a high salary, but they don't have experience. And we don't need people with no experience. You need people with experience to continue doing things in the innovation field. We are inventors. We need someone with knowledge and experience.
>
> *Healthtech Company Co-Founder, Interviewee*

In the short term, research contributors described rewriting job descriptions to adjust high expectations for education (e.g., where possible, skills-based hiring instead of requiring PhDs, RNs, or medical degrees). They also relied on subsidized student talent and outsourcing, remote hiring, and consulting for more senior talent.

What Roles Are Health Technology Companies Looking for Outside of Alberta?

Alberta health technology companies voiced a desire to hire Alberta-first but often couldn't find the talent they needed in the province at a rate they could afford. In addition, it was often instrumental to hire people with local expertise in markets that companies wanted to access. Two interviewees had marketing leads in Ontario, for example, while many others had looked internationally for business development leads heading up European or American efforts. In addition, interviewees described looking across Canada and internationally for affordable technology and clinical talent.

Figure 14, Figure 15, and Figure 16 use ICTC's dataset of health technology companies in Alberta and examine what types of jobs they maintain outside of Alberta and outside of Canada. Using this dataset, ICTC found that about one in five employees of Albertan health technology companies are based outside of Alberta.[128] Of the non-Albertan employees, 49.3% are based elsewhere in Canada, 26.8% are based in the United States, and the remaining 23.9% are based in other countries internationally.

First, Figure 14 shows health technology employee roles located outside of Alberta by domain and by seniority. It illustrates that for HR, Operations, and Administration, as well as Business Development and Marketing, many senior roles (Founder, C-Suite, Directors, Managers, VPs, and Heads) are located out-of-province. Meanwhile, for Medicine, Science, and Technology roles, many regular team members are located out-of-province.

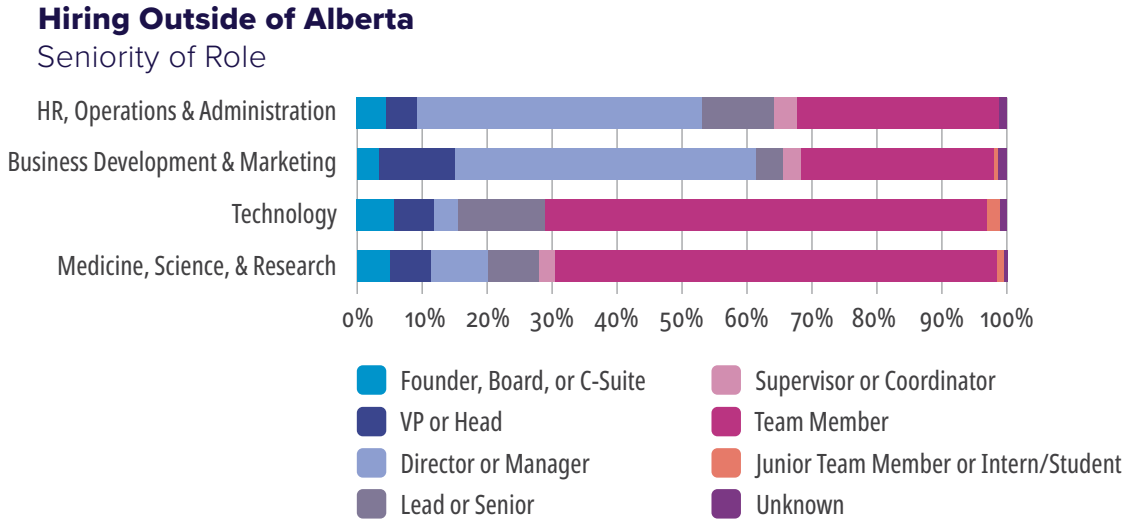


Figure 14: *Hiring Outside of Alberta, Health Technology Company Dataset, Role Type by Category and Seniority.*

Broken up by job category, Medicine, Scientists and Researchers comprise the biggest group of out-of-Alberta recruits (Figure 15). About 40% of these workers are in Canadian provinces, 37% are in the US, and the remainder are international (Figure 16).

[128] This figure also includes people who are not employed at the company, such as investors and board members.

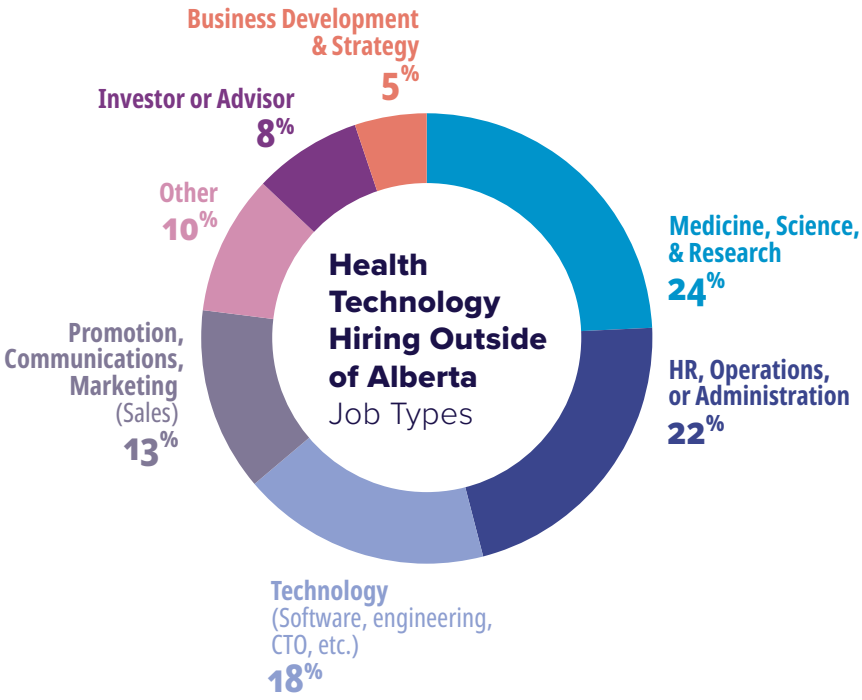


Figure 15: *Hiring Outside of Alberta, Health Technology Company Dataset, Role Type by Category.*

Hiring Outside of Alberta
Types of Roles and Geographies

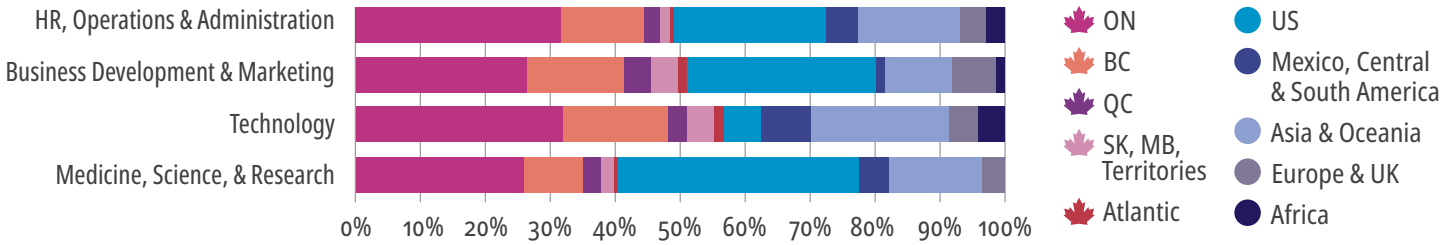


Figure 16: *Hiring Outside of Alberta, Health Technology Company Dataset, Role Type by Geography.*

There are many advantages to companies bringing in talent and expertise from other markets. Since health technology companies in Alberta want to hire local talent but find themselves unable to do so, workforce development initiatives are key. In addition, while senior business, strategy, technology, and medical talent may be easier to find outside of the province, experienced personnel bring a strong benefit to Alberta when hired locally: they teach classes, start businesses, and contribute to further job creation. Workforce development is, therefore, the focus of Section IV.

SECTION IV

Developing Health Technology Talent in Alberta

This project has so far outlined two different types of worker shortages in Alberta. First, health technology employers report a shortage of experienced, mid- and senior-career health, technology, and business workers in the province. And second, the province, like many jurisdictions, has reported a critical shortage of health care practitioners.

To acquire health technology talent in a constrained talent ecosystem, recruitment strategies like increased remuneration and skill-based hiring must be coupled with workforce development activity. Alberta has several existing strategies to promote workforce development in health care, discussed in Section II: expanding the number of seats offered in post-secondary programs and streamlining international credential recognition, for example. Meanwhile, for health technology companies, workforce development activity might take the form of fostering student talent through work-integrated learning.

Section IV will discuss workforce development for health technology in Alberta. This discussion implicates both health practitioners and health technology employees, as they are part of an integrated health innovation system. For example, health care practitioners' buy-in to technology in the workplace is part of a feedback loop that encourages or discourages health technology adoption, a key factor impacting ecosystem development, workforce development, and talent availability in Alberta.

Encouraging Student Health Technology Talent

Work-Integrated Learning

Work-integrated learning (WIL) can include practicums, course-based service learning, co-ops, internships, and any form of experience-based education that "formally integrates a student's academic studies with quality experience within a workplace or practice setting."[129] WIL-like residencies and practicums are well-established in medicine, and health care interviewees described hosting practicum or residency students and using the opportunity to teach them about real-world scenarios and tools like EHRs. Co-operative education programs (co-ops), meanwhile, are relatively well-established in STEM (science, technology, engineering, mathematics) fields in Canada. Both offer a hands-on experience that a student is unlikely to get only from theoretical classes. Executed well, WIL can help overcome the issue companies voiced of only finding "high-skilled" or "no-skilled" technical talent.

Many health technology companies who contributed to this study reported relying heavily on co-op students by:

- Working directly with Alberta post-secondaries' WIL offices to place students
- Hiring technical, business development, or regulatory interns who built needed domain expertise while finishing their degrees
- Using internships and co-ops as development periods and then bringing students into full-time roles
- Offering fellowships to doctoral and post-doctoral students with expertise in science, medicine, or technical fields like AI but without business experience
- Getting involved in capstone projects or initiatives where students receive company resources and mentorship as a part of a training program

Financial support can be essential to small companies' ability to foster a student who might, in the words of interviewees, "need four to six months of co-op training before they are ready to contribute" to a company. Research contributors encountered several barriers to participating in WIL:

[129] Co-operative Education and Work-Integrated Learning Canada, "What is Work-Integrated Learning?" accessed April 2022, https://cewilcanada.ca/CEWIL/CEWIL/About-Us/Work-Integrated-Learning.aspx.

- Not being able to access provincial funds if they were headquartered elsewhere (or had 51% of shareholders elsewhere) despite having brick-and-mortar premises in Alberta
- Not having the staff or internal resources to support students
- Not knowing who to approach to get involved in traditional WIL experiences, like capstones, pilots, or other talent development initiatives
- Not being able to use WIL funding to hire international students

For example, a wearable devices company commented that they had a specific person in mind: There's somebody who's a master's student here, an international student with specific expertise in quality management and risk management, which is really valuable and scarce locally. But we haven't managed to find the right program to hire them."

Curriculum Development

DIGITAL HEALTH CURRICULUM IN TECHNOLOGY AND BUSINESS PROGRAMS

For the most part, research contributors voiced a desire to see **improved transferable skills and workforce readiness** in new technical and business hires. Interviewed employers prioritized critical thinking, problem solving, and adaptability—qualities known to be taught effectively in high-quality WIL programs.[130] Companies can play an active role in curriculum enhancement even prior to taking on a co-op student. Interviewees described working directly with post-secondaries to trial their technologies and encourage student skill development. A wearable health technology company, for example, discussed bringing their prototypes to universities and having students help with tasks like user testing and marketing as a part of their school credits.

Employers also wanted improved **interdisciplinarity** and domain knowledge in more than one discipline. For example, they needed health care workers with technology or business expertise, or business students with expertise in technical regulatory compliance. Interdisciplinarity can be hard to teach in specialized programs, but this section gives several examples of initiatives designed to bridge the gaps between academic programs.

From February to May of 2023, Mount Royal University (MRU) piloted the first year of its **Health Technology Challenge.** Funded by Alberta Innovates and the John Dobson Foundation, the 13-week program is co-curricular WIL. It offers a $1000 stipend and a $1000 build budget for 15 students to complete a problem-solving capstone where they create a solution to solve a known problem in health

[130] Alexandra Cutean, Letitia Henville, and Faun Rice, "The Impact of Workforce Integrated Learning on Student Success and the Canadian Economy: A Case Study of Canada's Student Work Placement Program (SWPP)" Ottawa ON: Information and Communications Technology Council (ICTC), August 2023.

care.[131] In 2023, one student team built a robotic arm using motion reduction and tremor control methods to allow people with fine tremors to shave or apply makeup.[132] Students are overseen by mentors and can come from any discipline, such as computing, business, health care, and physical education. Some program graduates have found positions in health technology companies or have taken their first steps toward entrepreneurship.

Figure 17: *The Adaptive Brush, Team Mobility, Health Technology Challenge, Mount Royal University, 2023.*

Like the HealthTech Challenge at Mount Royal University, sometimes digital health curricular innovation is designed to bridge existing disciplines and sit on top of the regular curriculum. A group at the University of Alberta called the **Precision Health Signature Area** recently wrapped up a five-year program that aimed to bring computing science and health science together through collaborations across the university.[133] For example, the group organized an interdisciplinary workshop and lecture series on AI in Medicine. The PHSA mission is being continued by a new Natural Sciences and Engineering Research Council of Canada (NSERC) grant held at the University of Alberta focused on artificial intelligence and diabetes research, as well as workforce development at the intersection of these specializations.[134]

[131] Mount Royal University, "Igniting Health Technology Innovation: The HealthTech Challenge," accessed April 5, 2024, https://www.mtroyal.ca/ProgramsCourses/FacultiesSchoolsCentres/Business/Institutes/InstituteInnovationEntrepreneurship/Blog/mru-iie-W23HealthTech.htm.
[132] Ibid.
[133] University of Alberta,"What is the Precision Health Signature Area?" accessed March 28, 2024, https://www.ualberta.ca/precision-health/about/index.html.
[134] Gillian Rutherford, "Creating Canada's High-tech Innovators of Tomorrow," *University of Alberta Folio,* June 9, 2022, https://www.ualberta.ca/folio/2022/06/creating-canadas-high-tech-innovators-of-tomorrow.html.

Norquest College offers a micro-credential called **Introduction to Healthcare Technology,**[135] which is part of a set of three non-credit opportunities focused on health (also including health data and health business). Their goal is to offer foundational training for health care providers and other adult students who might want to test the waters of health informatics or health innovation as a new career path. Designed by health care providers and technologists, the program hasn't yet received industry feedback because of its recent launch. Evaluation will be the next step. The three courses include content on health regulation in Alberta and Canada, what is expected of innovators, and potential use cases for health technology solutions. Where possible, they incorporate simulation-based learning, where students participate in virtual scenarios and a debrief about how they would integrate technology into practice.

University	Program	Type	Student Group
Mount Royal University Calgary	Health Technology Program	Co-curricular Work Integrated Learning	Undergraduate Students
University of Alberta Edmonton	Precision Health Signature Area (Former), From Data to Decision (Current)	Interdisciplinary Collaboration	Graduate Students
Norquest College Edmonton	Introduction to Healthcare Tecnology	Micro-credential	Professionals

Figure 18: *Examples of Interdisciplinary Digital Health Programs in Alberta*

DIGITAL HEALTH CURRICULUM IN HEALTH CARE PROGRAMS

There is a decades-long history of Canadian and Albertan efforts to integrate digital health competencies into health practitioner education. Research contributors described national collaborations between professional associations for physicians, pharmacists, and nurses, and organizations like Canada Health Infoway and the Canadian Institute for Health Information.[136] Many interviewees had sat on committees working to articulate digital health competencies, build them into competency frameworks like CanMEDS, and create curriculum modules for schools to adapt in the classroom. Meanwhile, organizations like the Health Quality Council of Alberta, the College of Physicians and Surgeons of Alberta, and organizations like Alberta NGO Greg's Wings are active in provincial instructional committees, building bottom-up curricula, including educational videos that they can bring to clinical classrooms. In general, interviewees working in roles related to advising health practitioner curricula felt that the "wind has shifted" toward greater acceptance of the importance of digital health.

[135] NorQuest College, "Introduction to Healthcare Technology," accessed April 5, 2024, https://www.norquest.ca/programs-and-courses/programs/introduction-to-healthcare-technology/.
[136] Rashaad Bhyat, "Integrating Digital Health into Medical Education," *Canadian Family Physician* 65 (October 2019): 683, https://www.cfp.ca/content/cfp/65/10/683.full.pdf.

Despite this shift, not all research contributors have seen the results of digital health training for health practitioners yet. Health technology companies still reported experiencing a lot of "averseness" to digital health from clinicians.

Meanwhile, interviewees who had gone through health care programs felt there was some training still missing. As we saw in Section II, interviewees described a desire to see virtual care skills, data analysis skills, and other data literacy taught in post-secondaries. For example, a virtual care service provider who trained as a nurse would have really liked to see more "scenario-based education for digital health in the medical curriculum, from a patient safety perspective."

In the ICTC Health Practitioner Survey, most respondents felt that their post-secondary training had been "somewhat effective" in preparing them to use health technologies. However, a nearly equivalent number felt that it had been "not at all effective."[137]

How effective do you feel your post-secondary training was in preparing you to use health technologies?

	Not at all effective	*Somewhat effective*	*Effective*	*Very effective*
Health Aide	2	1	0	0
Nurse	3	3	0	0
Doctor	9	14	0	1
AHP	5	3	4	0
Other	0	0	2	0
Total	**19**	**21**	**6**	**1**

Figure 19: *Respondents to the ICTC Health Practitioner Survey address how effectively their post-secondary training taught digital health skills."*

When asked, "Is there anything education and training institutions could do better to improve health practitioners' ability to implement new technologies?" Respondents gave their priorities:

> "Oh heck, yes. We really didn't get any official 'training.' I answered 'somewhat effective' just because we had Netcare in training. I think training should focus around how tech will actually be used from a process perspective and how it bridges patient and provider (including managing patient behaviours around it). And security issues, I don't think enough doctors think about that.
>
> *Doctor, Greater Calgary Area*

[137] Importantly, due to its small convenience sample, this survey cannot be taken to be representative of health practitioners in Alberta. It simply reflects the perspectives of survey takers and adds context to their qualitative comments.

> Teach more about completing Privacy Impact Assessments and cybersecurity.
>
> *Doctor, Greater Calgary Area*

> Education on cybersecurity.
>
> *Nurse, Red Deer*

> Our EMRs and other systems are organisms. If not used appropriately, then they will never reach their full potential. Why not train our students how to be their experts and champions from the beginning?
>
> *Doctor, Greater Calgary Area*

> Provide an opportunity to trial a variety of virtual platforms and training for how to coach a client through a virtual consultation.
>
> *Allied Health Professional, Greater Edmonton Area*

> Add digital literacy to the CanMEDS roles and commit to high-quality training by installing tech leaders in academic medicine roles.
>
> *Doctor, Greater Calgary Area*

> Development of CME [Continuing Medicine Education] that is accredited and ongoing with funding support to undertake.
>
> *Doctor, Greater Calgary Area*

Curriculum development related to digital health faces some challenges that it shares with technology workforce development writ large. Namely, technology evolves faster than curriculum development, technologies become redundant as people are trained on them, and regulatory requirements in different jurisdictions make it hard to pick training priorities that will prepare clinicians to work across Canada. As one health innovation consultant commented, "The minimum amount of time a student can go through education until they come out the other side as a full-fledged physician is five years. So if you implement a policy today, you'll see the result of it in five years."

Upskilling Current Health Workers: Facilitating Conditions

> I've been speaking to primary health professionals, and there are people saying primary care physicians are in crisis. If you want them to use technologies, you have to give them ones that make their jobs easier right away and don't increase the stress related to technology.
>
> *Health Policy Subject Matter Expert, Interviewee*

Section II identified essential digital health competencies for today's health practitioners in Alberta. However, introducing new competencies for working professionals requires change management in a high-stress environment. On the one hand, health system innovation can remove tasks from health practitioners' plates. On the other hand, introducing new technologies without allowing extra time for professional development or designing mechanisms to account for new types of tasks can inadvertently contribute to clinician burnout.[138] While most research contributors in this project were onboarded to Connect Care and found it to be an ambitious and helpful project, some health practitioners felt that they had not been adequately incentivized to adopt the new EHR system:

> "My Community Connect Care training was 50 to 80 hours of training modules, in-person training, self-training, and on-site support/training with no remuneration, unlike all the other health care workers (RNs/AHS Pharmacists/LPNs/NPs/CAs/Administrators/Unit Clerks etc.), and further de-incentivized by understanding I would no longer have professional employment without its successful completion.
>
> *Doctor, Health Practitioner Survey*

Research contributors echoed this problem. One health policy researcher commented, "Don't put anything more on [the health system] when morale is low." Another remarked, "We need transformation. We need to be giving people the light at the end of the tunnel… How do we change the system so that they can care the way they want to and deliver the kind of care that they want to full-time?"

Intentional change management can help reduce burnout. A research contributor who had successfully encouraged early use of computers for charting (across Canada in the 2010s) described their approach: they funded provincial and territorial health authorities to support adoption, and they designed careful change management by creating "clinical peer networks that supported doctors to get on board." Making sure that health technologies fit into clinical workflows is critical.

Canadian health care researchers Lili Liu and Antonio Miguel-Cruz analyzed health technology adoption and diffusion during the COVID-19 pandemic and described basic characteristics needed to smooth the way for adoption, including "whether organizational and technical infrastructure exists (facilitating conditions) to support use of the technology."[139] Liu and Miguel-Cruz identify insurance billing regulations as one key barrier to health technology adoption in Canada, and interviewees in this study identified interoperability as another. Both of these "facilitating conditions" underpin technology adoption and its related skills development.

[138] Qi Yan et al., "Exploring the Relationship between Electronic Health Records and Provider Burnout: A Systematic Review," *Journal of the American Medical Informatics Association* 28, no. 5 (May 1, 2021): 1009–21, https://doi.org/10.1093/jamia/ocab009.
[139] Lili Liu and Antonio Miguel-Cruz, "Technology Adoption and Diffusion in Healthcare at Onset of COVID-19 and Beyond," *Healthcare Management Forum* 35, no. 3 (May 1, 2022): 161–67, https://doi.org/10.1177/08404704211058842.

Remuneration Methods

Clinician remuneration, such as insurance billing codes specific to particular health services, has been raised by both interviewees and digital health literature as a key system-level issue preventing health workers from adopting digital skills.[140] For example, billing codes might not be able to keep up with technology-enabled services or might value certain services higher or lower than others.[141] A health technology founder gave an example: "Doctors cannot bill for remote diagnostics… When they use my device, they have to bill each service separately. Is it a video conference, or is it a diagnostic test?"

Billing practices influence which patients can access health technologies. Some companies have not successfully navigated the regulatory landscape required to get public health insurance to reimburse their tests or technologies. For some interviewees speaking on behalf of companies who provide technology-facilitated care (e.g., on-demand virtual care services or e-consultations), this has meant creating billing arrangements with private rather than public insurers, leading to a disparity in how patients access their services.

In addition, billing codes might not adequately account for administration, onboarding, and skill training when a health care provider is using a new tool, or it might disincentivize spending more time with a single patient. In the Canadian Medical Association's 2021 national physician survey, when asked, "What challenges have you experienced in using virtual care in your practice?" 70% of Albertan respondents reported "inadequate remuneration for virtual care services," a significantly higher proportion than the 32% Canadian average.[142]

Pillar 5 of Alberta's Health Workforce Strategy, "Evolve," commits to innovate through activities, including modernizing the fee-for-service model that many practitioners use to better account for virtual care and technology-related tasks and services.[143] Billing codes may also disincentivize long-term, relationship-based family care, so Alberta Health and the Alberta Medical Association are creating a task force to investigate new payment models.[144]

Alberta's Alternative Relationship Plans (ARPs) are novel payment models that operate with different incentive structures. For example, one interviewee from a First Nations health organization commented that their doctors were paid under an ARP, which meant they were compensated daily instead of per patient. "That

[140] Competition Bureau Canada, "Empowering Health Care Providers in the Digital Era: Digital Health Care Market Study Report 3," November 11, 2022, https://ised-isde.canada.ca/site/competition-bureau-canada/sites/default/files/attachments/2022/04687-DHC-Market-Study-Part-3-Eng.pdf.
[141] Ibid.
[142] Canadian Medical Association, "2021 National Survey of Canadian Physicians: Quantitative Market Research Report," *Canada Health Infoway,* August 11, 2021, https://www.infoway-inforoute.ca/en/component/edocman/3935-2021-national-survey-of-canadian-physicians/view-document?Itemid=0.
[143] Government of Alberta, "Health Workforce Strategy 2023," March 13, 2023, https://open.alberta.ca/publications/health-workforce-strategy, p. 26.
[144] Government of Alberta, "Modernizing Alberta's Primary Health Care System (MAPS)," January 18, 2023, https://www.alberta.ca/modernizing-albertas-primary-health-care-system.

way, they can spend more time with their patients, and they're able to follow up better. It's not a five-minute appointment and then get out the door sort of thing." Another type of ARP is called a "blended capitation" model,[145] where family physicians receive a fixed amount per year for looking after the patients on their roster and a supplementary amount based on actual activity, number of visits, and types of services. "Then you can afford to invest in secure messaging for email communications," one interviewee offered as an example, "because that time is covered in your annual payment. And because you're so much more efficient, you can see more people."

Another interviewee working in health policy noted that ARPs were contractually connected to minimum compliance with norms such as the safe and adequate use of digital health information products. However, not all doctors are interested in ARPs. One health technology application developer commented that of the hundreds of physicians using their app, not one was on an ARP because (they assumed) it wasn't likely to pay as well. Further attention to how well different remuneration systems work to incentivize high-quality care will be an important part of digital skill adoption in Alberta.

Interoperability and Redundancy

A second "facilitating condition" for digital skill adoption is technological infrastructure with a positive user experience and few redundancies. If, for example, a family practice needs to use multiple different platforms to interact with a hospital, an allied health practice, and other care providers, health practitioners identify frustrating duplication of work.

In the ICTC Health Practitioner Survey, respondents (a mix of physicians, allied health professionals, and nurses)[146] were asked which technologies they found useful and not useful for improving the quality of care. Respondents named many specific tools that were useful, including EHRs, e-referral systems, patient portals, and transcription tools that helped them with their charting. For example, some AI-enabled transcription tools can analyze a recording of a patient interaction and generate structured digital health data for a practitioner to review and correct.[147]

Interestingly, instead of naming specific tools that were "not useful," respondents mostly talked about issues with functionality, redundancies, or fragmentation.

[145] Government of Alberta, "Blended Capitation Clinical Alternative Relationship Plan (ARP) Model," March 2, 2024, https://www.alberta.ca/blended-capitation-clinical-alternative-relationship-plan-model.
[146] See Appendix A for methodological details.
[147] An interviewee mentioned that this was likely to be available in Alberta EHR systems soon, but that it still had a "long way to go for more complex interactions." In addition, inclusive design and data richness in an EHR merits attention here, so that structured data is using appropriate variables to populate patient records.

WHAT HEALTH TECHNOLOGIES DO YOU NOT FIND PARTICULARLY USEFUL IN IMPROVING QUALITY OF CARE?

> Systems that are several layers deep and have poor EMR integration for community physicians.
>
> *Doctor, Greater Calgary Area*

> Too many EMRs.
>
> *Nurse, Red Deer*

> When there are multiple systems that do not properly interact and communicate with each other.
>
> *Allied Health Professional, Greater Calgary Area*

> E-referrals, only because they are underutilized.
>
> *Allied Health Professional, Athabasca-Grande Prairie-Peace River Region*

> Virtual care does not allow for as detailed assessments.
>
> *Nurse, Greater Edmonton Area*

> A lot of redundancies in the programs. Easier access to messaging also results in a high burden of questions/messages—I often get asked about clinic issues while on busy hospital services. Getting 20 small issues from outpatient workup while taking care of very sick hospital patients at the same time is not efficient—no clear system to differentiate from minor issues to major ones unless you go through all of it.
>
> *Doctor, Greater Calgary Area*

Respondents' answers to this question point to issues with interoperability and the administrative overhead of using new systems if they create redundancies in documentation or fail to triage tasks effectively. In a recent report titled "Interoperability Saves Lives," The Alberta Virtual Care Coordinating Body (AVCCB) finds that Alberta has pushed forward important technical advances in EHRs, including Albert Netcare, the MyHealth patient portal, and Connect Care (discussed earlier in this report). However, "interoperability of health data across community-based health services (e.g., primary care services), and different members of a patient's distributed care team has not yet materialized."[148] In some cases, interoperability is tied to access. For example, a project contributor working with a First Nations health organization described trying to get read/write access to Connect Care in their jurisdiction without success. "Interoperability Saves Lives"

[148] Alberta Virtual Care Health Data Interoperability Working Group, "Interoperability Saves Lives," October 2023, https://www.albertavirtualcare.org/_files/ugd/efde1a_43101bc906434781a6d497cd576602c1.pdf, p. 13.

recommends that Alberta introduce health data interoperability legislation, along with enhancing health sector "literacy about the foundational importance of interoperability."[149]

ICTC's focus is primarily on in-demand roles and skills in digital health, and topics regarding interoperability and systems integration have been better and more fulsomely addressed by organizations such as the AVCCB, the Application Integration Working Group of AHS,[150] and the Health Quality Council of Alberta (HQCA).[151] However, respondents in this study have emphasized that skill development is inextricable from the human and technological systems surrounding clinicians and how effectively they work.

Ecosystem Development

A strong business ecosystem contributes to both workforce development and job creation. In a previous ICTC study on innovation and Foreign Direct Investment, a case study on the medical devices industry illustrated how a critical mass of companies in a region helped retain senior talent in Canada if their company was acquired.[152] This study hypothesized that a critical mass of companies in a particular sub-sector could be "self-pollinating"; as companies successfully exit, senior talent has options in their city or province[153] and seasoned entrepreneurs moving to a new company can help train a new generation of founders and lend credibility to efforts to attract funding.

Many Alberta health technology companies who contributed to this study struggled to find senior talent with experience in business development, market access, and regulatory compliance in the province. A more robust health technology business ecosystem in the province would promote job creation, but it also has the potential to promote workforce development. As more experienced leaders are retained in the ecosystem, the next generation benefits from their expertise.

AI is a good example of this principle in Alberta. Despite the dissolution of Google's DeepMind office in Edmonton, senior researchers have gone on to new roles in the province, lending their names and expertise to new ventures.[154] A critical mass of talent, partnership opportunities, and AI businesses might have made this possible for ex-Google researchers, where ecosystem-building companies like the Alberta Machine Intelligence Institute (AMII) and companies that spun off of work at the University of Alberta created an ecosystem large enough to survive without Google. Workforce development also benefits directly from former Google leads continuing to teach new AI researchers at the University of Alberta.

[149] Alberta Virtual Care Health Data Interoperability Working Group, "Interoperability Saves Lives," October 2023, https://www.albertavirtualcare.org/_files/ugd/efde1a_43101bc906434781a6d497cd576602c1.pdf, p. 14.
[150] A group that works with SMEs to understand market opportunity in health information.
[151] See, for example, discussions of e-referral standardization in Health Quality Council of Alberta, "Patient Perspectives on an Electronic Referral System for Alberta," January 2016, https://hqca.ca/wp-content/uploads/2021/12/E_Referral_Summary_Report_FINAL.pdf.
[152] Mairead Matthews and Faun Rice, "Context Matters Strengthening the Impact of Foreign Investment on Domestic Innovation" (Ottawa, ON: Information and Communications Technology Council (ICTC), May 2022), https://www.digitalthinktankictc.com/reports/context-matters, p. 45.
[153] Ibid.
[154] Lynda Vang, Richard Sutton, and Cam Linke, "John Carmack and Rich Sutton Partner to Accelerate Development of Artificial General Intelligence (AGI)," *Amiii News,* Sept 25, 2023, https://www.amii.ca/latest-from-amii/john-carmack-and-rich-sutton-agi/.

Many ecosystem-building activities contribute to workforce development in health technology in Alberta. The following were top of mind for research contributors and focus primarily on opportunities within Alberta rather than federal measures like regulatory and policy levers.[155]

Accelerators, Incubators, and Post-Secondary Innovation Hubs

Companies described taking advantage of programs like the TELUS Community Safety & Wellness Accelerator[156] and Canadian Technology Accelerator for digital health, which offer advisory meetings, virtual workshops, and in-market visits to the US.[157] Network-building organizations like Plug and Play, Health Cities, and Platform Calgary also provide companies with an opportunity to meet like organizations, partner (in some cases, share senior or advisory talent) and take advantage of educational opportunities.

Several research contributors had gotten their start with help from innovation hubs at Alberta post-secondary institutions. However, one commented that they'd like to see more interconnection between innovation/entrepreneurship hubs and clinical programs, not just with science and technology programs. A precision health company said of a university incubator service, "Their executives in residence helped us with business development, the business plan, the pitch deck, the financial forecasts, and all those things we knew nothing about."

Granting Agencies, Venture Capital, and Scale-Up Funding

Alberta Innovates supports education and entrepreneurship, and has a health innovation priority area that funds research, commercialization, and talent development.[158] Research contributors relied on Alberta Innovates funding to support them in the early stages of company development and also took advantage of federal programs like the National Research Council's Industrial Research Assistance Program (IRAP).[159] Grant funding was particularly important for startups and scale-ups that found domestic fundraising challenging and relied on accelerators and non-dilutive funding to bring their products to market.

For the most part, interviewees piloted their solutions in Alberta but then worked to scale their products to markets outside the province. A CEO of an Alberta scale-up commented, "You need to leave Alberta to mature and then return to Alberta, which I feel like [is how we] lose a lot of companies and home-grown, scaled-up success stories." Another founder echoed this sentiment, "The thing about medical technology is that the Americans are way faster at taking it up." According to some

[155] For a discussion of federal regulation in health technology and its impact on adoption and company development, see for example: Rosina Hamoni, Mairead Matthews, and Maya Watson, (2021), "Digital Transformation: The Next Big Leap in Healthcare," Information and Communications Technology Council (ICTC), https://www.digitalthinktankictc.com/reports/digital-transformation.
[156] Telus Community Safety & Wellness Accelerator (CSW), "Our Why," accessed March 28, 2024, https://cswaccelerator.com/.
[157] Government of Canada, "United States Digital Health – Canadian Technology Accelerator," March 1, 2024, https://www.tradecommissioner.gc.ca/cta-atc/digital-health-sante-numerique.aspx?lang=eng.
[158] Alberta Innovates, "Health Innovation Team," accessed March 28, 2024, https://albertainnovates.ca/about/who-we-are/teams/health-innovations-team/.
[159] National Research Council of Canada, "Support for Technology Innovation," December 20, 2023, https://nrc.canada.ca/en/support-technology-innovation.

research contributors, this was in part due to investor pressure: "If you want to invest in my company, you want to see that I am signed onto AHS, but here I'm looking at a 24- to 26-month procurement cycle. So, the investor says, 'Go to the US to sell faster, then you can scale.'"

Health policy researchers have observed that health technologies "funded by and oriented to American markets where the technologies may be more rapidly commercializable and profitable" can become "inconsistent with the cost-containment and sustainability aims of a publicly funded health care system,"[160] In addition, if companies fail to pre-emptively understand the necessary requirements for privacy, security, and accessibility, their ability to commercialize their technologies in Alberta or Canada will be limited, as the subsequent section addresses.

Public Procurement, Pilots, and Partnered R&D

Public procurement is a powerful tool for supporting local innovation and job creation.[161] In the health care domain, however, public procurement must be limited by regulatory compliance (with, for example, health data privacy standards), interoperability with public systems, and responsible use of public funds. In addition, public procurement may have restrictions around vendor size and comparable experience that preclude local scale-ups.[162]

Alberta has set tools like the Health Technology Assessment (HTA) process to formally "provide evidence to decision-makers to help them determine whether to publicly provide select health technologies."[163] In addition, Alberta Health Services has an innovator toolkit that offers guidance to health technology companies that want to integrate with their existing services.[164] In partnership with Alberta Innovates, AHS also offers grants focused on piloting digital health solutions under the Partnership for Research and Innovation in the Health System (PRIHS) Program.[165]

Research contributors were of two minds about whether regulation surrounding public procurement in health was set to an appropriate standard:

> "We expect innovators/technology developers, who are often walled off from the health system, to build solutions that can meet the privacy and security standards of the health system, make it through a complex regulatory environment, and then a complex procurement

[160] Maggie MacNeil et al., "Enabling Health Technology Innovation in Canada: Barriers and Facilitators in Policy and Regulatory Processes," *Health Policy* 123, no. 2 (February 1, 2019): 203–14, https://doi.org/10.1016/j.healthpol.2018.09.018.
[161] Tyler Farmer, Mairead Matthews, and Faun Rice, "Procurement Office or 'Living Lab?' Experimenting with Procurement and Partnerships for Smart Cities Technologies in Canada" (Ottawa, ON: Information and Communications Technology Council, February 2021), https://www.ictc-ctic.ca/wp-content/uploads/2021/03/ICTC_Report_SmartCities_ENG.pdf.
[162] Ibid.
[163] Alberta Health, "Maximizing the Impact of Health Technology Assessment: The Alberta Framework," June 2017, https://open.alberta.ca/dataset/39ddae93-8840-49a3-aee2-9a88702a7e06/resource/b117e72d-eaec-4010-a5dc-1005dc9f8680/download/hta-framework-2017.pdf.
[164] "Connect Care Innovator Toolkit," Alberta Health Services, Health Evidence and Innovation, 2022, https://innovators.connect-care.ca/
[165] Alberta Innovates, "Partnership for Research and Innovation in the Health System (PRIHS) Program," accessed March 28, 2024, https://albertainnovates.ca/funding/partnership-for-research-and-innovation-in-the-health-system-prihs-program/.

> environment. It is common to see innovators start building for the health system, then realize how complicated it is and try to pivot to just targeting consumers. Health care is one of the most complex and difficult industries to build solutions for. As a result, many care providers/end users don't see fit-for-purpose solutions.
>
> *Advisory Committee Member*

> "I think the value demonstration needs to be at a much higher level in health than it does in other industries to be able to do those pilots and demonstrations. Last but not least is a financial issue. In general, our health system has no more money.
>
> *Public Health Researcher, Interviewee*

Family practices and community clinics often manage their own procurement, meaning that many health technology companies pitch their solutions to individual health clinics one at a time. For this reason, physician and clinic lead buy-in is essential to health technology adoption, and encouraging buy-in begins at the curricular level. Companies often need to run education campaigns making clinics aware of their products. Alberta organizations like Health Cities can help with this kind of initiative by distributing information through their Primary Care Networks.[166] The same is true for allied health private practices. For the most part, practitioners said that they were open to adopting technologies if they could see a clear value add for their businesses or clients:

> "I am not forced to use any particular tech. I incorporate [tech] with clients as it makes sense.
>
> *Kinesiologist, Greater Calgary Area*

> "[What incentivizes adopting a new technology?] Ease of use, increased patient benefit, faster referral times, ability to speak directly with a specialist in a timely manner.
>
> *Family Nurse, Drayton Valley*

Post-secondary institutions in Alberta also run pilot programs with some technology providers. One research contributor described, for example, a partnership allowing them to include their devices in a University of Alberta emergency medicine toolkit. However, another company mentioned they hadn't been able to participate in health technology pilots to date because it was difficult to find ones that would pay for their products. "We would have to pay them to use our device," they explained. A third described waiting for clinical trial approval and/or ethics approval as untenable for their timelines: they opened a subsidiary in

[166] An interviewee reported taking advantage of this service.

Melbourne, Australia, where they commented that they received ethics approval for human studies in "less than a month." Finally, a research contributor warned about "pilotitis": "We 'pilot' everything, prove that it's effective, and then never actually adopt." They cautioned that companies need infrastructure and strategies to scale past successful pilots.

Health insurance companies also procure digital health solutions and can act to encourage local innovation. One interviewee commented that insurers faced some of the same constraints as public procurers: they had minimum standards related to accessibility and privacy, for example, that they required vendors to meet. They found that Albertan vendors weren't always familiar with accessibility standards: "When we look at things like digital health for mental health or patient navigation, if I put an accessibility requirement and am very strict, we typically drop at least 90% of potential companies that we could have partnered with." Furthermore, individual clients of insurance companies decide which packages to add to employee benefit plans, such that companies less familiar with digital health might not see related solutions as valuable.

Health Data Sharing

> "Alberta has a strategic advantage: advanced computational approaches to understand, interrogate, and leverage the data assets and resources that we have here in the province. As Alberta has a single EMR system, we have more data resources, I think, than any comparable jurisdiction in North America.
>
> *Clinical Research Subject Matter Expert*

Shared responsibly and with appropriate attention to data quality and richness, health data from province-wide EHRs creates important potential for health technology innovation in the public and private sectors alike. One contributor commented, "Better access to the health datasets is going to help us have better adoption of technologies and medicines, predict health outcomes, identify precursors and early onset diseases."

Alberta has increasingly robust intersectoral organizations dedicated to ensuring that health data can be shared securely and with appropriate dedication to patient privacy. Within AHS, there are working groups dedicated to facilitating innovator applications for data and guiding innovators toward compliance and interoperability with AHS systems. Outside of AHS, accelerator and networking organizations also have staff dedicated to setting up appropriate connections between health technology companies and data stewards.

From a user perspective, health technology companies reported mixed experiences. One reported being successful in getting access to EHR data but commented that it had postponed their project by about a year because of the process of advocating for access. Yet another felt that information sharing was "open and collaborative":

"There is always something more we can do, but it's probably better than a lot of jurisdictions." All told, population-level data sharing appeals to most parties who contributed to this study if rolled out appropriately with respect for individual privacy and Indigenous data sovereignty. As with other facilitating conditions, secure and private health data sharing is not a simple task. Alberta has begun to tackle this, and further visibility for public sector initiatives to make data sharing accessible will be an important next step.

Conclusion

Health care innovation in Alberta is on its way to reducing the burden carried by an oversubscribed health care system. Health care practitioners, innovators, and policymakers are part of an interconnected innovation system driving this change. However, a cultural shift is required to make the most of health technologies and to be sure they are trialled and implemented responsibly.

This report has described the status of the health technology workforce in the province of Alberta and outlined priorities for talent development based on in-depth consultations with subject matter experts, health care practitioners, health technologists, and policymakers. For health practitioners, digital health competencies like data analysis and virtual care skills must be paired with facilitating conditions to support intentional change management while introducing new technologies to avoid additional health provider burnout. In addition, more attention to digital competencies up and down the clinical hierarchy is crucial to solving the problem of continuing care and an aging population. To this end, health care aides can also play a growing role in Alberta's health care workforce.

Meanwhile, Alberta's health technology business ecosystem is increasingly on the hunt for seasoned business and technology talent for companies to scale and create more jobs in the province. Unfortunately, affordable mid- and senior-career workers with interdisciplinary expertise are currently difficult to find. A combination of workforce development techniques, including work-integrated learning, public-private partnerships, and procurement, are required to fill this gap and build a self-sustaining pool of jobs and experienced workers to keep Alberta's health technology sector moving forward.

Finally, health innovation requires both a willingness to try new technologies and attention to public safety, privacy, and equity. Without careful, inclusive design, attention to equitable reimbursement, and adequate connectivity infrastructure, some health technologies run the risk of transporting existing inequities in access to and quality of care into a new era. This challenge is not small, but Alberta is well-positioned to take this challenge on. With its unified EHR system and its many advocacy and educational organizations, Alberta's health innovation advocates are working toward improved quality of care as a multi-lateral group.

Appendix A: Research Methods and Tools

This project involved a mixed-methods approach. It began with an environmental scan and literature review to refine the project scope and research questions. Secondary data used throughout the report includes information from Statistics Canada's 2021 Census, the Statistics Canada Labour Force Survey, and the Canadian Institute for Health Information, as well as project partners. Additional primary and secondary research tools are described below.

ICTC Health Technology Company Dataset

ICTC leveraged Pitchbook data to generate a list of Alberta-based health technology companies by using an extensive list of search terms to describe the digital health business ecosystem. Additional data was sourced from Vicinity Jobs Inc. In addition, ICTC added missing health tech companies that were recommended by key informant interviewees or advisory committee members. The original list of companies had 241 entries. The ICTC team manually checked companies from PitchBook to ensure they were still operational (based on a web presence and/or social media activity) and removed 51 entries from the list for a final total of 190. Not all figures include all 190 companies (e.g., the illustration of founding dates) for items where a data point does not exist.

Key Informant Interviews

ICTC conducted 39 key informant interviews (KIIs) with representatives from health care providers, health tech companies, and public institutions. Interviews were semi-structured, approximately 45 minutes in length, and conducted virtually.

Health Practitioner Survey

The ICTC Health Practitioner Survey was distributed to a mix of Albertan physicians, allied health professionals, and nurses to gather information on what technologies health practitioners found most or least helpful, what skills they most wanted to develop, and other relevant topics. The survey received 52 complete responses. The survey was built to replace roundtable and interview feedback when health practitioners did not have adequate time to meet an ICTC team member. Accordingly, it was primarily qualitative, involving several open-ended questions. Survey responses are only intended to represent the views of those in the sample and cannot be said to represent health practitioners across the province more broadly.

Advisory Committee

ICTC created a project advisory committee of 19 subject matter experts from Alberta's health technology industry, health care system, and other related fields. Most advisory committee members are based in Edmonton or Calgary, but invitations were extended to people from all regions of Alberta. The project advisory committee guided the study methodology and provided feedback on the research as it progressed.

Roundtables

ICTC planned to host three virtual roundtables of approximately 15 participants each to collect feedback from health technology employers and practitioners. However, participant recruitment proved challenging, and attendance at the first two roundtables was low. ICTC hypothesized that a virtual meeting during the workday was a challenging commitment for health care providers. To pivot, ICTC gathered additional interview data for health technology companies and created a qualitative health practitioner survey that was distributed with the help of partners.

Limitations and Opportunities for Future Research

Several limitations related to this project's data sources have been discussed throughout the report. First, it is likely that some companies (e.g., companies not yet hiring) are missing from the health technology company dataset. In addition, Section III of this study describes the challenge of ascribing a number to the health technology workforce in the province without double counting. Furthermore, this study likely involves response bias: interviewees and survey respondents who engaged with the research team were likely to be interested in the topic of technology. Finally, this project occurred in the midst of organizational changes in Alberta Health Services. Advisory Committee members and interviewees advised that the likely impact of the structural change at AHS on the labour market, as described in this project, won't be clear right away.

This study primarily offers a synthesis of research and primary research participants' perspectives on health technology and the labour market in Alberta. Future research might explore specific questions arising from this synthesis, such as the following:

- What incentivizes/disincentivizes ARP payment plan uptake, and how do remuneration schemes impact the use of different digital health technologies in Alberta?
- What role might there be for improved incentives for health care practitioner upskilling after post-secondary education?

- How will e-scribe and e-abstraction tools (NLP tools for charting and populating EHRs) change the clinical informatics skills that health practitioners require?
- What is the best way to balance Indigenous data sovereignty and principles such as OCAP (ownership, control, access, and possession) with health data interoperability in Connect Care? (Best led by an Indigenous organization)
- What is the role of national and multinational organizations in Alberta's health technology ecosystem: How many Albertans are employed by these firms? What firms are they acquiring? What impact does this have on talent retention and job creation?
- What incentivizes mid- and senior-career health technology talent to stay in Alberta?
- What changes will the new structure of AHS make to topics discussed in this report, including health technology adoption, implementation, and talent?