



BMJ Open What is the level of information technology maturity in Ontario's long-term care homes? A cross-sectional survey study protocol

Ramtin Hakimjavadi,^{1,2} Sathya Karunanathan,^{2,3} Gregory Alexander,⁴ Celeste Fung,^{5,6} Mohamed Gazarin,⁷ Deanne Houghton,² Amy T Hsu ^{2,8}, James LaPlante,² Cheryl Levi,⁹ Peter Tanuseputro,^{2,6,8} Clare Liddy ^{2,6,10}

To cite: Hakimjavadi R, Karunanathan S, Alexander G, *et al*. What is the level of information technology maturity in Ontario's long-term care homes? A cross-sectional survey study protocol. *BMJ Open* 2023;**13**:e064745. doi:10.1136/bmjopen-2022-064745

► Prepublication history and additional supplemental material for this paper are available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2022-064745>).

Received 12 May 2022
Accepted 29 January 2023



© Author(s) (or their employer(s)) 2023. Re-use permitted under CC BY-NC. No commercial re-use. See rights and permissions. Published by BMJ.

For numbered affiliations see end of article.

Correspondence to
Dr Clare Liddy;
cliddy@uottawa.ca

ABSTRACT

Introduction The number of Canadians 75 years and older is expected to double over the next 20 years, putting continuing care systems such as long-term care (LTC) homes under increasing pressure. Health information technology (IT) has been found to improve the quality, safety and efficiency of care in numerous clinical settings and could help optimise LTC for residents. However, the level of health IT adoption in Ontario's LTC homes is unknown and, as a result, requires an accurate assessment to provide a baseline understanding for future planning.

Methods and analysis We will use a cross-sectional design to investigate the level of IT maturity in Ontario's LTC homes. IT maturity will be assessed with the LTC IT Maturity Instrument, a validated survey examining IT capabilities, the extent of IT use and degree of internal/external IT integration across the domains of resident care, clinical support and administrative activities. All LTC homes in Ontario will be invited to participate. The Director of Care for each home will be directly contacted for recruitment. The survey will be distributed online (or by paper, if preferred) to LTC homes and completed by a staff member designated by the LTC to be knowledgeable about its IT systems. Analyses will consist of descriptive statistics characterising IT maturity across LTC homes and inferential statistics to examine the association between key facility-level characteristics (size, ownership, rurality) and IT maturity.

Ethics and dissemination This study was reviewed by the Ottawa Health Science Network Research Ethics Board and was exempt from full ethics review. Findings will be disseminated through peer-reviewed publication and presentations to the scientific community and stakeholders. Dissemination of our findings will not only inform provincial planning for harnessing the potential of technology in LTC but may also enable quality improvement initiatives in individual LTC homes.

INTRODUCTION

In Canada, the population of adults aged 75 years or older is anticipated to double over the next 20 years,¹ leading to unprecedented pressures on continuing care systems and a

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ This province-wide assessment of information technology (IT) maturity in long-term care (LTC) will be the first of its kind in Canada.
- ⇒ The IT Maturity survey comprehensively measures IT adoption in the LTC setting, has been validated and undergone several revisions by LTC experts, and has previously been distributed in several nationwide studies in the USA.
- ⇒ We will contact every provincial LTC facility individually and personalise the follow-up to optimise participation rate.
- ⇒ The anticipated length of time for completing the survey may be a limiting factor for achieving higher response rates.

considerable increase in the need and demand for long-term care (LTC) homes. Before the COVID-19 pandemic, Canadian LTC homes faced issues with integrating transitions in care across health systems, implementing routine monitoring and data collection, and using available data to promote change and address other deep-rooted problems.² During the pandemic's first wave, residents in LTC homes were disproportionately affected and accounted for more than 80% of pandemic-related deaths, further exposing many of these long-standing and significant disparities in care delivery.³

Health information technology (IT), which encompasses the technological tools and software used to support the clinical, financial and operational needs of health-care providers,⁴ can positively impact the quality, safety and efficiency of care across multiple clinical settings.⁵ With planning and appropriate investment, these gains may also be realised in LTC,^{6–8} where residents are more likely to have complex needs that require the coordination of multiple

healthcare professionals, particularly during transitions of care.⁹ Early research supports that health IT in LTC can improve care quality, resident outcomes and clinical support,^{10–14} thus helping address some of the deficiencies in the sector. Several changes in the care received by residents during the pandemic illustrate some of these opportunities. This includes residents experiencing a reduction in contact, whether in-person or virtually, with family and friends.¹⁵ Fewer physician visits for LTC residents, and a similar reduction in physician care orders, also suggest that in-person visits were not being replaced with virtual visits.¹⁵ While the causes of these changes in care delivery are complex and require multifaceted solutions, they highlight adoption of basic telemedicine tools and communication technologies as an important part of the solution to such gaps.^{15–17} Indeed, technology adoption has already been included by the Public Health Agency of Canada in their strategy to combat social isolation and promote the overall well-being of residents.¹⁸ In other countries, similar support has taken place to promote the use of technology, such as telehealth, in LTC to protect residents during the pandemic.^{19–21} Beyond telehealth and telemedicine, many technologies have been described in LTC, including applications in remote monitoring, family caregiver support, assisted living and robotics,²² further illustrating the breadth of opportunities available for driving innovation in the sector. The integration of these IT tools into LTC settings can improve communication between and across healthcare providers, caregivers and patients in LTC, which leads to improved health outcomes and quality of life for patients in LTC.^{14 18–22}

Although recent reporting suggests an overall growth in health IT adoption across the Canadian healthcare system,²³ routine and detailed assessments from LTC homes are lacking.² Available literature shows that investment and adoption of foundational IT systems, such as interoperable electronic health records and health information exchange systems, has lagged in LTC when compared with ambulatory and community care settings.^{9 24 25} Beyond this, however, the level of IT adoption across the sector is poorly understood. This

lack of accurate assessment of health IT adoption makes it difficult for jurisdictions like Ontario, Canada's most populous province, to understand what technologies are being used in its LTC homes. To this end, a baseline understanding of the current level of health IT adoption in LTC (eg, access to reliable internet or tools supporting provider-to-provider communication), and the specific gaps that may exist in Canadian LTCs, will be fundamental in harnessing the potential of technology in the sector.

The LTC IT maturity survey is a tool for establishing robust health IT evaluations and addressing these information disparities in Ontario.²⁶ The LTC IT maturity survey, comprised of a survey and its associated staging model, has evolved through several iterations of development, validation and well-documented testing in the USA.^{27 28} It describes a framework for understanding IT adoption levels in LTC and IT maturation over time. The distribution of this survey allows for exploring associations between IT maturity and key LTC facility characteristics. Studies of LTC IT in the US have found differences in IT sophistication (an analogous measure to IT maturity) relative to LTC home characteristics (ie, ownership, location and size).^{29–31} A spectrum of IT maturity may exist across the LTC sector in Ontario, the setting of the proposed survey, and it will be helpful to identify inter-facility differences that may contribute to different levels of IT adoption.

Research aims

We have selected the LTC IT maturity instrument for this study to:

1. Establish a baseline assessment of IT maturity in Ontario's LTC sector across three dimensions of IT—capabilities, extent of use and degree of integration—using the LTC IT maturity instrument.
2. Explore the association of key facility characteristics with measures of IT maturity, including facility (bed) size, ownership type and rurality of participating LTC homes.

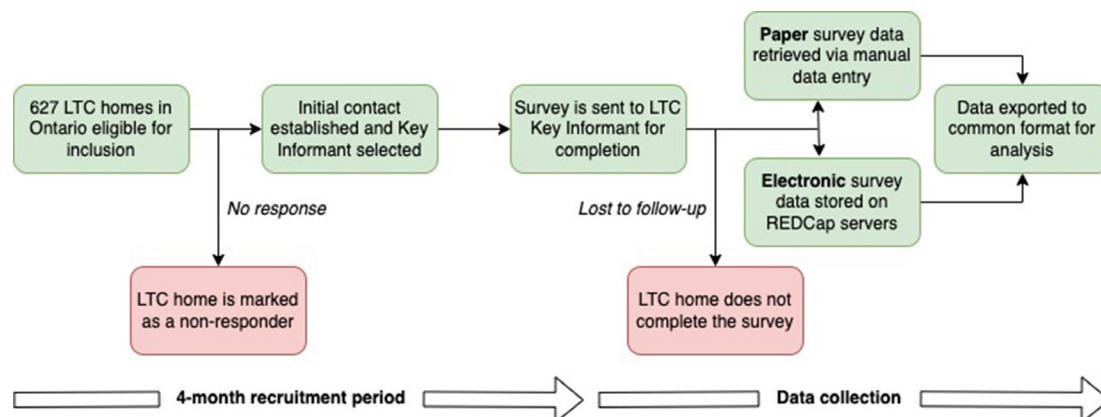


Figure 1 Recruitment and data collection period. LTC, long-term care.

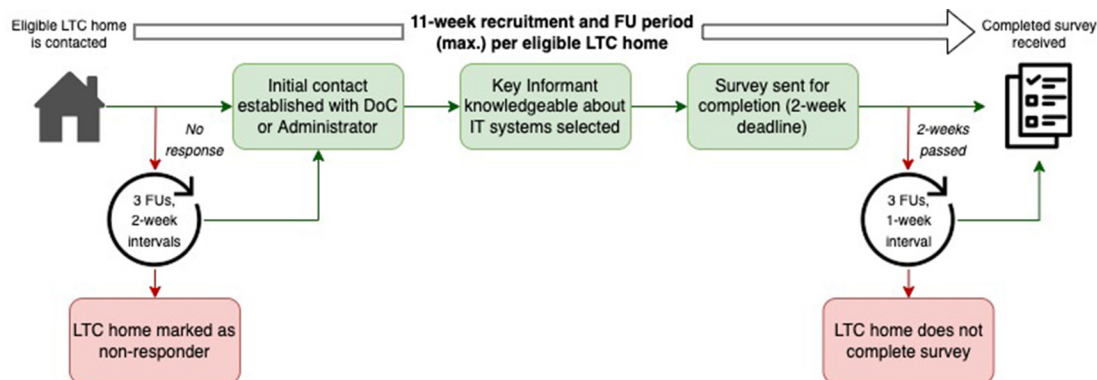


Figure 2 Individual LTC home recruitment and follow-up flowchart. DoC, director of care; FU, follow-up; LTC, long-term care.

METHODS AND ANALYSIS

Design

This is a cross-sectional study of IT maturity in Ontario's LTC homes at the time of survey start, anticipated to be in January 2023. Once started, the study will take 12 months to complete (online supplemental figure 1).

Patient and public involvement

A multidisciplinary team codesigned this study using an integrated knowledge translation approach. Stakeholders and knowledge users (ie, clinicians and patient partners) have and will continue to be involved in all stages of the study, including the development of the research questions and the selection and piloting of the survey.

With many Canadian LTC homes overburdened by COVID-19, stakeholders will help ensure that recruitment strategies are tailored and considerate. Those with direct experience working in LTC also advised on the feasibility of participating in a survey study from the LTC work environment and assisted with identifying suitable ways for compensating survey respondents for their time. All stakeholders will be invited to contribute to the presentation and interpretation of the results and prepare findings for dissemination.

Lastly, our team will engage select local and provincial organisations involved in the LTC sector to seek their support in distributing the survey and advocating for its completion.

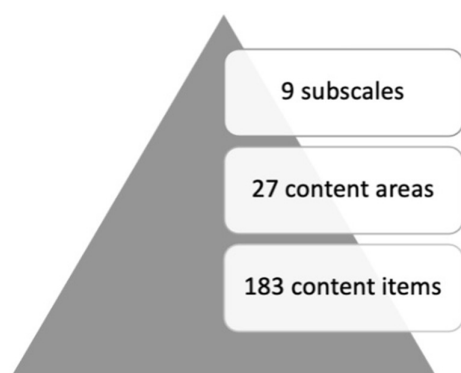


Figure 3 LTC IT maturity survey hierarchy.

Population

As of January 2022, there were 627 publicly funded LTC homes operating in the province of Ontario, accounting for 30.2% of all homes across Canada.³² Ownership status of these homes can be public or private. In Ontario, 16% are publicly owned, 57% are owned by private for-profit organisations and 27% are owned by private not-for-profit organisations. We retrieved detailed information for each facility, including the Home Master Number (a unique four-digit identifying code assigned to all homes), complete address and contact information for the Director of Care and the facility's Administrator, via a data request made to the Ontario Ministry of Long-Term Care (MLTC).

We will contact all LTC homes in Ontario for inclusion in the study.

Recruitment

We will extend invitations to the Director of Care or an Administrator from all LTC homes operating in Ontario, using the contact information provided in the data request to the MLTC. Each respondent will be asked to select a staff member knowledgeable about the IT systems within their facility to complete the survey. This individual, the key informant, will be chosen depending on the organisational hierarchy, availability and level of IT training of the institutions' staff. [Figure 1](#) provides an overview of recruitment and data collection processes.

We will conduct participant recruitment and follow-up for a period of 4 months ([figure 1](#)). Contacting and following up with a single eligible LTC home could take 11 weeks ([figure 2](#)). We will first contact the Director of Care or the LTC administrator by phone to inform them about the study; if there is no response, we will follow-up by phone or email three times at 2-week intervals. After this, if contact is unsuccessful, the facility will be marked as a 'non-responder'.

An invitation to complete the survey will be sent by email to participating respondents, offering the choice of an electronic or paper survey. This email will include a description of the study's objectives, an overview of the survey questions and a summary of rights as participants. Respondents will be informed that the survey will take

between 30 and 45 min to complete and that completing the survey will be considered giving consent to participate. An honorarium (CAD \$100) will be sent to participating LTC homes as compensation for completing the survey.

Respondents will be asked to complete the survey within 2 weeks of sending the invitation to participate. Once this deadline has passed, up to three follow-up calls or emails will be made at 1-week intervals.

IT maturity and the stage of IT maturity in LTC

The LTC IT maturity instrument comprises a hierarchy of IT maturity subscales, content areas and content items (figure 3). IT maturity is assessed by evaluating three IT dimensions: IT capabilities, extent of IT use and degree of internal/external IT integration. Across all three,

there are 27 content areas: 12 relating to IT capabilities, 8 relating to extent of IT usage and 7 relating to IT integration internally and externally to each LTC home (table 1). Content areas consist of dichotomous, Likert-scale and scoring content items, totalling 183 items to be completed by the survey respondent. Selection of the items contained within the survey resulted from four Delphi rounds involving a panel of LTC experts.²⁶ In addition to being distributed across three IT dimensions, the content items assess IT integration across three healthcare domains relevant to LTC. These domains are resident care, clinical support (ie, laboratory, pharmacy, radiology) and administrative activities. The IT dimensions and healthcare domains combine to form a 3×3 matrix, consisting of nine subscales (figure 4). Each

Table 1 IT maturity content areas by IT dimension

IT dimension	Content area
IT capabilities	1. Resident management processes that are computerised
	2. Documents in resident care that are computerised
	3. Clinical processes or documents that are computerised
	4. Physical/occupational therapy processes that are computerised
	5. Technology that is available for residents or their representatives
	6. Processes that are computerised in the laboratory systems
	7. Processes that are computerised in radiology systems
	8. Processes that are computerised in pharmacy systems
	9. Processes for managing IT issues
	10. Connectivity technologies used in the nursing home
	11. Internet-based applications used in the nursing home
	12. IT activities which are currently outsourced to external providers
Extent of IT use	13. Extent of use of technologies in resident care
	14. Extent of use of technology in nursing care
	15. Extent of use of technology in physical/occupational therapy
	16. Extent of use of resident or their representative's technology
	17. Extent of use of laboratory technology
	18. Extent of use of radiology technology
	19. Extent of use of technology for pharmacy management
	20. Extent of use of office automation applications in the nursing home
Degree of IT integration internally and externally	21. Resident care systems are integrated (electronic/automatic transfer of information) with other nursing home systems
	22. Nursing information systems are integrated (electronic/automatic transfer of information) with other information systems
	23. Physical/occupational therapy systems are integrated (electronic/automatic transfer of information) with other information systems
	24. Laboratory systems are integrated with other information systems
	25. Radiology systems are integrated with other information systems
	26. Pharmacy systems are integrated with other information systems
	27. Total number of IT personnel in the nursing home (or corporate staff) excluding long-term care consultants or subcontractors

IT, information technology.

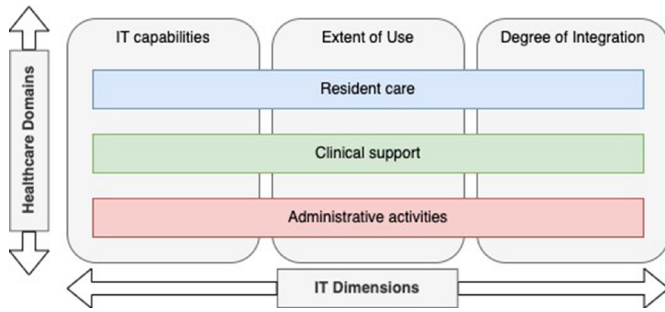


Figure 4 IT maturity measurement matrix. IT, information technology.

subscale is scored from 0 to 100, allowing for a maximum score of 900, representing the total IT maturity score for a particular LTC home.

The LTC IT maturity staging model, developed in conjunction with the IT maturity scoring system, is a tool used to assign stages of IT maturity to LTC homes (table 2). Maturity is placed on a 7-stage model ranging from stage 0 (disparate or non-existent systems) to stage

6 (fully integrated systems; see table 2). Maturity models assume that predicted patterns or stages are sequential and cumulative, and involve various structures and activities.³³ Rooted in Nolan's early model of IT maturity, these models propose six stages of growth—from the initiation of technological components into the organisation (stage 1) to technological maturity and system stability that supports person-centred care (stage 6).³⁴ The 183 content items in the survey produce a total IT maturity score, and the staging model describes different ranges of total IT maturity scores that correspond to each stage in the model. A complete description of how each content item corresponds to a particular IT maturity stage has been previously published.²⁶ In summary, LTC homes are assigned stages based on their survey results.

The LTC IT maturity survey and staging model have been shown to be an acceptable and valid instrument in a pilot conducted with a group of US-based LTC representatives.³⁵

Stage 0	Non-existent IT solutions or EMR	EMR not used. No overarching IT governance.
Stage 1	Incomplete or disparate fragmented IT solutions	Different incongruous IT systems that have distinct functionality, with no integration, isolated systems, may use some standardised terminology in documentation (eg, clinical diagnosis, nursing interventions, medical records, lab results).
Stage 2	Established IT leadership that governs and coordinate structures, procedures, processes and policies	IT leadership with specific duties and functions; incorporates super-users (eg, staff knowledgeable about IT use) to assist in building, troubleshooting, implementing and supporting front line staff with IT tasks. Implementing IT governance and data stewardship processes (eg, ensuring data quality, capturing appropriate information for each data element). Some techniques are available to join data across disparate systems and are used for data analytics and reporting.
Stage 3	Automated internal connectivity and reporting	Utilises common interfaces that permit secure sharing of data across multiple internal applications. Uses master data sources and classifications to establish data relationships between systems. Implementation of new applications requires adherence to standards for connectivity and internal reporting.
Stage 4	Automated external connectivity and reporting	Utilises standard interfaces that permit secure data sharing across external applications (eg, interface with vendors such as pharmacy, labs, radiology, therapies, and/or other procedures) for treatment related purposes. Interface with third parties for revenue cycle or quality management. Incorporates HIE technology. Implementation of new systems requires adherence to standards for external connectivity. Includes nursing and ancillary services documentation used in care management, also for claims and billing purposes.
Stage 5	Clinical risk intervention and predictive analytics	System-driven tools that influence the development of treatments and care plans, while minimising risk. Includes clinical decision support. Analytics guide timely intervention to improve clinical outcomes. Interfaces allow delivery of all-inclusive clinical reporting using virtually all relevant data from internal and external systems. Enables association of external and internal data to predict outcomes and provide benchmarks.
Stage 6	Use of data by resident and/or resident representative to generate clinical data and drive self-management	A secure and protected means for resident and/or resident representative to generate and access clinical data. Increases transparency of their clinical data in a format that is easily understood by these types of end users. Resident data are accessible electronically.

EMR, electronic medical records; HIE, Health Information Exchange; IT, information technology.



Survey pilot

The LTC IT maturity survey was first adapted to the Canadian context by reassessing language used to describe various IT components and technology-related concepts (see online supplemental appendix A).

To evaluate the content validity and readability of the LTC IT maturity survey in the context of Ontario's healthcare system, we piloted the electronic version of the instrument in two phases: internally, by members of the research group, and externally to a convenience sample of LTC home representatives (n=3) contacted through our local network of clinicians. During the survey pilot, we aimed to identify unclear terms or phrases in their meaning or context, and inapplicable questions and the reasons for being identified as such (eg, questions asking for information that is only relevant to LTC homes operating in the USA).

We piloted the electronic survey on our institution's Research Electronic Data Capture (REDCap) server.³⁶ REDCap is a secure, web-based application designed to support data capture for research studies, providing: (1) an intuitive interface for validated data entry; (2) audit trails for tracking data manipulation and export procedures; (3) automated export procedures for seamless data downloads to common statistical packages and (4) procedures for importing data from external sources. REDCap was selected for its ability to provide a convenient electronic format for collecting survey responses and for helping streamline the process of participant recruitment, survey dissemination, follow-up communications and data collection.

Team members were sent a survey invitation and instructions via the REDCap platform for the initial internal pilot. Feedback was solicited from participants in the internal pilot via a structured pilot feedback form developed by our research team, and via email for participants representing the three LTC homes.

On completion of the pilot period, participants reported no technical issues when using the survey. Several changes to the wording of questions were suggested for grammar and clarity, and the branching logic of some sections were also fixed. Experiences gained through the pilot study will facilitate improved implementation and data management practices of the survey on our institution's REDCap platform, verify the applicability of questions to LTC homes operating in Ontario and ensure the use of effective and unambiguous language in the survey. Moreover, the pilot experience will inform the development of information resources (eg, FAQ sheets, troubleshooting guides) for distribution to survey respondents in the more extensive province-wide study.

Data collection

The survey has been implemented electronically on REDCap to facilitate easy widespread distribution and future scaling of survey distribution both temporally (ie, routine assessments over time) and geographically (ie, to

more regions). An identical version will be available in a paper format on request.

Responses to the IT maturity survey will be stored on REDCap servers and exported to a Microsoft Excel spreadsheet. For responses returned using the paper survey, researchers will use double-entry procedures by entering each paper survey received into separate spreadsheets, cross-checking files for accuracy and resolving any discrepancies by consensus. Survey data will include responses to questions about the LTC facility's IT capabilities, extent of use and degree of integration across the healthcare domains of resident care, clinical support and administrative activities (Sections I–III; see and online supplemental file 1 for further details); questions about the facility's use of specific IT portals and other tools (Section IV); and general demographic information about the respondent and the facility (Section V) which will be used to stratify survey data by facility characteristics.

The research team added Section IV and modified Section V to tailor the original survey to LTC homes in Ontario. Responses to these sections gather descriptive information and will not influence the IT maturity scoring or staging (see online supplemental appendix C).

Alongside the primary data collection described based on responses to the IT maturity survey, details on participant recruitment, follow-up and survey completion will be collected for assessment of non-response bias. Our team will do this by implementing an additional database on REDCap, which we will refer to as the 'recruitment database'. The recruitment database will be used to collect information on:

- ▶ frequency of contacts and total number of attempts to contact a participant;
- ▶ response given (ie, yes, no, maybe);
- ▶ reasons for declining to participate;
- ▶ choice in survey format (paper or electronic);
- ▶ frequency of follow-up calls/emails after agreeing to participate;
- ▶ when the survey was sent and received;
- ▶ year-to-year turnover in dedicated LTC IT personnel (only applicable in longitudinal study).

These data on recruitment processes will contribute to best practices in survey distribution, enabling IT maturity measurements to be collected routinely and consistently over time.

Data analysis

As appropriate, continuous variables will be presented as means (SDs) and medians (IQRs), and categorical variables as frequencies and percentages. We will report 95% CIs for all means and proportions.

Based on facility characteristics, including size, ownership type and rurality, participating LTC homes will be compared with non-responders or those that opted not to participate. Reasons for not participating, when provided, will be described. Participating LTC homes will also be compared with nationally reported facility-level characteristics in Canada. We will use IT maturity scores to compare

Table 3 Categorisation of survey response scores

IT dimension	Categorisation of survey scores	Proportion of LTC homes (n, %)			
IT capabilities	0=Not available; 1=Available	Not available (score: 0)		Available (score: 1)	
Extent of IT use	0=Not used; 1–3=Barely used; 4–6=Somewhat used; 7=Extensively used	Not used (score: 0)	Barely used (score: 1–3)	Somewhat used (score: 4–6)	Extensively used (score: 7)
Degree of IT integration	0=Not integrated; 1–3=Barely integrated; 4–5=Somewhat integrated; 6=Very much integrated	Not integrated (score: 0)	Barely integrated (score: 1–3)	Somewhat integrated (score: 4–5)	Very much integrated (score: 6)

LTC, long-term care.

survey response type differences and explore differences between LTC homes who completed the online survey versus the paper version. Associations between total IT maturity scores and characteristics of LTC respondents (eg, level of education, job title, number of years of experience) will be presented.

IT maturity scores for every IT dimension and health-care domain will be calculated for each survey received. For descriptive purposes, responses for each of the three IT dimensions will be categorised and reported as presented in table 3.²⁸ Each dimension will be used to describe the three clinical domains of interest. In addition to an IT maturity score, each LTC home will be assigned an IT maturity stage (range: 0–6) based on results from the survey. Here, we will summarise the stages for all LTC homes by reporting how many fall into each stage.

We will conduct descriptive analyses of facility characteristics of LTC homes, including size, ownership and rurality. The mean (SD) and median (IQR) IT maturity score for each of the nine subscales (ie, each IT dimension/healthcare domain combination) and the IT maturity stage will be summarised and compared across strata of facility characteristics. We will use the Wilcoxon rank-sum Test to analyse differences across groups, given the anticipation of skewed distributions.²⁸

DISCUSSION

Before the pandemic, technology had already captured the attention of stakeholders concerned with improving the quality and safety of care in Ontario's LTC sector.³⁷ Although pandemic-related pressures may have increased the use of technology in Canadian LTC homes, such changes were typically due to random, ad hoc purchases and implementation of technologies.¹⁶ Research suggests that implementing health IT without adequate investment in preparation, infrastructure, and training can lead to suboptimal gains or potential harms in productivity and quality of care.⁶ IT adoption should recognise the unique technological needs of different facilities.³⁸ To realise purposeful IT implementation in LTC homes, we must understand the sector's current state of IT adoption.

To facilitate an accurate assessment of the level of IT adoption in Ontario's LTC sector, we sought valid and reliable evaluation methods specific to the LTC context, encompassing the breadth of potential health IT functions. Furthermore, any measure of IT adoption should be grounded in a conceptual framework that precisely links health IT functions to clinical care practices to facilitate research on the association between adoption and quality outcomes.⁴ As such, we selected the LTC IT maturity instrument.

An earlier iteration of the survey—the IT sophistication measure—has been used in two nationwide 3-year annual surveys conducted in 815 (first national survey (2013–2017)) and 719 (second national survey (2018–2022)) US-based LTC homes.^{29–31} IT sophistication was shown to be a valid and reliable measure for assessing changing trends in key IT dimensions and associated quality and safety measures.^{31 39}

Based on the precursory IT sophistication survey, efforts to develop an LTC IT maturity measure were motivated by improving the communication of its highly technical survey components and producing a staging measure amenable to comparison with IT maturity measures in other healthcare settings (eg, acute care settings).²⁶ The subsequent development and testing of the IT maturity framework involved iterative consultations with 31 US-based experts in LTC administration and health IT systems using the Delphi method.^{26 40} The expert panel also included recommendations for staging criteria illustrative of the logical sequencing of stages (ie, from primitive to advanced stages of maturity). This resulted in a comprehensive survey instrument enabling detailed assessments of LTC IT maturity and stage. The adoption of this survey, its adaptation to the Canadian context, and the methods for its distribution will set a robust process for measuring IT maturity in Ontario's LTC sector.

The IT maturity instrument was intended to be a part of routine assessments.²⁶ To enable this, here we describe several measures, including developing detailed recruitment and follow-up protocols and the recruitment database to track and evaluate these processes. As IT is not



currently evaluated in the LTC sector, it is unknown how IT maturity (or other measures of IT adoption) relates to provincially reported measures of LTC care quality, staff turnover or resident satisfaction. As such, the more assessments conducted, the more valuable the information will be in establishing baseline and ongoing trends of LTC IT maturity and its relationships with other key indicators. This information is indispensable given that LTC in Canada faces a critical moment for change and reform.^{2 16} Recognising changes in IT adoption leads to understanding decisions about and factors associated with it, as well as disparities contributing to differences in LTC resident outcomes, and quality and safety impacts for facilities experiencing (or preparing to experience) large amount of system change.

An understanding of the level of IT maturity in individual facilities will help ensure that interventions and policies designed to support the adoption of IT in LTC homes are targeted, equitable and tailored to the local context in which LTC homes operate—a key element to successfully fulfil the potential of technology in Canada's LTC sector.⁴¹ Alongside measures of IT maturity, the survey will also collect data on LTC home characteristics (ie, size, ownership, rurality) and staffing. LTC home characteristics are essential to assess because the needs of different facilities are likely variable²⁹ and may impose barriers to the uptake of new technologies, particularly for LTC homes operating in rural areas.^{16 42} Information about staffing in LTC is of interest given the importance of staff training and preparation for the effective adoption of IT in LTC.^{6 8} LTC homes have experienced high staff turnover and higher-than-normal use of temporary staff, particularly during the pandemic.^{2 16} Additionally, an increasing proportion of the LTC workforce has limited training in Canada and elsewhere.^{2 43 44} This could pose barriers to delivering the consistent training needed to adopt and implement technology in LTC effectively. Furthermore, workforce factors, such as the differences in informants' training, might affect responses to questions regarding facilities' IT systems by potentially confounding results. This highlights the importance of characterising the training and professional background of respondents.

As a next step in the path towards using IT maturity assessments to provide evidence for improved safety, efficiency and quality of care for residents and to justify greater, sustained, and equitable IT adoption across the sector, measures of IT maturity should eventually be linked with quality outcomes.²⁹ Similar measures of IT maturity have been linked with positive resident outcomes for urinary tract infections and antibiotic use in LTC facilities in the USA.^{45 46} By routinely collecting the facility name, address and postal code, this study aims to produce a dataset amenable to linkage and analysis with LTC quality outcomes drawn from the ICES (formerly the Institute of Clinical and Evaluative Studies). This independent, not-for-profit research institute manages Ontario's health-related data to inform health system policy and planning.

Limitations

This study may have several limitations. Participation may be hindered by lack of staff and other pressures faced by LTC homes, particularly due to COVID-19. Previous experience distributing the survey indicates that a response rate of up to 45% can be expected.^{28 29} However, these estimates are drawn from a pre-pandemic period and different geographical regions. We aim to promote a higher response rate by personalising recruitment efforts and diligently adhering to follow-up calls and email processes.

Additionally, to facilitate participation, the type of staff members from LTC homes eligible to complete the survey will not be standardised. There may be variability in LTC staff responsible for IT systems; thus, participants who complete the survey may also vary. The time commitment required from participants to complete the survey may influence the response rate. We are offering financial compensation commensurate with employee wages to avoid using LTC home resources for survey completion. Facilities with lower resources and technology use may be less inclined to participate, thereby affecting the representativeness of our sample. To address the potential impact of these confounding factors on the validity of our results, our team will collect participant and facility data to compare participating LTC homes to those that did not participate, as well as to provincially reported data on all LTC homes in Ontario.

CONCLUSION

This protocol describes a cross-sectional study for measuring IT adoption in Ontario's LTC sector using a validated survey that has not yet been used in Canada. Our objectives will be to: (1) produce a baseline understanding of the level of IT maturity, a comprehensive measure of IT adoption, in Ontario's LTC homes, and (2) explore facility characteristics associated with levels of IT maturity, and barriers and enablers to the distribution of the survey. There is growing recognition that more advanced technology systems can address some of the most fundamental issues challenging LTC.^{16–18 37} A better understanding of the spectrum of IT maturity in LTC will support and encourage the development, evaluation and implementation of appropriate technologies in LTC. Furthermore, this study will help pave the way for routine assessments of IT maturity, and research on its impact on resident care, both provincially and nationally.

ETHICS AND DISSEMINATION

This study was reviewed by the Ottawa Health Science Network Research Ethics Board (OHSN-REB) and, as the study does not involve patients or access to any health data, was exempt from full ethics review. We plan to share consolidated findings in an article, which will be submitted for publication in a peer-reviewed journal. Finally, findings will be disseminated through academic

platforms, such as conference presentations and meetings. Dissemination through these means will provide a common framework for understanding the IT capabilities, extent of use and degree of integration for LTC operators, staff and other stakeholders interested in advancing technology adoption in the LTC setting (eg, residents/families seeking an LTC home and health institutions wishing to exchange information cross-institutionally). LTC IT maturity assessments will facilitate communication and collaboration among these different parties, and potentially enable codesign processes for developing and adopting technologies that simultaneously meet the needs of residents and their caregivers, support the operation of LTC homes, and strengthen integration with the broader health system.¹⁶

Author affiliations

¹Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada

²C.T. Lamont Primary Health Care Research Centre, Bruyère Research Institute, Ottawa, Ontario, Canada

³Interdisciplinary School of Health Sciences, University of Ottawa, Ottawa, Ontario, Canada

⁴Columbia University School of Nursing, New York, New York, USA

⁵St. Patrick's Home of Ottawa, Ottawa, Ontario, Canada

⁶Department of Family Medicine, University of Ottawa, Ottawa, Ontario, Canada

⁷Centre of Excellence for Rural Health and Education, Winchester District Memorial Hospital, Winchester, Ontario, Canada

⁸Clinical Epidemiology Program, Ottawa Hospital Research Institute, Ottawa, Ontario, Canada

⁹Emergency Department Outreach Program, Ottawa Hospital, Ottawa, Ontario, Canada

¹⁰Ontario eConsult Centre of Excellence, The Ottawa Hospital, Ottawa, Ontario, Canada

Twitter Amy T Hsu @amytmhsu

Acknowledgements The authors would like to express their gratitude to the administrators and patient partners who have piloted the survey and provided valuable feedback. They also wish to thank Jessika Hammond for her assistance in preparing the manuscript for publication. PT is supported by a PSI Graham Farquharson Knowledge Translation Fellowship.

Contributors RH, SK, CF and ClareL designed the study. RH, GA, CF, MG and ClareL adapted and piloted the survey. RH, SK, GA, CF, MG, DH, ATH, JL, CherylL, PT and ClareL reviewed the project protocol and provided important feedback to ensure the research would be relevant for the research end users. RH, SK and ClareL drafted and revised the manuscript. All authors provided feedback and critical revisions for important intellectual content. All authors approved the final draft of the manuscript.

Funding This project was supported by Grant No. R01HS022497 from the Agency for Healthcare Research and Quality. The content is solely the responsibility of the authors and does not necessarily represent the official views of the Agency for Healthcare Research and Quality. Funding for this project was also provided by INSPIRE-PHC.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Provenance and peer review Not commissioned; externally peer reviewed.

Supplemental material This content has been supplied by the author(s). It has not been vetted by BMJ Publishing Group Limited (BMJ) and may not have been peer-reviewed. Any opinions or recommendations discussed are solely those of the author(s) and are not endorsed by BMJ. BMJ disclaims all liability and responsibility arising from any reliance placed on the content. Where the content includes any translated material, BMJ does not warrant the accuracy and reliability of the translations (including but not limited to local regulations, clinical guidelines,

terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

Open access This is an open access article distributed in accordance with the Creative Commons Attribution Non Commercial (CC BY-NC 4.0) license, which permits others to distribute, remix, adapt, build upon this work non-commercially, and license their derivative works on different terms, provided the original work is properly cited, appropriate credit is given, any changes made indicated, and the use is non-commercial. See: <http://creativecommons.org/licenses/by-nc/4.0/>.

ORCID iDs

Amy T Hsu <http://orcid.org/0000-0002-2747-4121>

Clare Liddy <http://orcid.org/0000-0003-0699-5494>

REFERENCES

- Canadian Institute for Health Information. *Seniors in transition: exploring pathways across the care continuum*. Ottawa, ON: CIHI, 2017. Available: <https://www.cihi.ca/en/seniors-in-transition-exploring-pathways-across-the-care-continuum>
- Estabrooks CA, Straus SE, Flood CM, *et al*. Restoring trust: COVID-19 and the future of long-term care in Canada. *FACETS* 2020;5:651–91.
- Canadian Institute for Health Information. *Pandemic experience in the long-term care sector: how does canada compare with other countries?* Ottawa, ON: CIHI, 2020: 9.
- Degenholtz HB, Resnick A, Lin M, *et al*. Development of an applied framework for understanding health information technology in nursing homes. *J Am Med Dir Assoc* 2016;17:434–40.
- Jones SS, Rudin RS, Perry T, *et al*. Health information technology: an updated systematic review with a focus on meaningful use. *Ann Intern Med* 2014;160:48–54.
- Ko M, Wagner L, Spetz J. Nursing home implementation of health information technology: review of the literature finds inadequate investment in preparation, infrastructure, and training. *Inquiry* 2018;55:0046958018778902.
- Kruse CS, Mileski M, Alaytsev V, *et al*. Adoption factors associated with electronic health record among long-term care facilities: a systematic review. *BMJ Open* 2015;5:e006615.
- Cherry B, Carter M, Owen D, *et al*. Factors affecting electronic health record adoption in long-term care facilities. *J Healthc Qual* 2008;30:37–47.
- Tharmalingam S, Hagens S, English S. The need for electronic health records in long-term care. *Stud Health Technol Inform* 2017;234:315–20.
- Alexander GL, Madsen RW. A report of information technology and health deficiencies in U.S. nursing homes. *J Patient Saf* 2021;17:e483–9.
- Rantz MJ, Hicks L, Petroski GF, *et al*. Cost, staffing and quality impact of bedside electronic medical record (EMR) in nursing homes. *J Am Med Dir Assoc* 2010;11:485–93.
- Resnick HE, Manard BB, Stone RI, *et al*. Use of electronic information systems in nursing homes: united states, 2004. *J Am Med Inform Assoc* 2009;16:179–86.
- Handler SM, Sharkey SS, Hudak S, *et al*. Incorporating INTERACT II clinical decision support tools into nursing home health information technology. *Ann Longterm Care* 2011;19:23–6.
- Kruse CS, Mileski M, Vijaykumar AG, *et al*. Impact of electronic health records on long-term care facilities: systematic review. *JMIR Med Inform* 2017;5:e35.
- Canadian Institute for Health Information. *The impact of COVID-19 on long-term care in canada: focus on the first 6 months*. Ottawa, ON: CIHI, 2021: 34.
- Gauvin F, Wilson M, DeMaio P, *et al*. *Evidence brief: identifying and harnessing the potential of technology in long-term care settings in canada*. Hamilton: McMaster Health Forum, 2021.
- Eghtesadi M. Breaking social isolation amidst COVID-19: a viewpoint on improving access to technology in long-term care facilities. *J Am Geriatr Soc* 2020;68:949–50.
- Volling C, Popalvar A, Defalco K. *Infection prevention and control for COVID-19: interim guidance for long term care homes*. Public Health Agency of Canada; National Advisory Committee on Infection Prevention and Control (NAC-IPC), 2020.
- Office of the National Coordinator for Health Information Technology. Telemedicine and telehealth [internet. n.d. Available: <https://www.healthit.gov/topic/health-it-health-care-settings/telemedicine-and-telehealth>
- Centers for Medicare and Medicaid Services. Medicare telemedicine health care provider fact sheet [Internet]. n.d. Available: <https://www>



- cms.gov/newsroom/fact-sheets/medicare-telemedicine-health-care-provider-fact-sheet
- 21 National Academies of Sciences, Engineering, and Medicine; Health and Medicine Division; Board on Health Care Services; Committee on the Quality of Care in Nursing Homes. *The national imperative to improve nursing home quality: honoring our commitment to residents, families, and staff*. Washington, DC: The National Academies Press, 2022.
 - 22 Chapman S, Miller J, Spetz J. *The impact of emerging technologies on long-term care and the health workforce*. San Franc CA: UCSF Health Workforce Res Cent Long-Term Care, 2019.
 - 23 Canada Health Infoway. *Connected health information in canada: A benefits evaluation study*. Canada: Canada Health Infoway, 2018. Available: <https://www.infoway-inforoute.ca/en/component/edocman/3510-connected-health-information-in-canada-a-benefits-evaluation-study-document/view-document?Itemid=0>
 - 24 Vest JR, Jung H-Y, Wiley K, et al. Adoption of health information technology among US nursing facilities. *J Am Med Dir Assoc* 2019;20:995–1000.
 - 25 Abramson EL, McGinnis S, Moore J, et al. A statewide assessment of electronic health record adoption and health information exchange among nursing homes. *Health Serv Res* 2014;49:361–72.
 - 26 Alexander GL, Deroche C, Powell K, et al. Forecasting content and stage in a nursing home information technology maturity instrument using a Delphi method. *J Med Syst* 2020;44:60.
 - 27 Alexander GL, Wakefield DS. Information technology sophistication in nursing homes. *J Am Med Dir Assoc* 2009;10:398–407.
 - 28 Alexander GL, Madsen R, Wakefield DS. A regional assessment of information technology sophistication in Missouri nursing homes. *Policy Polit Nurs Pract* 2010;11:214–25.
 - 29 Alexander GL, Madsen R, Deroche CB, et al. Ternary trends in nursing home information technology and quality measures in the United States. *J Appl Gerontol* 2020;39:1134–43.
 - 30 Alexander GL, Madsen R. A national report of nursing home quality and information technology: two-year trends. *J Nurs Care Qual* 2018;33:200–7.
 - 31 Alexander GL, Madsen RW, Miller EL, et al. A national report of nursing home information technology: year 1 results. *J Am Med Inform Assoc* 2017;24:67–73.
 - 32 CIHI. *CIHI's operational plan and budget, 2019–2020*. n.d.: 36.
 - 33 Rocha Á. Evolution of information systems and technologies maturity in healthcare. *Int J Healthc Inf Syst Inform* 2011;6:28–36.
 - 34 Nolan R. Managing the crises in data processing. *Harv Bus Rev* 1979;115–26.
 - 35 Powell KR, Alexander GL. Qualitative validation of the nursing home it maturity staging model. *J Gerontol Nurs* 2020;46:47–54.
 - 36 Harris PA, Taylor R, Thielke R, et al. Research electronic data capture (redcap) -- a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform* 2009;42:377–81.
 - 37 Gillese EE. *Public inquiry into the safety and security of residents in the long-term care homes system*. Woodstock, ON: Long-Term Care Homes Public Inquiry, 2019. Available: <https://longtermcareinquiry.ca/en/final-report/>
 - 38 Bunn F, Goodman C, Corazzini K, et al. Setting priorities to inform assessment of care homes' readiness to participate in healthcare innovation: a systematic mapping review and consensus process. *Int J Environ Res Public Health* 2020;17:987.
 - 39 Alexander GL, Deroche CB, Powell KR, et al. Development and pilot analysis of the nursing home health information technology maturity survey and staging model. *Res Gerontol Nurs* 2022;15:93–9.
 - 40 Alexander GL, Powell K, Deroche CB, et al. Building consensus toward a national nursing home information technology maturity model. *J Am Med Inform Assoc* 2019;26:495–505.
 - 41 Milat AJ, Bauman A, Redman S. Narrative review of models and success factors for scaling up public health interventions. *Implement Sci* 2015;10:113.
 - 42 Marchildon GP, Allin S, Merkur S. Canada: health system review. *Health Syst Transit* 2020;22:1–194.
 - 43 Castle NG, Engberg J, Anderson R, et al. Job satisfaction of nurse aides in nursing homes: intent to leave and turnover. *Gerontologist* 2007;47:193–204.
 - 44 Lerner NB, Johantgen M, Trinkoff AM, et al. Are nursing home survey deficiencies higher in facilities with greater staff turnover. *J Am Med Dir Assoc* 2014;15:102–7.
 - 45 Cohen CC, Powell K, Dick AW, et al. The association between nursing home information technology maturity and urinary tract infection among long-term residents. *J Appl Gerontol* 2022;41:1695–701.
 - 46 Cohen CC, Powell K, Dick AW, et al. Examining nursing home information technology maturity and antibiotic use among long-term care residents. *J Am Med Dir Assoc* 2022;23:1019–24.