CADTH Horizon Scan

Virtual Medicine Wards and Hospital-at-Home Programs

Health Technology Update

Key Messages

What Is the Issue?

- In 2021, the occupancy rate of acute care hospital beds in Canada was 86.7%. High occupancy rates without turnover to accommodate all hospitalization needs is an indicator of potential bed shortages and health system pressure.
- Patients have historically remained in hospital beds until their treatment or recovery is complete. Some patients may be well enough to continue their treatment or recovery at home sooner if provided with the right supports.

What Are the Technologies?

- Virtual wards, also known as hospital-at-home programs, support the provision of inpatient-level acute medical care in a patient's home.
- There are 2 main models of these programs: admission avoidance and supported early discharge. This report focuses on the latter type.
- Many of these programs are technology-enabled and incorporate remote monitoring devices to record the patient's vital signs and tablets or web portals to facilitate data sharing. Video calls with the clinical team are also used in combination with in-person visits by health care providers.

What Is the Potential Impact?

- Hospital beds can be freed up more quickly to provide space for newly admitted patients with more acute care needs.
- The safety and effectiveness of virtual ward programs have been examined in several systematic reviews in the existing clinical literature. Factors evaluated include mortality, length of stay, hospital readmissions, and costs as outcomes. Both admission avoidance and early supported discharge via hospital-at-home programs had lower or similar mortality and hospital admission outcomes as inpatient care after completion of care.
- Patients, caregivers, and health care providers appear to be generally satisfied with their participation in virtual ward programs. Comfort and satisfaction can be improved by allowing patients to receive treatment in a familiar and comfortable environment without compromising patient outcomes. However, increased caregiver burden, lack of sufficient training for participants and staff, and difficulties recruiting health care providers were identified as challenges associated with virtual ward programs.

Key Messages

What Else Do We Need to Know?

- The level of technological support required by patients, caregivers, and staff participating in these programs should be considered when developing a program. Adequate training about how to use provided equipment and other tasks needed to manage care in the home (e.g., drug administration, symptom monitoring, communication with health care professionals) is required for patients and caregivers. There should also be provision of all necessary equipment with supports to overcome any barriers (e.g., visual impairment, physical limitations) to ensure comfort and proficiency.

- Care coordination and communication among the multidisciplinary care team, the patient, and their caregivers is important.

- Canadian cost data were not identified, but it is generally accepted that virtual ward programs are associated with reduced costs when compared with traditional in-hospital care.

- The inclusion of digital monitoring and record keeping technologies as part of virtual ward programs may disproportionately exclude people from some groups, including older people, people living in social housing or without housing, people with lower incomes, people who are unemployed, people living with disabilities, and people who live in rural areas without access to such programs.

- Key recommendations for development of virtual ward programs in Canada include using a single remote patient-monitoring platform that connects with the hospital's electronic health record system, choosing a technology to connect patients and providers that best fits the needs of the virtual ward program, and ensuring data security, confidentiality, and data management protocols are in place.

Virtual Ward Programs Allow People to Heal at Home

Virtual ward programs allow people to avoid hospitalization or leave the hospital earlier so they can receive their treatment in the more familiar environment of their own home.

What Is the Technology and How Does It Work?

Hospital-at-home (HAH) models, in which inpatient-level acute medical care is provided in a patient's home, have been used internationally for more than 30 years.[1] The term *virtual ward* is often used interchangeably with HAH. These programs can be categorized into 2 main types:

- a means to avoid admission for people who would otherwise need to be hospitalized[1]
- an early supported discharge of patients admitted to the hospital who require continued acute care for short-term episodes after hospital discharge.[1]

Virtual ward services for early supported discharge of patients who require acute care can shorten the amount of time patients need to stay in the hospital. This can free up inpatient beds more quickly while allowing patients to complete their treatment or recovery in their own homes. Nurses, doctors, and allied health professionals connected with the hospital may visit the patient in their home to monitor their progress as a continuation of the care they received as an inpatient. In technology-enabled models, patients are responsible for measuring vital sign data. This information may be wirelessly transferred to their physicians via a continuous monitoring wearable device or it may need to be manually entered into an app or website.[2] The software platforms alert the medical team any time the patient's measurements fall outside the expected parameters, so they can take the appropriate medical action.

Purpose and Scope

The purpose of this Horizon Scan is to present any existing evaluations of virtual ward and HAH programs for early supported discharge, highlighting their structure, patient population, outcomes measured, and any patient or provider experiences associated with them as well as any descriptions of virtual ward programs in Canada.

This report focuses on the use of early supported discharge for generalist care settings. Information related to patients receiving postsurgical, oncology, or palliative care in specialist settings were not included. Due to the volume of available literature, publications that investigated the creation and use of virtual wards specifically to manage patients with COVID-19 during the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic were not included in this report.

Who Might Benefit? How Could This Change Care?

In 2021, the occupancy rate of acute care hospital beds in Canada was 86.7%.[3] High occupancy rates without turnover to accommodate all hospitalization needs is an indicator of potential bed shortages and health system pressure. The use of virtual wards can result in a reduced demand for hospital beds or a faster bed turnover time between patients depending on which type of program has been implemented.[4] Use of these programs may also reduce hospital-related complications like delirium, falls, and hospital-acquired infections.[5]

In a review conducted by Denecke and colleagues (2023),[5] the most common conditions targeted for HAH programs were acute medical conditions, COVID-19, cancer, hip fracture, chronic obstructive pulmonary disease, and orthogeriatric conditions. Participants in these programs, in randomized trials and real-world settings, were mainly white females between 64 and 84 years.[6,7]

How Are They Used in Canada?

Virtual ward and HAH programs have been used across Canada in different ways for many years. In July 2023, researchers at McGill University Health Centre published a set of guiding principles for the establishment of virtual acute care wards in Canada.[1] These principles were created in collaboration with representatives from other established HAH or remote monitoring programs in Quebec, Ontario, and British Columbia.[1] The principles were created to inform a pilot project in which 8 hospitals in Quebec would implement a HAH care model for patients to receive acute care while remaining at home.[1]

Representatives from the following institutions with existing HAH or remote monitoring programs provided input into the recommendations:

- Island Health, Victoria
- Jewish General Hospital, Montreal
- Hospital Montfort, Ottawa
- Ottawa Heart Institute, Ottawa
- Michael Garron Hospital, Toronto East Health Network, Toronto[1]

Most of the Canadian virtual ward models identified in the review used a "device and tablet" concept in which patients use Bluetooth-enabled medical devices (e.g., blood pressure monitors) to measure biometric data and a tablet to transmit that data to the clinician for monitoring and interpretation. This model requires the patient be provided access to the smart devices as well as have a reliable Wi-Fi connection.[1] These digital monitoring systems can be integrated with existing electronic health record systems. A summary of technologies that may be used to enable HAH models in Canada and elsewhere is provided in Table 3 (page 10) of the McGill report[1] No other features about these models were reported.[1]

What Does It Cost?

Specific costs related to the provision of HAH services in Canada were not identified. Through an overview of systematic reviews, researchers at the Institut national d'excellence en santé et services sociaux (INESSS) in Quebec concluded that HAH programs may be associated with reduced costs compared with traditional in-hospital care; however, the design of the studies examining costs and the programs they examined were heterogenous which limits the generalizability of these findings to the Canadian context.[4]

As an example of the costs associated with these programs, the 2022−2023 UK National Health Service (NHS) budget for virtual wards was £200 million.[2] The approximate breakdown of costs was:

- consumable costs (1%)
- interoperability costs (2%)
- licensing costs (7%)
- other operating costs (8%)
- workforce pay costs (82%)

There was also some modelling of the financial savings associated with acute bed days saved for 1 virtual ward in South London, UK, with estimated savings of £3,000 to £4,500 per patient. These estimations did not take into account the costs associated with running the virtual wards.[6]

What Is the Evidence?

Clinical Evidence

The safety and effectiveness of HAH models have been reported by several systematic reviews. An overview of systematic reviews by Leong and colleagues (2021)[8] compared the 2 types of HAH models (i.e., early supported discharge versus admission avoidance) and each model to inpatient care. The primary studies included in the reviews were mainly conducted in the UK, the US, Australia, Italy, and Spain.[8] The reviews of early supported discharge found mortality and readmissions (admission to hospital following completion of hospitalization and the supported discharge period) were comparable to inpatient care but with a shorter length of stay. For admission avoidance, there was a trend toward lower costs and mortality and similar or lower hospital readmissions (admission to hospital following completion of the HAH program) compared to inpatient care.[8] Based on the results, the authors concluded that admission avoidance models could be prioritized over early supported discharge because of the potential for reduced costs and improved outcomes. However, the comparison was indirect and the strength of the evidence low, so further research is required before coming to a firm conclusion.

INESSS conducted an overview of reviews related to HAH services for adults.[4] The results of the reviews they identified showed that HAH was as safe as conventional in-hospital care and had equivalent or better outcomes for readmissions, service utilization, and mortality without additional adverse events. There did not

appear to be a standard approach to the organization of these programs. They typically included daily visits from nurses supported by a physician and often a multidisciplinary team.[4]

Descriptions and Evaluations of HAH Programs

Australia

Hecimovic and colleagues (2020)[9] described the characteristics and outcomes of patients receiving HAH services across the South Western Sydney Local Health District in Australia between 2017 and 2019. The health district serves approximately 1 million people. The patients who participated were referred to the HAH program following presentation to the emergency department (ED), after an acute stay in hospital, or through a community general practitioner.[9] The program was overseen by a nurse practitioner and clinical nurse specialist in coordination with the 4 local ambulatory care services. The main key performance indicator was unplanned hospital presentation while participating in HAH (e.g., presentation to the ED for clinical deterioration, need for vascular access, or to receive care not available in the community setting).[9] The main reasons for participating in HAH were to receive IV medications, postoperative drain management, rehabilitation in the home, bridging anticoagulant therapy, and intraperitoneal medication delivery. The average length of HAH treatment was 7 days.[9] Two percent of participants in the program had to present to the ED for treatment during the evaluation period. The authors found that the percentage of patients presenting to the ED decreased over time from 3.4% in 2017 to 1.8% in 2019.[9]

Sweden

Kastengren and colleagues (2024)[10] described the implementation of Sweden's first 24/7 high-acuity virtual ward through a "digi-physical" patient care program (i.e., a HAH model combining a virtual hospital-based medical command centre and in-person ambulating medical services) between October 2022 and June 2023. Sweden has the lowest number of hospital beds per 100,000 population in Europe and often experiences hospital overcrowding.[10] The primary outcome of the study was patient satisfaction; secondary outcomes were health care use (e.g., total length of stay, digital consultations and activities, laboratory orders, radiological examinations, and escalations), safety (e.g., frequency of iatrogenic complications such hospital-related infections, delirium, and fall injury), and quality during the care episode.[10] Patients received medical devices that could be used to measure their vital signs. The supplied devices included a blood pressure cuff, a pulse oximeter, an ear thermometer, and a scale.[10] A back-up power supply battery and cellular communications modem were provided as needed. Patients participated in virtual rounds with a physician daily and received at least 1 physical visit per day from a nurse who provided any required acute care services (e.g., physical examination; illness and vital signs monitoring, IV infusions, wound care, medication administration, mobile diagnostics such as ultrasound and 12-lead electrocardiogram, nursing care, and education).[10]

Patients participating in the HAH program were treated for 63 different clinical conditions during the study. The most common were infectious disease and pulmonary disease.[10] While at home, patients used an in-home technology kit, which also included a tablet that they could use to contact the medical command centre at any time. They could also use the tablet to view their appointment schedule. The median length of stay in hospital before inclusion in the HAH program was 2 days; the median length of stay in the program

was 3 days. There were no incidents of patient mortality or hospital-related complications during the HAH period. There were 11 hospitalizations (5.5% of patients) reported during the HAH period.[10] Self-reported patient satisfaction with HAH was high, with a net promoter score of 88 (no details on the measure or scale provided).[10]

The UK

In 2022, the Health Innovation Network conducted an evaluation of 3 virtual wards located in South West London on behalf of the NHS.[6] The virtual ward programs were implemented to support early hospital discharge and reduce hospital readmissions. The evaluation was meant to assess the core components of the virtual ward models, facilitators of the implementation of these wards, the demographics of the patients admitted, patient engagement and adherence to the remote monitoring technology, patient and staff experience, and patient outcomes.[6]

The 3 virtual wards were set up using different configurations of staffing and patient monitoring, but all 3 types were considered successful for safely treating patients in their homes.[6] The patients were generally satisfied with the care they received and were compliant with the use of remote monitoring devices, particularly when the care team was able to support the patients and caregivers in learning to use the technology correctly. More than 25% of patients wore their remote monitoring devices at least 60% of the time, which was the amount of time the researchers considered complete adherence to the technology.[6] The staff involved also reported satisfaction associated with the ability to develop new skills while working with multidisciplinary teams.[6] Establishing a comprehensive training program for virtual ward staff was identified as an important priority because the use of virtual wards evolves within the NHS. Patients across the 3 services were generally able to be cared for at home through a combination of remote monitoring, telephone calls, and home visits.[6] The authors concluded that further evidence is needed to understand the full impact of the virtual ward services within the NHS.

Issues to Consider

Patient, Caregiver, and Provider Preferences and Experiences

Patient and Caregiver Experience

A meta-synthesis of existing studies examined the perceptions and experiences of people who had participated in HAH programs.[11] Patients found HAH to be more comfortable and the care was more patient-centred than they would experience as an inpatient. Being at home allows patients to maintain some normalcy and routine through the acute care period. This resulted in reduced anxiety and increased morale for some patients.[11] Care in the home reduced the burden on caregivers, friends, and family to visit the patient by reducing the some of the burden of travel, parking, restricted visiting hours, and fear or dislike of hospitals. Couples emphasized the importance of being able to remain together through the treatment period.[11] Patients were able to build a rapport more easily with the care providers who were spending time with them in their home.

> ## The lack of round-the-clock patient supervision was highlighted as a challenge, mainly by patients whose caregivers did not live with them.[11]

Being at home alone during the acute HAH period made some patients anxious. In particular, 1 study that included mothers who were experiencing serious mental health conditions found they preferred to remain in hospital for treatment where they were more able to focus on their treatment and recovery instead of receiving treatment at home where they were also responsible for childcare and other household tasks.[11]

When patients received HAH care there was an increased burden placed on caregivers. They were often tasked with multiple responsibilities, such as aiding the patient and health care providers and being available in case of an emergency. The burden was heightened for people caring for patient with dementia or mental illness.[11] Some patients reported having issues dealing with complex medical equipment (e.g., dialysis), found remote monitoring and telemedicine burdensome, and/or experienced technical issues. In a Cochrane meta-synthesis, caregivers reported disruptions to their normal routine, work, sleep, and energy levels when caring for someone at home.[12] Many caregivers felt unprepared to care for their loved ones in the way they were expected to. There were concerns reported regarding patient privacy and the impact that providing care for a loved one could have on the relationship between the patient and caregiver.[12]

Other studies have highlighted the level of technology support that will be required by patients in HAH programs should be considered when developing a HAH program.[2,6] Patients in the NHS evaluation reported they preferred continuous vital sign monitoring over spot monitoring because it required less technical expertise on their part.[6] Inadequate patient and carer education regarding their tasks and responsibilities as part of the HAH program can lead to poor patient outcomes and increased feelings of stress by both patients and caregivers.[5] The effects of inadequate education can disproportionately impact specific patient groups, such as older people or people with limited literacy or language skills.[5]

Patients who were attending an ED in Boston, Massachusetts and declined enrolment in an HAH program in favour of inpatient treatment were surveyed to determine why they declined to participate.[7] The authors of the study categorized 10 themes capturing the responses of 147 people who declined participation. These themes included:

- fear or safety at home (20%)
- comfort, ease, or desire to stay in traditional hospital (20%)
- clinician or ED declined enrolment because of patient factors (16%)
- patient declined without reason (11%)
- nontherapeutic home (11%)
- concern for caregiver burden (6%)
- other reason (6%)
- could not reach caregiver (4%)

- no response captured (3%)
- facility time constraints prevented enrolment (2%).[7]

Provider Experience

Clinical staff involved in virtual ward programs in the NHS reported positive experiences with their work with the HAH program.[6] They attributed their satisfaction with the composition of the multidisciplinary team, their relationships with their colleagues, the ability to learn new skills or upskill, the flexibility and adaptability of the team, and the lack of a perceived hierarchy within the team. They felt a sense of pride and job satisfaction from working in a new and emerging service that they believed was beneficial to the patients they were caring for.[6]

When asked about their perceptions of HAH programs, some health care professionals had experienced a power shift between them and their patients when providing acute care within patients' homes.[11] The providers were not just there to provide health care, they were also a guest invited into the patient's home with their permission, providing the patient with more perceived power in the dynamic. Providers also reported they had more opportunities to collaborate with their patients regarding their care plans and they were able to offer medical advice that was more customized to the patient in relation to their home environment and realities of their daily lives.[11] In addition, providers were better able to facilitate continuity of care during and after HAH and were able to help integrate acute care into long-term treatment or management strategies. Health care providers found it difficult to adequately capture their time or tasks in existing payment or tracking systems.[11] Some providers found that the technology they were using was not well integrated, and electronic health records were not able to keep up with the needs of real-time monitoring or to properly sync with hospital data. The HAH workflows were sometimes confusing to the health care providers, and they found it challenging to simultaneously coordinate care, manage their travel, and adjust to a new workflow.[11] High levels of staff turnover were reported in some studies partly due to an increased burden of care placed on the staff.

Equality and Health Inequities

The inclusion of digital monitoring and record keeping technologies as part of HAH may disproportionately exclude people from some groups, including older people, people living in social housing or without housing, people with lower incomes, people who are unemployed, people living with disabilities, and people living in rural areas without access to such programs.[13] The NHS guide to setting up technology-enabled virtual wards recommends that an equality impact assessment be completed as part of the development of any HAH program to ensure the program offerings are as inclusive as possible and allow for the provision of alternative arrangements for those patients who are unable or unwilling to use the technology provided.[2]

> **People living in rural areas often have difficulty accessing health care. HAH is a method that could be useful to people living in rural areas to increase their access to health care.**

Levine and colleagues (2021)[14] interviewed patients and health care providers from rural areas across the US to capture their perceptions of acute care at home. The participants shared that currently available rural health care is inefficient, with challenging logistics and care coordination as well as long waits for testing and specialist referrals. Patients who are admitted to hospital often end up staying longer than necessary because it is difficult to arrange their transport back home.[14] In addition, people reported that some rural hospitals are more clinically conservative, forcing patients to seek treatment at larger urban hospitals instead of remaining closer to home. The patients living in rural areas interviewed were positive overall about their perceptions of HAH. They were open to the idea of receiving acute care in their homes because of the potential for increased comfort and easier access to health care.[14] Health care providers were concerned about starting programs in their own communities due to concern about patient's abilities to manage their own care, patient health literacy, and patient safety (particularly in areas where drug use was common).[14] An advantage to HAH in rural areas could be the health care team's familiarity with the local patients. Access to reliable cellular or internet services, challenges with geographic accessibility and weather, and the availability of skilled staff in rural areas were cited as potential barriers to implementing an HAH program.[14]

Key Recommendations and Requirements for Virtual Ward Programs

The McGill research team identified the following key recommendations for the development of virtual ward programs in Canada:

- Plan for a single remote patient-monitoring platform that connects with the hospital's electronic health record system to reduce user fatigue and staff burnout from trying to manage multiple platforms.[1]
- The technology that is chosen to connect the patient and their health care providers does not need to be the most current, but rather the most closely aligned with the needs of the program and its stakeholders.[1]
- Ensure data security, confidentiality, and data management protocols are in place to manage the secure transmission and storage of patient data from outside of the hospital setting.[1]

The McGill research team grouped key requirements for virtual care wards or HAH programs into 4 categories: patient eligibility criteria, human resources, technology considerations, and care coordination and communication.[1] A summary of recommendations and requirements for program components from several publications have been categorized into these headings and are provided here.

- Patient eligibility criteria (and referral)
  - Refer a small but targeted group of patients to HAH programs with a focus on conditions that can be adequately monitored remotely using available remote monitoring devices and technology.[6]
  - Have clear selection, referral, and discharge pathways for target patient populations from a range of intake points (e.g., EDs, inpatient wards, community services).[1,6]
  - Have virtual ward staff embedded in acute care settings to help identify patients suitable for referral to HAH and virtual wards.[6,15]
- Human resources

- Build multidisciplinary teams with a mix of skills to increase job satisfaction and enable staff to provide holistic care to patients.[1,6]
- Teams may include key roles such as clinical leadership, operational leadership, program or project management support, procurement expertise, digital expertise, data and reporting expertise, and patients or people with lived experience.[2]

- Technology considerations
  - Standard procedures should be in place to outline how technology will be provided to the patient, how it will be returned to the HAH program, and any infection control procedures that may be necessary before the equipment is reissued to another patient.[13]
  - Plan for a single remote patient-monitoring platform that connects with the hospital's electronic health record system to reduce user fatigue and staff burnout from trying to manage multiple platforms.[1]
  - The technology that is chosen to connect the patient and their health care providers does not need to be the most current, but rather the most closely aligned with the needs of the program and its stakeholders.[1]
  - Ensure data security, confidentiality, and data management protocols are in place to manage the secure transmission and storage of patient data from outside of the hospital setting.[1]

- Care coordination and communication
  - Have clear clinical governance and procedures to protect both patients and staff and avoid confusion over who is responsible for what while patients are being cared for in a virtual ward program.[6]
  - Provide health care providers with a clear escalation protocol to manage ED attendance and hospital readmission.[1]

Implementation

Several publications included in this report outlined the barriers and facilitators to the implementation of HAH programs. These factors include the following:

- Barriers
  - clinical instability or poor home conditions[5]
  - a lack of similar existing models to refer to or build off of when establishing a new program[6]
  - a lack of consistency in defining what virtual wards are and are not meant to do[6]
  - a lack of awareness of the HAH program by primary and acute care physicians[6]
  - staff recruitment challenges[6,14]

- Facilitators
  - integration of patient selection criteria and workflows with existing electronic health record systems[1,15]

- providing patients with 24/7 access to health care providers via telemedicine or phone via a virtual command centre with a dedicated team to manage patients participating in HAH[6,12,15]
- training patients and caregivers adequately in how to use any equipment provided and the tasks needed to manage care in the home (e.g., drug administration, symptom monitoring, communication with health care professionals)[5] along with providing all necessary equipment with supports to overcome any barriers (e.g., visual impairment, physical limitations)[5,13]
- training staff adequately and documenting procedures to ensure comfort with expanded roles outside of standard scope of practice[2,12]
- engaging caregivers as partners in care through informed discussions about treatment options and their capacity to provide care, respecting their right to decline caregiving if unable or unwilling[11-13]
- providing programs that are designed to support unpaid and informal caregivers and to prevent burnout through education, advocacy, and respite care[11,13] and ensuring program administrators are aware of legislation and regulation that support patients and caregivers[6]
- including health care providers with strong clinical and communication skills to facilitate collaboration with other providers, patients, and caregivers[11] and provision of documentation and effective, tailored information sharing between staff, patients, and caregivers to facilitate effective and high-quality care[12]
- establishing supportive operational, regulatory, and legal frameworks to promote home-based care delivery[11]
- engaging stakeholders early to navigate regulatory requirements, build trust, and ensure health care providers are aware of how to, and comfortable with, referring patients to the program[12]
- realistically assessing team capacity and internal capabilities and determining whether the program and patients would benefit from collaboration with external partners[15]
- embedding implementation scientists within the operations team to encourage learning, outcome measurement, and model innovation[15]
- engaging patients and providers in continuous improvement of the care model and operational infrastructure[15]

Related Developments

Automation in health care decision-making is becoming more common to speed up patient flow and conserve resources. For example, Maniaci and colleagues (2024)[16] described the development and implementation of a practice advisory tool embedded within electronic health records that identifies patients who are eligible for the Mayo Clinic's Advanced Care at Home program. The purpose of the tool was to reduce the clinician burden associated with manually screening patients for eligibility. It was developed based on the Advanced Care at Home program inclusion and exclusion criteria, which were based on inputs from clinical guidelines, expert consensus, and literature review.[16] The tool was integrated with the electronic

health record system and displayed a pop-up notification when a patient met the inclusion criteria for the Advanced Care at Home program to prompt the clinician to refer the patient, defer the decision, or dismiss the notification.

The Advanced Care at Home tool was implemented in 2 US states (Florida and Wisconsin). During the study period, 2,847 patients triggered 8,962 notifications. There were 324 unique patients referred to the program based on 711 notifications (11.4%).[16] After evaluation by the Advanced Care at Home program team, 31 of 324 patient referrals (8.6%) met the full inclusion criteria and were enrolled in the program.[16]

The authors reported the shift to automated alerts did not increase the volume of referrals to the Advanced Care at Home program as much as they had anticipated. They observed a difference in referral patterns between the 2 clinical sites included in the study, suggesting these alerts may be more useful to some groups than others.[16] Although this particular tool did not significantly increase the number of patient referrals, there remains a need for similar tools to help reduce the burden on health care providers of manually selecting patients for virtual ward programs. There are many variables that need to be considered at enrolment, such as clinical stability, confirmation of a safe home setting, and chart review results.[16]

> The eventual development of tools to effectively automate or facilitate this process will help decrease the administrative burden on health care providers, freeing up time to be spent caring for patients.

Looking Ahead

The approaches to managing hospital overcrowding and bed shortages will continue to evolve as the limitations in human and physical resources in hospitals in Canada are addressed. The solutions to these issues will change as new technologies emerge. The medical device space is ever evolving, and new ways to connect the patient and provider and to monitor patients' vital signs and well-being will continue to change. Virtual wards may be useful to save resources while improving patient satisfaction and maintaining the quality of patients' clinical outcomes. To realize these potential improvements, there is a need for access to reliable technology and adequate training for all users. Acknowledgement of the extent of caregiver burden imparted by caring for people outside of the hospital setting will also be important.

References

1. Almeida N, Suarthana E. Hospitals at home: guiding principles for establishing virtual acute care wards. *(Report no. 93)*. Technology Assessment Unit (TAU) of the McGill University Health Centre (MUHC): Montreal (QC); 2023: https://muhc.ca/sites/default/files/micro/m-TAU/Home_Hospitals_report_2023-07-18.pdf. Accessed 2024 Mar 19.

2. NHS England. A guide to setting up technology-enabled virtual wards. *(Transformation Directorate)* 2021; https://transform.england.nhs.uk/key-tools-and-info/a-guide-to-setting-up-technology-enabled-virtual-wards/. Accessed 2024 Mar 21.

3. Yang JS. Hospital acute care bed occupancy rates in select countries worldwide, 2010 and 2021. New York (NY): Statista Inc.; 2023: https://www.statista.com/statistics/1116612/oecd-hospital-acute-care-occupancy-rates-select-countries-worldwide/. Accessed 2024 Mar 28.

4. Hospital at home: an alternative to conventional hospitalization. English Summary. Montreal (QC): INESSS; 2021: https://www.inesss.qc.ca/fileadmin/doc/INESSS/Rapports/Soins_critiques/INESSS_HAD_Summary.pdf. Accessed 2024 Mar 19.

5. Denecke K, May R, Borycki EM, Kushniruk AW. Digital health as an enabler for hospital@home: a rising trend or just a vision? *Front Public Health*. 2023;11:1137798. PubMed

6. Evaluation of virtual ward models in South West London. London (UK): Health Innovation Network South London; 2022: https://healthinnovationnetwork.com/wp-content/uploads/2022/11/SWL-VW-evaluation-report_final-version-21.11.22.pdf. Accessed 2024 Mar 21.

7. Levine DM, Paz M, Burke K, Schnipper JL. Predictors and reasons why patients decline to participate in home hospital: a mixed methods analysis of a randomized controlled trial. *J Gen Intern Med*. 2022;37(2):327-331. PubMed

8. Leong MQ, Lim CW, Lai YF. Comparison of Hospital-at-Home models: a systematic review of reviews. *BMJ Open*. 2021;11(1):e043285. PubMed

9. Hecimovic A, Matijasevic V, Frost SA. Characteristics and outcomes of patients receiving hospital at home services in the South West of Sydney. *BMC Health Serv Res*. 2020;20(1):1090. PubMed

10. Kastengren M, Frisk L, Winterfeldt L, Wahlstrom G, Dalen M. Implementation of Sweden's first digi-physical hospital-at-home care model for high-acuity patients. *J Telemed Telecare*. 2024:1357633X241232176.

11. Chua CMS, Ko SQ, Lai YF, Lim YW, Shorey S. Perceptions of hospital-at-home among stakeholders: a meta-synthesis. *J Gen Intern Med*. 2022;37(3):637-650. PubMed

12. Wallis JA, Shepperd S, Makela P, et al. Factors influencing the implementation of early discharge hospital at home and admission avoidance hospital at home: a qualitative evidence synthesis. *Cochrane Database Syst Rev*. 2024;3(3):CD014765. PubMed

13. Supporting information for ICS leads: enablers for success: virtual wards including hospital at home. London (UK): NHS England and NHS Improvement; 2022: https://www.england.nhs.uk/wp-content/uploads/2022/04/B1382_supporting-information-for-integrated-care-system-leads_enablers-for-success_virtual-wards-including-hos.pdf. Accessed 2024 Mar 21.

14. Levine DM, Desai MP, Ross J, Como N, Anne Gill E. Rural perceptions of acute care at home: a qualitative analysis. *J Rural Health*. 2021;37(2):353-361. PubMed

15. Rothman RD, Delaney CP, Heaton BM, Hohman JA. Early experience and lessons following the implementation of a Hospital-at-Home program. *J Hosp Med*. 2024. PubMed

16. Maniaci MJ, Torres-Guzman RA, Avila FR, et al. Development and evaluation of best practice advisory alert for patient eligibility in a hospital-at-home program: a multicenter retrospective study. *J Hosp Med*. 2024;19(3):165-174. PubMed

Appendix 1: Methods

Note that this appendix has not been copy-edited.

Literature Search Strategy

An information specialist conducted a literature search on key resources including MEDLINE, the Cochrane Database of Systematic Reviews, the International HTA Database, the websites of Canadian and major international health technology agencies, as well as a focused internet search. The search approach was customized to retrieve a limited set of results, balancing comprehensiveness with relevancy. The search strategy comprised both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. Search concepts were developed based on the elements of the research questions and selection criteria. The main search concepts were virtual wards and implementation, utilization, or evaluation. The search was completed on March 5, 2024, and limited to English-language documents published since January 1, 2019.

Selection Criteria

One author screened the literature search results and reviewed the full text of all potentially relevant publications. Publications were considered for inclusion if the intervention was a 'virtual ward' or 'hospital at home' program. Due to the volume of relevant literature identified, inclusion of publications in the evidence section was limited to systematic reviews or overviews of systematic reviews that focused on general acute care needs. Reviews or studies focused on management of patients during the acute phase of the SARS-CoV-2 pandemic were not included. Grey literature was included when it provided additional information to that available in the published studies.

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