



Technology Assessment Unit (TAU) of  
the McGill University Health Centre  
(MUHC)



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# Hospital at Home: Guiding Principles for Establishing Virtual Acute Care Wards

Brief Report  
Report no. 93

# Report prepared for the Technology Assessment Unit (TAU) of the McGill University Health Centre (MUHC)

by

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## **Mission Statement**

The MUHC Health Technology Assessment Unit (TAU) advises hospital administrators and clinical teams in difficult resource allocation decisions. Using an approach based on independent, critical evaluations of the available scientific evidence and a transparent, fair decision-making process, novel and existing medical equipment, drugs and procedures used by healthcare professionals are prioritized on a continuous basis ensuring the best care for life with the best use of resources.

## **Brief Reports**

Brief reports are prepared in response to urgent requests for information or to update previous reports with new evidence; in such cases an in-depth evaluation is not possible or is unnecessary. Brief reports are reviewed by the Manager of TAU and the Chair of the Policy Committee, but are not submitted to or approved by the Policy Committee, and usually contain no recommendations.

## **Declaration of Conflicts of Interest**

Members of TAU's research staff and policy committee declare no conflicts of interest.

## **Suggested Citation**

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- Dr. Nancy Humber, Clinical lead, Hospital at Home, Royal Jubilee Hospital and Victoria General Hospital
- Tara Mulcaster, Manager, Hospital at Home, Royal Jubilee Hospital and Victoria General Hospital

### **Jewish General Hospital, Montreal, QC**

- Erin Cook, MSN, Director of Quality, Transformation, Evaluation, Value, Clinical & Organizational Ethics, and Virtual Care, CIUSSS Centre-Ouest-de-l'Île-de-Montréal

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## REPORT REQUESTOR

This report was requested by Dr. Lucie Opatrny, President and Executive Officer of the MUHC, on June 14, 2023.

## TYPES OF RECOMMENDATIONS ISSUED BY THE TAU COMMITTEE

Type of recommendation	Explanation
<b>Approved</b>	<ul style="list-style-type: none"> <li>Evidence for relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, is sufficiently strong to justify a recommendation that the technology be accepted, used and funded through the institutional operating budget</li> </ul>
<b>Approved for evaluation</b>	<ul style="list-style-type: none"> <li>There is a reasonable <i>probability</i> that relevant decision criteria, including efficacy, safety, and cost, as well as context-specific factors such as feasibility, are favorable but the evidence is not yet sufficiently strong to support a recommendation for permanent and routine approval.</li> <li>The evidence is sufficiently strong to recommend a <i>temporary</i> approval in a restricted population for the purposes of evaluation, funded through the institutional operating budget.</li> </ul>
<b>Not approved</b>	<ul style="list-style-type: none"> <li>There is insufficient evidence for the relevant decision criteria, including efficacy, safety, and cost;</li> <li>The costs of any use of the technology (e.g. for research purposes) should not normally be covered by the institutional budget.</li> </ul>

## DISCLAIMER

The Technology Assessment Unit (“TAU”) of the McGill University Health Centre (“MUHC”) was created in order to prepare accurate and trustworthy evidence to inform decision-making and when necessary to make policy recommendations based on this evidence. The objective of the TAU is to advise the hospitals in difficult resource allocation decisions, using an approach based on sound, scientific technology assessments and a transparent, fair decision-making process. Consistent with its role within a university health centre, it publishes its research when appropriate, and contributes to the training of personnel in the field of health technology assessment.

The information contained in this report may include, but is not limited to, existing public literature, studies, materials, and other information and documentation available to the MUHC at the time it was prepared, and it was guided by expert input and advice throughout its preparation. The information in this report should not be used as a substitute for professional medical advice, assessment and evaluation. While MUHC has taken care in the preparation of this report to ensure that its contents are accurate, complete, and up-to-date, MUHC does not make any guarantee to that effect. MUHC is not responsible for any liability whatsoever, errors or omissions or injury, loss, or damage arising from or as a result of the use (or misuse) of any information contained in or implied by the information in this report.

We encourage our readers to seek and consult with qualified health care professionals for answers to their personal medical questions. Usage of any links or websites in the report does not imply recommendations or endorsements of products or services.

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## EXECUTIVE SUMMARY

### BACKGROUND

In May 2023, the Quebec government announced a pilot project wherein eight hospitals in the province would implement 'Hospital at Home' care models for patients to receive acute level care while remaining in their own homes. Hospital at Home models have been used in other countries for over 30 years, and were conceived as alternative to the traditional inpatient hospital stay as a way to alleviate the strain on hospital resources and bed capacity. The two main types of Hospital at Home models target (1) admission avoidance in acute patients who would otherwise be hospitalized, and (2) early discharge in admitted patients needing post-discharge acute care.

### OBJECTIVES

Following a call for proposals from the Institut de pertinence des actes médicaux (IPAM) of the Ministry of Health (MSSS) to develop a hospital at home model, TAU was requested by Dr. Lucie Opatrny, President and CEO of the MUHC, to evaluate the requirements of establishing a home hospital care model, with a particular emphasis on the technologies involved. The specific objectives were to:

- Review the technologies (telehealth platforms and remote patient monitoring equipment) required for hospitals at home;
- Review general guiding principles for the establishment of hospitals at home.

### FINDINGS

Our literature review and interviews with Hospital at Home and remote patient monitoring centres revealed that diligent planning and mapping is required to establish a successful model, with the following as key requirements:

#### **Key requirements for acute care Hospital at Home models:**

1. **Patient eligibility criteria:** It is critical to clearly define the target patient population or conditions, including patient accessibility issues such as language, vision and mobility constraints, digital literacy, and suitability of the home environment. Protocols for consistent referral, selection and discharge pathways need to be established, to ensure appropriate care of home hospital patients.
2. **Human resources:** Established hospital at home models have identified staffing needs as one of the most important threats to sustainability, given the need for recruitment and retention of highly skilled and accessible staff in a competitive



workforce market. Burnout and user fatigue due to working with multiple, fragmented digital health platforms is an important consideration.

3. **Technology considerations:** Remote monitoring of acute care patients requires continuous, responsive monitoring to ensure patient safety. Three factors are key to success:
  - i. **Interoperability of systems:** All the interviewees indicated the need for establishing a uniform digital infrastructure, rather than multiple, siloed platforms, to allow easy integration of digital platforms and devices with the hospital's electronic health record (EHR) system. This would also reduce user fatigue and workload;
  - ii. **Ease of use and accessibility of the technologies:** Multiple centres have documented that the complexity of technology may hinder patient safety and continuity of care. Given the explosion of vendors on the market, experienced centres have indicated that it is unnecessary to seek out the latest innovation, because easily available home monitoring devices that are Bluetooth-enabled allow for effective remote patient monitoring. It is more important to understand user needs, for example, patient digital literacy and accessibility issues, and ensure alignment of the remote patient monitoring program goals with these needs;
  - iii. **Data security and governance** to ensure patient confidentiality and secure transmission, management and analysis of data.
4. **Care coordination and communication:** Remote patient monitoring in a home setting requires the involvement of a different set of people compared to in-hospital management, including active participation of patients and caregivers in their own care; coordination with paramedics and community services; and involvement of allied health professionals. Regular interaction with the home hospital team is needed to coordinate visits and diagnostic interventions and reduce distress among patients and care providers. Finally, establishment of an **escalation protocol** in case of emergencies is imperative.

#### **Remote monitoring technologies to enable Hospital at Home models:**

- We identified several Canadian and international Hospital at Home models and further explored the technologies most frequently used within these care models. The market for remote patient monitoring grew exponentially during COVID, though it remains geared towards long-term chronic disease management.

- Most Canadian models use the ‘Device and Tablet’ concept, wherein patients are provided with a preconfigured tablet able to transmit data back to the clinician’s dashboard, and Bluetooth-enabled devices (e.g. blood pressure monitors) to measure and automatically upload biometric data. This concept requires the provision of preconfigured tablets or smartphones and Wi-Fi connectivity.
- Several companies provide turnkey solutions that integrate the telehealth platform with cellular-connected preconfigured devices (Cellular-connected concept), which enable real-time monitoring and avoid the need for tablets or smartphones. However, coverage in rural or remote settings may be an issue. Furthermore, proprietary software may make interoperability and configuration more difficult.
- Both concepts described above allow for integration with the electronic health record system (e.g. EPIC, Cerner, etc.)

## CONCLUSIONS

- Established Hospital at Home models have identified **staffing** considerations, care **coordination and communication** protocols, and **technology interoperability** as key factors and potential threats to sustainability.
- The market for remote patient monitoring has grown exponentially. However, remote monitoring of patients for acute care requires technology that can:
  - i. meet continuous monitoring demands to ensure patient safety;
  - ii. interface seamlessly with the electronic health record system to avoid multiple fragmented and siloed platforms;
  - iii. be accessible and user-friendly for patients and staff alike.

## KEY RECOMMENDATIONS

- It is important to plan for a single remote patient monitoring platform that interfaces with the hospital’s electronic health record system to reduce user fatigue and burnout caused by working with multiple siloed digital platforms.
- It is unnecessary to acquire the latest technology on the market. It is far more important to assess stakeholder and program needs, and ensure the technology matches those requirements.
- It is critical to establish data security, confidentiality and management protocols for the secure transmission and storage of data from patients managed outside the hospital setting.

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**LIST OF ABBREVIATIONS**

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BP	Blood Pressure
CADTH	Canadian Agency for Drugs and Technologies in Health
DQEPE	Direction de la qualité, de l'évaluation, de la performance et de l'éthique
DSP	Direction des services professionnels
EHR	Electronic Health Record
ED	Emergency department
GP	General Practitioner
HaH	Hospital at Home
HCP	Healthcare professionals
HiTH	Hospital in the Home
HTA	Health Technology Assessment
INESSS	Institut National d'Excellence en Santé et en Services Sociaux
IT	Information Technology
JGH	Jewish General Hospital, Montreal
NICE	The National Institute for Health and Care Excellence, UK
RPM	Remote Patient Monitoring
SaMD	Software as Medical Device
TAU	MUHC Technology Assessment Unit

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# HOSPITAL AT HOME: GUIDING PRINCIPLES FOR ESTABLISHING VIRTUAL ACUTE CARE WARDS

## 1. BACKGROUND

The Quebec government recently announced that several hospitals in the province would pilot the use of ‘Hospital at Home’ care models, which enable patients to receive acute level care while remaining in their own homes.<sup>1</sup> The government estimates this measure could free up approximately five percent of hospital bed capacity, thus relieving some of the pressure on overextended emergency departments and hospital capacity.

### 1.1 Reason for Brief Report

The McGill University Health Centre was chosen as one of eight sites to pilot the home hospital model. In preparation for submitting a proposal to the Ministry, TAU was requested by Dr. Lucie Opatrny, President and CEO of the MUHC, to evaluate the requirements of establishing a home hospital care model, with a particular emphasis on the technologies involved.

## 2. OBJECTIVES

- To review the technologies (telehealth platforms and remote patient monitoring equipment) required for home hospitals;
- To review general guiding principles for the establishment of home hospitals.

## 3. METHODS

### 3.1 Literature search

We conducted a literature search to identify published articles or guidance documents on home hospitals and remote monitoring technology by searching PubMed and the health technology assessment (HTA) databases (CADTH, INESSS and NICE). The most recent search was conducted on July 10, 2023 using the following keywords: "remote

monitoring" OR "home hospital" OR "virtual ward" OR "hospital at home" OR "hospital in the home".

We identified further home hospital models and the technologies they use through the [World Hospital at Home Congress](#) website, Google searches, and the Gartner market analysis report.

### **3.2 Experience at the MUHC and elsewhere**

We obtained information on the experience of the MUHC and hospitals with established 'hospital at home' or remote patient monitoring models through correspondence, interviews or information sessions with the following people:

#### **Island Health, Victoria, BC:**

- Sean Spina, principal investigator for the Alternatives to Traditional Hospital Care Offered in Monitored Environments (AT-HOME) research team and Regional Manager, Clinical Pharmacy Services, Island Health;
- Dr. Nancy Humber, Clinical lead, Hospital at Home, Royal Jubilee Hospital and Victoria General Hospital;
- Tara Mulcaster, Manager, Hospital at Home, Royal Jubilee Hospital and Victoria General Hospital;

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#### **Hopital Montfort, Ottawa, ON**

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#### **MUHC**

- Carole Lapierre, Associate Director, Partnership Office, DSP
- Keith Woolrich, Director, DQEPE

## 4. HOSPITALS AT HOME: DEFINITION AND KEY FEATURES

### 4.1 Definition

- Hospital at Home, or home hospitalization, is defined as the provision of **acute**, hospital-level care delivered by healthcare professionals in a patient's own home for a condition that would traditionally require a hospital admission.<sup>2</sup>
- The two most common types of Hospital at Home models target (1) avoidance of hospitalization in non-admitted patients needing acute or sub-acute care, and (2) early discharge and transitional care for admitted patients needing sub-acute follow-up care.

#### KEY FEATURES OF HOSPITAL AT HOME:

- **Acute care:** Care provided through home hospitals is for short-term, time-limited episodes, delivered through a combination of in-person and virtual visits *at the same priority* as an inpatient would receive.
- **Targeted patient population:** Hospital at Home is not intended to replicate existing community healthcare services; it targets patients with sub-acute and acute care needs who would otherwise be hospitalized.
- **Access to hospital-level diagnostics:** Patients admitted to Hospital at Home receive the same care as inpatients i.e. access to specialized healthcare professionals and hospital-level diagnostics, but are managed at home.
- **Continuous monitoring:** Remote monitoring of patients with acute care needs requires establishment of well-defined communication channels, escalation protocols, and coordination with multidisciplinary teams including allied healthcare professionals and community services.

### 4.2 Context

- Home hospital models have been used in a number of countries for the past 30 years, and are particularly well established in the UK,<sup>2</sup> Australia,<sup>3</sup> New Zealand and parts of Europe.<sup>4</sup> [Appendix Table A-1](#) lists Hospital at Home models and their features.
- Hospital at home models were conceived as an innovative approach to healthcare delivery, offering an alternative to the traditional inpatient hospital stay by allowing patients to receive medical care in a familiar and comfortable environment while reducing the strain on hospital resources.
- These models gained further impetus during the pandemic when virtual care became a necessity, and was considered a way to relieve pressure on healthcare

systems by increasing hospital bed capacity. However, Hospital at Home services alone are unlikely to alleviate these pressures, and should be considered in conjunction with a global approach to system transformation.

- Experience from established centres indicates that home hospitals are preferred by patients as a more patient-centred approach,<sup>5,6</sup> while also impacting clinical outcomes such as nosocomial infections and risk of institutionalization.
- In Canada, hospital at home models for admission avoidance and post-discharge in acute care patients have been implemented at the Jewish General Hospital in Montreal in 2021 and in Island Health in Victoria, BC in 2020.

## 5. KEY REQUIREMENTS: LESSONS FROM ESTABLISHED HOSPITALS AT HOME

Hospitals in the UK and Australia have well-established home hospitalization models, and have developed comprehensive guides on planning and implementing Hospital at Home initiatives.<sup>2,3</sup> These guides, along with our interviews with other centres,<sup>7,8</sup> have identified the following as key requirements for success.

### 5.1 Patient eligibility criteria

- It is necessary to establish clear selection, referral and discharge pathways for patients who qualify for home hospitalization. Selection criteria typically include the patient's medical condition, stability, and the availability of a suitable home environment to support the required medical care.
- [Table 1](#) below lists medical conditions most often included and excluded by established home hospitals.<sup>2,3,6</sup>

**Table 1. Patient eligibility criteria for admission into home hospitals**

Included Medical Conditions	Excluded Medical Conditions
Pneumonia	Stroke
Congestive cardiac failure	Acute coronary syndromes
Hyponatremia and unstable metabolic conditions	Orthopaedic admissions with lower limb fractures
Pulmonary embolism and deep vein thrombosis	Surgical presentations
Urinary sepsis	Medically unstable patients
Complex falls	Conditions requiring complex care
Acute functional decline due to underlying medical conditions	Cognitively impaired or physically incapacitated patients with no live-in caregiver
Acute delirium	Demonstrated poor compliance with medical care
Exacerbations of COPD and Asthma	Active substance use disorder
Acute Kidney Injury	
Acute atrial fibrillation	
Gastroenteritis	

Included Medical Conditions	Excluded Medical Conditions
Neurological disorders including Parkinson's Disease	
Infected skin conditions such as cellulitis and infected ulcers	
Dementia and related complications	
Anemia	
Upper limb fractures after initial assessment	
Influenza	
Acutely unwell nursing home patients	

- Home Environment: A key eligibility criteria is the suitability of the patient's home environment, which should be accessible for healthcare providers, have the necessary space for medical equipment and the facilities to cater to the patient's needs.
- Other considerations: Patient preference for digital technologies, physical limitations (vision, dexterity), and language of communication.<sup>9</sup>

## 5.2 Human resources

- Established hospital at home models have identified staffing needs as one of the most important threats to sustainability, given the need for recruitment and retention of highly skilled and accessible staff in a competitive workforce market.<sup>2,3,8</sup>
- Hospital at Home teams can include physicians (as well as family physicians), nurses, pharmacists, paramedics, social workers, occupational and rehabilitation therapists.<sup>2,3,7,8</sup> All staff require training in the clinical and decision-making skills necessary to provide the same level of care that patients would receive in a hospital.
- Clinical and decision-making skills required include: medical assessment, non-medical prescribing, medication reconciliation, assessment screening, functional assessment, and assessment of family support and home environment.<sup>2</sup>

## 5.3 Care coordination and communication

- Established centres all stress the need for well-defined communication channels with the hospital to ensure safe and secure monitoring of patients with acute care needs. This includes regular interactions with the home hospital team to coordinate visits, schedule diagnostic tests and arrange specialist consultations, as well as daily physician-led discussions and virtual ward rounds to ensure continuity of care.<sup>2,3,7,8</sup>



- Interactions may take place over the phone, during in-person home visits, or virtually using a tablet or computer.
- It is necessary to have a point of contact for patients, and to provide comprehensive discharge planning and coordination with community services for the patient at discharge.
- Establishment of an **escalation protocol** in cases of an emergency is imperative to ensure safety and effectiveness of the program.<sup>3,7</sup>

#### 5.4 Technologies (see Section 6)

- Patients hospitalized at home require continuous monitoring and access to diagnostics tests with the same priority as hospital inpatients. In addition to medical equipment and supplies (infusion pumps, oxygen therapy equipment, wound care supplies, and medications), patients in home hospitals rely on remote patient monitoring for virtual consultations and measuring vital signs.
- Established hospital at home models have identified the following key considerations for remote monitoring devices and platforms, developed further in Section 6:
  1. Interoperability of systems: Having an **established digital infrastructure** to allow digital health platforms/devices to interface with the electronic health record system, to **reduce burden** on staff
  2. Ease of use of the technologies: Technologies need to be user friendly and accessible, and not overly complicated to reduce burden on staff and patients.
  3. Data security and governance: Given the relative novelty of using digital tools to acquire, process, or analyze data to support the remote treatment of patients, establishment of data governance protocols and compliance with government regulations for the secure management and transmission of patient data is needed.

#### 5.5 Emergency response

- Patients identified robust safety measures and effective and reliable communication channels in case of emergencies as priorities to ensure care they receive is as safe as that in-hospital. Protocols and information pamphlets that clearly outline emergency measures and contact information are essential for patients and caregivers.

## 5.6 Patient and caregiver education

- All Hospital at Home centres have established protocols to educate and train patients and their caregivers about the care plan, medication administration, monitoring protocols, and managing potential emergencies.
- Given the increased involvement of caregivers, there is a need to recognize unpaid caregivers as key and equal partners in the delivery of care.

## 5.7 Regulatory and legal considerations

- Hospital at home models are governed by the same regulations and guidelines governing healthcare delivery in a hospital setting. With the use of remote patient monitoring technology, it is imperative to ensure patient privacy and data security in compliance with government requirements and standards.

# 6. TECHNOLOGIES TO ENABLE HOSPITALS AT HOME

## 6.1 Key questions to consider when exploring technologies for home hospital services

- Home hospital models initially did not rely on digital technology, with patients being monitored through regular phone calls and in-home visits.<sup>3,4,8</sup> With the advent of connected health technologies and the experience gained from virtual consultations during COVID-19, home hospitals have increasingly adopted remote monitoring technologies. However, the use of these technologies requires several important considerations, which are listed in [Table 2](#) and adapted from INESSS<sup>9</sup> and the [NASSCAT](#) framework.
- Health Canada Approval: Health Canada considers software as a medical device (SaMD) when it is used to acquire, process, or analyze a medical image, or to support or provide recommendations to health care professionals, patients or non-healthcare professional caregivers about prevention, diagnosis, treatment, or mitigation of a disease or condition. Given the acute care needs of patients hospitalized at home, remote monitoring technologies would be classified as [Class III devices](#), subject to Health Canada approval.

**Table 2. Principal considerations for telemonitoring technologies in home hospitals**

Criteria	Considerations
<b>Impact on user</b>	
<b>User-specific needs</b>	<ul style="list-style-type: none"> <li>Who will be using the technology (e.g. staff or patients) and what is most appropriate for them?</li> </ul>
<b>Ease of use</b>	<ul style="list-style-type: none"> <li>Is the technology easy to use for patients and staff? <ul style="list-style-type: none"> <li>Patients may be frustrated with digital health devices based on their digital literacy, which could interfere with their care<sup>9</sup></li> <li>Burden on staff if poor interoperability and multiple platforms increases workload</li> </ul> </li> </ul>
<b>Accessibility &amp; acceptability</b>	<ul style="list-style-type: none"> <li>Will the technology prevent access to care for certain populations? <ul style="list-style-type: none"> <li>Patients in remote or rural areas; elderly patients; vulnerable patients (e.g. due to ethnicity/race, income or education)<sup>9</sup></li> <li>Patients not speaking French or English<sup>9</sup></li> <li>Physical limitations: Vision (font too small on phones/tablets), dexterity (to take photos of physical symptoms)</li> </ul> </li> <li>Patient informed consent for conducting medical interventions remotely</li> </ul>
<b>Accuracy of data</b>	<ul style="list-style-type: none"> <li>How accurately is remote data collected? <ul style="list-style-type: none"> <li>Errors in self reporting data<sup>9</sup></li> <li>Health conditions (e.g. dehydration) that could impact results<sup>9</sup></li> </ul> </li> </ul>
<b>Access to emergency response services</b>	<ul style="list-style-type: none"> <li>Can the technology connect the user automatically to resources in case of a crisis situation or emergency?</li> </ul>
<b>Clinical benefit</b>	<ul style="list-style-type: none"> <li>Are data available on impact of the technology on clinical effectiveness and safety outcomes?</li> </ul>
<b>Patient-clinician relationship</b>	<ul style="list-style-type: none"> <li>Would there be challenges with building a relationship of confidence?<sup>9</sup></li> <li>Are staff trained in culturally safe care, based on the culture and values of the patient?<sup>9</sup></li> </ul>
<b>Organizational Factors</b>	
<b>Privacy and security of confidential data</b>	<ul style="list-style-type: none"> <li>What is the best software for shared electronic records?</li> <li>Have quality standards and regulatory requirements for using the technology in a healthcare setting been fully defined?</li> </ul>
<b>IT connectivity and interoperability of systems</b>	<ul style="list-style-type: none"> <li>Does the system need to be upgraded for the technology to be installed (e.g. hardware, bandwidth)?</li> <li>Does a key technology need to be installed across multiple technical systems to achieve 'integration'?</li> <li>Does the technology interface with the electronic health record for data collection and evaluation?</li> </ul>
<b>Training</b>	<ul style="list-style-type: none"> <li>Are sufficient people with the right skills available?</li> <li>Are lines of responsibility for tasks clearly defined?</li> <li>Do staff have confidence and knowledge about the technology?</li> <li>Are staff trained in remotely administering culturally safe care?</li> </ul>
<b>Availability of resources (human, financial and material)</b>	<ul style="list-style-type: none"> <li>Will the technology require significant changes in care pathways and organizational routines?</li> <li>Is the pace of the project (time to achieve key goals and milestones) achievable?</li> <li>Will new management tools and data sources be needed to guide, monitor and evaluate the project?</li> <li>Is the physical space (calm, confidential setting) for virtual consultations and coordination available?<sup>9</sup></li> </ul>
<b>Acquisition costs</b>	<ul style="list-style-type: none"> <li>Is the cost justified with respect to expected benefits, other available software systems and need for continued support?<sup>9</sup></li> </ul>
<b>Cost-effectiveness</b>	<ul style="list-style-type: none"> <li>Is the cost justified with respect to an efficient use of resources?<sup>9</sup></li> </ul>
<b>Environmental impact</b>	<ul style="list-style-type: none"> <li>Are the technologies environmentally sustainable?<sup>9</sup></li> </ul>

## 6.2 Remote Patient Monitoring (RPM) Technologies

- Remote patient monitoring, a subcategory of virtual care, includes:
  1. Telehealth platforms to conduct virtual consultations and support operations, and
  2. Remote patient monitoring devices to regularly capture and transmit health data from the patient's location to a health care provider for review.
- Remote patient monitoring uses devices that remotely monitor pulse, temperature, oxygen saturation, blood pressure, movement and posture continuously and relay the information wirelessly to a central monitoring system. This would allow close supervision of high-risk patients.
- The market is currently inundated with vendors of telemedicine technology and services promoting the latest innovations in remote patient monitoring; however, these have traditionally been geared towards chronic disease. Unlike chronic disease monitoring, acute care management requires continuous monitoring capabilities.
- Canadian Hospital at Home and remote patient monitoring centres we spoke with tend to partner with a telehealth platform company but procure their own remote monitoring device kits, usually consisting of a tablet able to transmit data back to the clinician's dashboard, and Bluetooth-enabled devices such as thermometer, scale, pulse oximeter, blood pressure monitor to automatically upload data (**Device and Tablet concept**). This concept requires the provision of preconfigured tablets or smartphones and Wi-Fi-connectivity.
- Several companies provide turnkey solutions that integrate the telehealth platform with cellular-connected preconfigured remote monitoring devices (**Cellular-connected concept**), which enable real-time monitoring and remove the need for tablets or smartphones to transmit data. However, coverage in rural or remote settings may be an issue.
- [Table 3](#) lists technologies being used to facilitate several Hospital at Home models in Canada and elsewhere.

Table 3. Technologies to enable Hospital at Home models used in Canada and elsewhere

Technology	Manufacturer	Function	Features (from company website)	Strengths/Limitations identified by users	Centres using the technology/Model
<b>Canadian models</b>					
<a href="#">Cloud DX Connected Health Kit</a>	Cloud DX	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>• <b>Device and Tablet concept</b></li> <li>• Includes custom tablet, Pulsewave wrist cuff monitor, an oximeter, weight scale, and thermometer</li> <li>• Wrist cuff measures blood pressure, heart rate, breathing rate and scans for 7 different cardiac anomalies</li> <li>• Devices optimized to work together, prepared via Bluetooth, and ready to go out of the box</li> <li>• Health Canada approved</li> <li>• Cloud DX data transmitted to a cloud and patients and physicians interact with it through a Web-based portal.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b></li> <li>• Can be integrated into EPIC</li> <li>• A Canadian platform, which reduces issues with patient data storage and transmission, and data plan costs</li> <li>• Colour-coded alerts at a glance</li> <li>• <b>Limitations:</b></li> <li>• Needs internet connection for transmission; Ottawa Heart Institute ensures connectivity by paying for a cellular package for their tablets.</li> </ul>	<p><b>University of Ottawa Heart Institute, ON /</b> Telehome Monitoring Program (THM) for <u>long term</u> monitoring of acute heart failure patients, cardiac patients requiring daily monitoring post-discharge</p> <p><b>St. Mary's General Hospital, ON/</b> RPM to support pulmonary COPD rehab patients</p>
<a href="#">Home Health Monitoring (HHM)</a>	Telus	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>• <b>Device and Tablet concept</b></li> <li>• Patients are either provided with a tablet or a unique link to set up a 'myMobile' account on their personal device. Each patient also receives a BP cuff, thermometer, scale and oxygen saturation sensor.</li> <li>• The myMobile application is the virtual tool used by Island Health to provide Remote Patient Monitoring services.</li> <li>• The app includes consent form, daily questionnaires, upcoming appointments, biometric readings and educational material.</li> <li>• For biometric devices, if using a provided tablet with Bluetooth enabled devices, readings are uploaded automatically. If using personal devices, patients manually enter data into the tablet.</li> <li>• Providers have access to a centralized view of all patients on the HHM program, and ability to create customized care plans</li> <li>• Alerts and reminders that trigger patient alerts</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Limitations:</b></li> <li>• Conceived for intermittent chronic disease monitoring</li> <li>• Loss of contact with patients is extremely distressing to HCPs</li> <li>• Burn out from staff since technology is not integrated with their EHR system (Cerner); increases their workload</li> </ul>	<p><a href="#">Island Health, Victoria, BC/</a> Hospital at Home for admission avoidance or acute post-discharge care</p>
<b>Zoom for Healthcare + iPads</b>	Zoom	Telehealth platform for virtual consults	<ul style="list-style-type: none"> <li>• <b>Device and Tablet concept</b></li> <li>• iPads are configured to access cellular data as it is more secure than Wi-Fi.</li> <li>• Zoom for Healthcare is a cloud-based video conferencing software approved by the Provincial Health Services Authority of BC for the delivery of virtual visits.</li> </ul>	<ul style="list-style-type: none"> <li>• Island Health, BC recently switched from Telus' Home Health Monitoring platform to Zoom for Healthcare, with iPads and Bluetooth-connected devices</li> </ul>	<p><b>Island Health, Victoria, BC/</b> Hospital at Home for admission avoidance or acute post-discharge care</p>
<b>Call4care</b>		Alert pendant	<ul style="list-style-type: none"> <li>• A single push button that can be used remotely to reach HCPs easily</li> </ul>	<ul style="list-style-type: none"> <li>• Voice-activated would be better</li> </ul>	<p><b>Island Health, Victoria, BC</b></p>

Technology	Manufacturer	Function	Features (from company website)	Strengths/Limitations identified by users	Centres using the technology/Model
<a href="#">Virtuose Dialogue, Console, Assistant Virtuel, and Proximité</a>	Virtuose Technologies	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>• <b>Device and Tablet concept</b></li> <li>• Virtuose Dialogue : A user-friendly interface for designing care plans that feed into existing software to allow integrated monitoring of the resulting activities</li> <li>• Virtuose Console : Design and automate sending of messages to the user</li> <li>• Virtuose Assistant Virtuel : Remote interaction with users using the “Visioconference” function, following a notification from the Virtuose console (abnormal result, emergency, follow-up, technical support, etc.) and collect information relevant to clinical follow-up and user safety in an efficient and secure manner</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b></li> <li>• A Canadian platform, which reduces issues with patient data storage and transmission, and data plan costs</li> </ul>	<b>Centres intégrés de santé et services sociaux (CISSS) of Gaspésie, Chaudière-Appalaches and Outaouais, QC / Home Care Service for <u>long term</u> monitoring of heart failure patients (pilot project in Fall 2023)</b>
<a href="#">aTouchAway</a>	Aetonix	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>• <b>Device and Tablet concept</b></li> <li>• Allows audio/video conferencing, secure messaging and file storage and transfer</li> <li>• Sends alerts using real-time monitoring</li> <li>• For the Surgical Remote Care Monitoring (STRCM) Program at Hôpital Montfort, patients bring their own device (BYOD) and download the application on their chosen device, or use the web version to access the remote care-monitoring platform.</li> <li>• For the Enhanced In-Home Remote Care Monitoring Program, patients are provided with the kit, which includes tablet with Wi-Fi integrated and Bluetooth-enabled devices (BP cuff, oximeter, scale).</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b></li> <li>• A Canadian platform, which reduces issues with patient data storage and transmission, and data plan costs</li> <li>• Aetonix has SOC2 Type 2 certification to ensure protection of patient data and confidentiality</li> <li>• The platform could be used for acute care patients, depending on clinical pathway and established monitoring guidelines</li> </ul>	<p><b>Hôpital Montfort, Ottawa Community Paramedics and Prescott-Russell Community Paramedics/ Post-surgical remote care monitoring (STRCM) program</b></p> <p><b>Champlain Home and Community Care Support Service, Ottawa Community Paramedics and Prescott-Russell Community Paramedics/ Enhanced in-home remote care monitoring program</b></p>
<a href="#">SeamlessMD</a>	SeamlessMD	Telehealth platform for chronic disease monitoring	<ul style="list-style-type: none"> <li>• Guides patients before, during and after hospitalization via smartphone, tablet or computer.</li> <li>• Patients use the application to answer health survey questions.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b></li> <li>• SeamlessMD has SOC2 Type 2 certification to ensure protection of patient data and confidentiality</li> <li>• <b>Limitations:</b></li> <li>• Conceived for intermittent chronic disease monitoring</li> </ul>	<b>Michael Garron Hospital, Toronto / Virtual Ward for chronic disease remote monitoring</b>

Technology	Manufacturer	Function	Features (from company website)	Strengths/Limitations identified by users	Centres using the technology/Model
<a href="#">Biobeat sensor</a>	Bio-beat	Device for remote patient monitoring	<ul style="list-style-type: none"> <li>• Wrist monitor or chest monitor paired with a mobile application (JGH only uses chest monitor)</li> <li>• Can record 13 medical vital signs including cuffless blood pressure, pulse rate, respiratory rate, blood oxygen saturation, temperature, ECG.</li> <li>• Automated real-time early warning score (EWS) system to provide alerts on potential deterioration.</li> <li>• Health Canada-approved under interim COVID order</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b> <ul style="list-style-type: none"> <li>• Captures full range of vital signs on a regular basis with one single device.</li> <li>• Seamless for patients, reported by patients to be comfortable.</li> <li>• Requires no manipulation from any caregivers or patients to measure vitals or synch with tablet after initial onboarding completed.</li> </ul> </li> <li>• <b>Limitations:</b> <ul style="list-style-type: none"> <li>• Device is connected to patient via chest patch. At times if the connection is not great (i.e. due to sweating, scarring, excessive movement) the device can stop measuring at which point virtual nurses have to troubleshoot with the patient.</li> </ul> </li> </ul>	<b>Jewish General Hospital (JGH), QC/Hospital at Home</b> for acute post-discharge care
<a href="#">Masimo SafetyNet Alert</a>	Massimo	Device for remote patient monitoring	<ul style="list-style-type: none"> <li>• Masimo SafetyNet Alert is an oxygen monitoring and alert system designed to help protect patients at risk by sending alerts when help may be needed.</li> <li>• Continuously monitors physiological data—even during sleep—to identify respiratory depression;</li> <li>• Sends automatic alerts to the patient and emergency contacts when life-saving intervention may be needed; (At JGH, alerts sent only to clinical team)</li> <li>• Features a disposable fingertip sensor, a Home Medical Hub, and intuitive mobile app</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b> <ul style="list-style-type: none"> <li>• Accurate and consistent transmission of information;</li> <li>• No manipulation required by patients;</li> <li>• Easy to use</li> </ul> </li> <li>• <b>Limitations:</b> <ul style="list-style-type: none"> <li>• Patients report it being inconvenient (device is a finger probe).</li> <li>• Only captures oxygen and HR</li> </ul> </li> </ul>	<b>Jewish General Hospital, QC/Hospital at Home</b> for acute post-discharge care
<b>International models</b>					
<a href="#">VitalOn</a>	Essence Smart care	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>• <b>Cellular-connected concept</b></li> <li>• VitalOn combines telecare, telehealth, and wellness capabilities into a single, comprehensive remote patient monitoring platform.</li> <li>• It provides 24/7 monitoring for a wide range of aging-related and chronic conditions, including diabetes, hypertension, and congestive heart failure.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Strengths:</b> <ul style="list-style-type: none"> <li>• User-friendly solution operates independently, without the need for a smartphone or tablet-based apps;</li> <li>• Real-time data transmission</li> </ul> </li> </ul>	Israel's largest HMO, <a href="#">Clalit Health Services</a> , and homecare provider, <a href="#">Sharan Medical Care, Israel</a>
<a href="#">Doccla</a>	Doccla	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>• <b>Device and Tablet concept</b></li> <li>• Doccla is a virtual ward company</li> <li>• The service includes a tailor-made box of equipment, with pre-configured smartphones with a large font, and wearable medical devices to measure parameters such as heart rate, respiration rate, body temperature, spO2, and blood pressure.</li> <li>• Clinician dashboard: Providers can track patients' vital signs and follow an agreed clinical escalation protocol.</li> </ul>		20+ hospitals in the National Health Service (NHS) in <b>England, UK/Hospital at Home</b> for admission avoidance or acute post-discharge care

Technology	Manufacturer	Function	Features (from company website)	Strengths/Limitations identified by users	Centres using the technology/Model
			<ul style="list-style-type: none"> <li>Integrates with a wide range of EHR systems</li> <li>Doccla app connects patient and clinicians with in-app messaging and video calls.</li> </ul>		
<a href="#">MyCuviva, Cuviva Cloud, Cuviva Home and Cuviva Communication</a>	Cuviva	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>MyCuviva: user-friendly tool to manage all personal needs regarding medications, health monitoring, food, social contacts</li> <li>Cuviva Cloud: safe storage and self-learning data processing</li> <li>Cuviva Home: open platform that connects and integrates a variety of sensors, wearables, and devices</li> <li>Cuviva Communication: connect health care providers with patients, family and friends</li> </ul>	<ul style="list-style-type: none"> <li><b>Strengths:</b> <ul style="list-style-type: none"> <li>Cuviva has a design and interface made to suit frail older people.</li> <li>Open platform able to integrate large range of devices</li> </ul> </li> </ul>	<b>Borgholm Health Center, Öland, Sweden</b> / The Borgholm (virtual) Home Hospital
<a href="#">CareMonitor</a>	Care Monitor	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li><b>Cellular-connected concept</b></li> <li>CareMonitor collects medical and health information from a patient's vital signs or other data points, such as weight and blood pressure, through connected mobile devices or sensors.</li> <li>Real-time data is transmitted to a remote clinician for review and analysis</li> <li>Won the Australian Digital Health Agency Innovative Challenge in 2020</li> </ul>	<ul style="list-style-type: none"> <li><b>Strengths:</b> <ul style="list-style-type: none"> <li>Real-time data transmission</li> <li>No need to provide pre-configured smartphone/tablet</li> </ul> </li> </ul>	<b>New South Wales, Australia</b> / Hospital in the Home (HITH program) for admission avoidance and post-discharge care
<a href="#">Biofourmis</a>	Biofourmis	Telehealth platform for virtual consults, remote patient monitoring, and prediction analytics	<ul style="list-style-type: none"> <li><b>Cellular-connected concept</b></li> <li>Comprehensive, turnkey virtual care solution for patients with acute, post-acute and chronic conditions</li> <li>BiofourmisCare solution: Clinical teams have real-time view of patients' status and trajectory through a continuously updated visual dashboard</li> <li>Biovitals™ Analytics Engine: Leverages <b>artificial intelligence and machine learning</b> to analyze data collected in real time to identify shifts in patients' health that may require proactive interventions</li> <li>FDA-cleared</li> </ul>	<ul style="list-style-type: none"> <li><b>Strengths:</b> <ul style="list-style-type: none"> <li>Real-time data transmission</li> <li>No need to provide pre-configured smartphone/tablet</li> <li>Personalized interventions using artificial intelligence</li> </ul> </li> </ul>	<b>Augusta University Health, Georgia, US</b> / <a href="#">Virtual Care at Home</a> for admission avoidance and post-discharge care <b>Brigham Health Home Hospital, Boston, US</b> / Home hospital for admission avoidance
<a href="#">Medically Home</a>	Medically Home	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li><b>Cellular-connected concept</b></li> <li>Central to the model is a Medical Command Center staffed by physicians and nurses who virtually oversee the patient's care 24/7. The command center team can provide care to patients who may be miles – even states – away.</li> <li>Uses <b>Cesia™</b>, proprietary software, for in-home care orchestration, voice and video</li> </ul>	<ul style="list-style-type: none"> <li><b>Strengths:</b> <ul style="list-style-type: none"> <li>Proven clinical model and technology</li> <li>Breadth of potential use cases of the Medically Home platform</li> <li>Real-time data transmission</li> <li>No need to provide pre-configured smartphone/tablet</li> </ul> </li> </ul>	<b>Mayo Clinic, FL WI, US</b> / Post-discharge care <b>Cleveland Clinic's Care at Home program, Florida, US</b> / Admission avoidance and post-discharge care <b>Yale New Haven Health, CT, US</b> / Admission avoidance and



Technology	Manufacturer	Function	Features (from company website)	Strengths/Limitations identified by users	Centres using the technology/Model
			consults, biometric data and alerts		post-discharge care <b>UNC Health, NC, US</b> /Admission avoidance and post-discharge care
<a href="#">Health Recovery Solutions</a>		Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li>Fully managed device "kit" that provides a Bluetooth-enabled blood pressure cuff, thermometer, pulse oximeter and tablet to send vitals and symptoms data to nursing for monitoring.</li> </ul>	Integrates with EPIC and other EHR	<b>University of Michigan, MI, US</b> /Patient Monitoring @ Home for post-discharge care
<a href="#">Current Health</a>	Best Buy Health	Telehealth platform for virtual consults and remote patient monitoring	<ul style="list-style-type: none"> <li><b>Cellular-connected concept</b></li> <li>FDA-cleared wireless biosensor continuously and passively captures vital signs (respiratory rate, oxygen saturation, pulse rate, skin temperature, mobility and step count)</li> <li>Device agnostic approach</li> <li>Devices come pre-configured and paired for a seamless patient experience</li> <li>Care teams have unified insight into all vital signs within a single dashboard</li> <li>Open ecosystem allows to tailor program to the individual patient</li> </ul>	With Connectivity hub requiring only a standard electrical outlet, can deliver safe acute care in almost any home	<a href="#">UMass Memorial Health, MA, US</a> /Admission avoidance and post-discharge care
<a href="#">Contessa</a>	Amedisys	Telehealth platform for virtual consults & remote patient monitoring	<ul style="list-style-type: none"> <li>Uses <b>Care Convergence</b>, proprietary technology platform.</li> </ul>		<b>Mount Sinai, NY, US</b> / Hospital at Home for recovery, rehabilitation or palliative care at home

## 6.3 Summary of key findings

### 6.3.1 Interoperability of systems:

- All the interviewees indicated that implementing a model that uses multiple fragmented and siloed digital platforms and devices was more cumbersome than helpful. It led to user fatigue, burnout and frustration with trying to keep up with multiple technology changes, while adding to the workload. Therefore, it is important to **establish a digital infrastructure** to allow for a single platform that interfaces with the hospital's electronic health record system, which would:
  - **Reduce burden** on staff dealing with multiple, fragmented digital health platforms;
  - Allow for tracking and evaluation of data for continuous improvement
- According to our review, the Cloud DX platform, from a Canadian company, has been successfully integrated into EPIC (an electronic health record system), and is being used in several Canadian centres for remote patient monitoring. Many of the US RPM technologies use proprietary software, which may make interoperability more difficult.

### 6.3.2 Ease of use of the technologies:

- Multiple centres have documented that patients may be frustrated and overwhelmed by complicated technology, which may interfere with the safety and continuity of care. Technologies need to be user friendly and accessible to reduce:
  - Burden on healthcare staff: Staff have indicated fatigue with keeping up with constantly changing technologies.
  - Burden on patients/caregivers: Patients may be overwhelmed with complicated digital tools or being bombarded with reams of data. Patients also indicated it was extremely important to them to have seamless and reliable contact with healthcare teams in case of emergencies.
- Given the explosion of vendors on the market, experienced centres have indicated that it is unnecessary to get the latest cutting-edge technology, but rather to align stakeholder and program needs with device functionalities.
- Several Canadian remote monitoring centres partner with a telehealth platform (Cloud DX, Zoom for Healthcare, Telus Home Health Monitoring) but acquire and

supply patients with their own device kit, consisting of a tablet and basic home monitoring devices (BP cuff, thermometer, scale and oxygen saturation sensor) that are Bluetooth-enabled. The tablet comes pre-loaded with the telehealth platform e.g. Cloud DX, through which transmission of questionnaires, images, vital signs and video calls may take place. Such a system alleviates the burden on both patients and healthcare staff by reducing the number of platforms they need to interact with.

### 6.3.3 Data privacy and security

- Monitoring patients outside the regular hospital setting requires stringent data security and governance protocols to safeguard patient personal health information.
- Provincial authorities have established provincial standards for privacy and security, interoperability, and technical requirements for solutions using videoconference or secure messaging, and maintain lists of verified virtual visit solutions:
  - Quebec's [list](#)
  - Ontario's [list](#)

## 7. IMPLEMENTING HOSPITALS AT HOME: CHANGE MANAGEMENT

- Established centres all identified the importance of change management i.e. the development of a precise set of processes, tools, and techniques to navigate the organizational transition effectively. The following section lists basic requirements for implementing Hospitals at Home, change management tools, and potential threats to sustainability.

## 7.1 Needs assessment

- [Healthcare Improvement Scotland](#) developed the following Quick Start Guide to establish basic requirements:

### **BASIC REQUIREMENTS BEFORE IMPLEMENTING HOME HOSPITALS**

1. Equipment:
  - a. Medical supplies: Portable oxygen, infusion pumps, wound care supplies, and medications including IV fluids, oral or IV antibiotics.
  - b. Equipment to support daily activities such as commodes and walkers
  - c. Point of care testing: Blood work, ultrasounds
  - d. Blood transfusions: Delivery and administered at home
  - e. IT and digital technologies: integrated with electronic health record, data safety/confidentiality protocols, user-friendly devices
2. Space: For virtual consultations – ideally on an acute site, calm and confidential setting
3. Staff: Team with the necessary skills and training; retention issues
4. Access to labs and diagnostics in line with acute response times
5. Communication: Established communication and clinical decision-making methods
6. Data recording: Creation of a virtual ward on telehealth platform
7. Escalation protocol: Transport and emergency response services
8. Referral protocol: Clear pathways of referral from family physicians
9. Integration with existing community services: Social work, long term care, community pharmacy
10. Inclusion of Allied Health Professionals (physiotherapists, dieticians,

## 7.2 Drivers for change

The driver diagram, developed by [Healthcare Improvement Scotland](#), is a useful tool to define the overarching objective and map required change and process ideas to successfully implement a home hospital model. The following driver diagram has been adopted for a potential MUHC model (Figure 1).

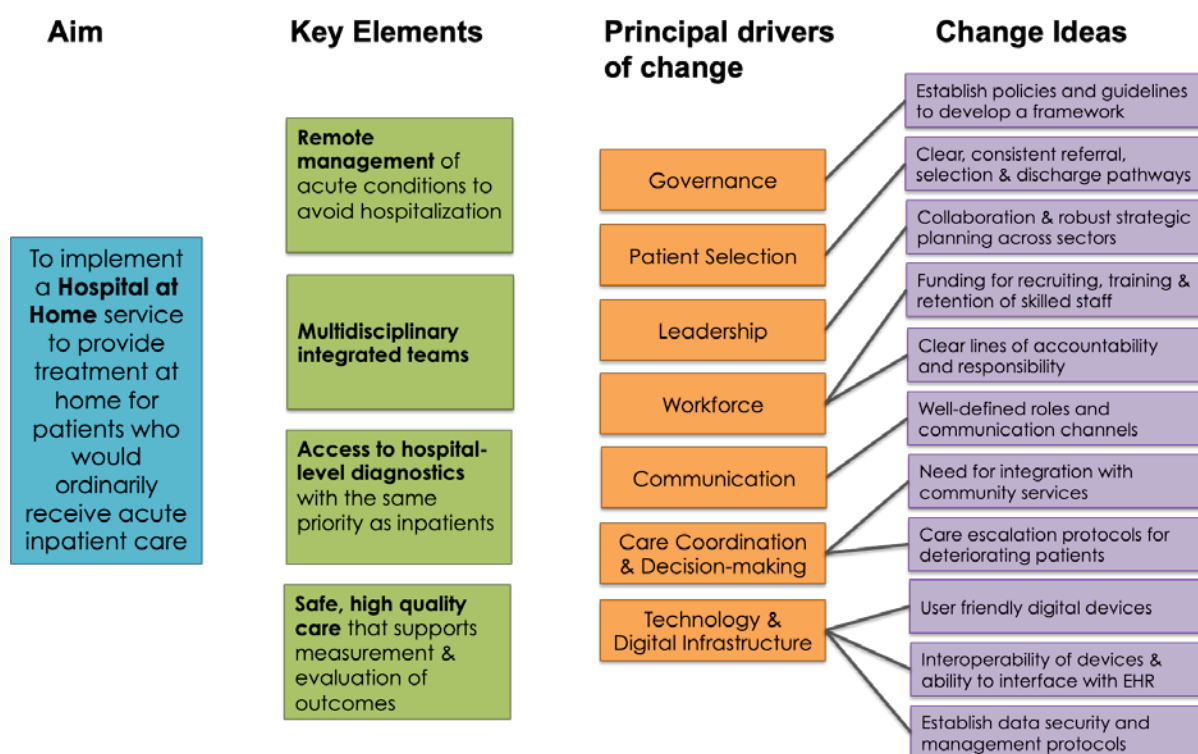


Figure 1. Principal drivers for change in a potential MUHC home hospital model

## 7.3 Stakeholder engagement

- Obtaining stakeholder (patient, clinicians, IT and data security staff, allied health professionals) buy-in is a critical determinant of the success and sustainability of any quality improvement initiative. Healthcare Improvement Scotland has developed an excellent [guide for stakeholder analysis](#) to identify the relevant people who need to be involved in planning and implementing the change.

## 7.4 Threats to sustainability

- Several centres identified various barriers and potential threats to sustaining the home hospital model, listed in [Table 4](#).

**Table 4. Threats to sustainability**

Barrier/Threat	
<b>Staffing</b>	
Scotland, JGH	<ul style="list-style-type: none"> <li>• Shortage of doctors and GPs (latter often called back into their practice)<sup>2</sup></li> <li>• Need to ensure core staff able to progress to help recruitment and retention<sup>2</sup></li> <li>• Volume of referrals increasing without corresponding increase in staffing.<sup>2</sup></li> <li>• Nursing staff need to be highly specialised practitioners<sup>2</sup></li> <li>• Recruitment and retention of highly skilled staff in a workforce market that offers many opportunities for advanced practice clinicians<sup>2</sup></li> <li>• Preparing future healthcare workers</li> </ul>
<b>Integration with community services</b>	
Scotland, JGH	<ul style="list-style-type: none"> <li>• Integrating and dovetailing with existing services</li> <li>• Initial perceptions around the role and potential unintended consequences of the service on community.</li> </ul>
<b>Burden on caregivers</b>	
Island Health, BC	<ul style="list-style-type: none"> <li>• Emotional toll of caregiving: concerns about having the expertise to provide care, being able to reach a provider in case of emergencies and exhaustion, energy, social isolation, lack of physical fitness to support a patient, or caregivers' own health issues.<sup>6</sup></li> </ul>
<b>Technology</b>	
Island Health, BC; Scotland; Ottawa Heart Institute; JGH	<ul style="list-style-type: none"> <li>• Constantly evolving technology leading to user fatigue</li> <li>• Accessibility and connectivity in rural settings, for patients with low digital literacy</li> <li>• Need for a single platform that integrates with electronic health record</li> <li>• Remote monitoring technology market in Canada</li> </ul>

## 8. EFFECTIVENESS AND SAFETY FROM PUBLISHED LITERATURE

### 8.1 Mortality and hospital re-admission rates

- A 2016 Cochrane systematic review evaluating the effectiveness of admission avoidance hospital at home compared with inpatient hospital care found no difference in rates of mortality at six months [risk ratio (RR): 0.77; 95% confidence interval (CI): 0.60 to 0.99; six trials, n=912] and no difference in re-admission rates [RR: 0.98; 95% CI: 0.77 to 1.23; p = 0.84; seven trials, n=834].<sup>5</sup>

- The authors rated the GRADE certainty of evidence for these findings as moderate due to imprecision (wide confidence intervals) of the primary studies i.e. “Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate”.<sup>10</sup>

## 8.2 Risk of institutionalization

- The same Cochrane systematic review found that admission avoidance Hospital at Home may reduce the likelihood of patients living in residential care at six months' follow-up (RR: 0.35; 95% CI: 0.22 to 0.57;  $p < 0.0001$ ; 5 trials;  $n=727$ ).<sup>5</sup>
- However, the authors rated the certainty of this evidence as low (“Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate”), due to imprecision and heterogeneity among the primary studies.

## 8.3 Patient satisfaction with the quality of care

- The Cochrane review reported that more patients reported satisfaction with healthcare received through admission avoidance hospital at home compared with inpatient hospital care (range 8% to 40%; 5 trials;  $n=646$ ), but the certainty of this evidence is low.<sup>5</sup>
- A survey of 75 patients and 57 caregivers with recent experience with a Hospital at Home (for admission avoidance and early discharge) in British Columbia found:
  - High patient and caregiver satisfaction with their overall experience; responsiveness of healthcare providers (89% were able to connect in under 10 minutes); quality of care received; and quality of training received for medication and technology use.
  - Patients reported high levels of being able to complete their daily vital sign measurements on time.
  - An area for improvement concerned written information given to the patients regarding their medication and some aspects of post-discharge care.<sup>6</sup>

## 8.4 Patient-centred care

- The British Columbia survey found that patients and caregivers felt respected and treated with courtesy and compassion; they were listened to carefully; and their homes, cultural values and practices were respected.<sup>6</sup>

## 8.5 Caregiver burden

- The British Columbia study surveyed 57 caregivers about issues such as ‘loss of privacy/personal time’, ‘disturbed sleep’, and ‘feeling strained between responsibilities’ (work, family, etc.), and the majority (88-95%) reported these as being manageable. 41% reported having ‘sometimes’ felt overwhelmed, but 96% of caregivers also indicated that they would agree to be a caregiver again in the future.<sup>6</sup>

## 8.6 Health Technology Assessments

- We reviewed health technology reports from CADTH (Canada), AHRQ (US) and NICE (UK) but none have currently published reports on the evaluation of technologies specifically for acute care home hospitals. [Appendix Table B-1](#) includes findings from reports on remote patient monitoring for chronic conditions.

# 9. EVALUATING IMPACT AND OUTCOMES

- Several centres have developed evaluation frameworks to measure key performance indicators and ensure continuous improvement, summarized in [Table 5](#).<sup>2,3,7,8</sup>



**Table 5. Key Performance Indicators for Evaluation**

Metric Category	
<b>Essential Performance Metrics</b>	
Number of patients referred per month	
Proportion admitted of total referrals	
Number of patients managed at home	
Length of stay	
Mortality during admission	
30-day outcomes (death, re-admissions)	
Patient satisfaction	
<b>Operational Metrics</b>	
Financial governance	
Training/education	
Staff governance workforce (recruitment, retention, development)	
<b>Clinical Governance Metrics</b>	
Clinical risk/adverse event reviews	Pressure injuries
	Venous/pulmonary embolism and bleeds
	Falls
	Healthcare acquired infections
	Drug events
	Medication errors and near misses
	Uncontactable patient events
	Discharge against medical advice
<b>Patient/caregiver-identified Metrics</b>	
Effective communication channels and responsiveness <sup>7</sup>	Proportion of patients requiring emergency services receiving it on time
	Proportion of patients who tried to contact the HCPs able to connect in under 10 minutes
Receiving respectful, culturally safe treatment <sup>7</sup>	
Provision of supports to reduce caregiver burden <sup>7</sup>	

## 10. CONCLUSIONS

The review of the available literature and our interviews with several hospital at home centres have revealed that establishing a successful hospital at home model requires careful planning and consideration of the following key factors:

### 10.1 Technology considerations

- Interoperability of systems:** All the interviewees indicated the need for establishing a uniform digital infrastructure, rather than multiple, siloed platforms, to allow easy integration of digital platforms and devices with the hospital's electronic health record (EHR) system. This would also reduce user fatigue and workload.

- **Ease of use of the technologies:** Multiple centres have documented that the complexity of technology may hinder patient safety and continuity of care.
  - Given the explosion of vendors on the market, experienced centres have indicated that it is unnecessary to seek out the latest innovation, because easily available home monitoring devices that are Bluetooth-enabled allow for effective remote patient monitoring.
  - It is more important to understand user needs, for example, patient digital literacy and accessibility issues, which align with the remote patient monitoring program goals.
- **Data security and governance:** Protocols for the secure collection, transmission and management of patient data are necessary.

#### KEY RECOMMENDATION

- It is important to plan for a single remote patient monitoring platform that interfaces with the hospital's electronic health record system, to reduce user fatigue and burnout.
- It is unnecessary to acquire the latest technology on the market. It is far more important to assess stakeholder (patient and clinician) and program needs, and ensure the technology matches those requirements.
- It is critical to establish data security, confidentiality and management protocols for the secure transmission and storage of data from patients managed outside the hospital setting.

## 10.2 Staffing

- **Recruitment and Retention:** Established hospital at home centres have identified staffing needs as one of the most important threats to sustainability, given the need for recruitment and retention of highly skilled and accessible staff in a competitive workforce market.

- **Training and Change Management:** Implementing hospital at home models will require significant changes in care pathways and organizational routines. Staff will need training in new technology, confidence in administering care outside a hospital setting, and the ability to deliver culturally safe care remotely.

### 10.3 Processes for reliable care coordination and communication

- **Coordination protocol channels:** Successful implementation of hospital at home centres requires clear and consistent referral, selection and discharge care pathways.
- **Communication channels:** Patients and staff have stressed the need for clearly-defined lines of responsibility and escalation protocols in case of emergencies to ensure patient safety and continuity of care.

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## APPENDICES

## APPENDIX A: HOSPITAL AT HOME CARE MODELS

Table A-1: Hospital at Home Models of Care in Canada and Elsewhere (non-exhaustive list)

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
<b>Admission Avoidance Models</b>								
Victoria General Hospital, Victoria BC (Canada, Nov. 2020)	8 months	<ul style="list-style-type: none"> <li>Substitutive hospital-at-home care for adults with expected length of stay less than 10 days and unlikely to require multiple in-hospital tests, treatments or consultations</li> <li>Actively supported by virtual care technologies</li> </ul>	<p><b>Demographics</b></p> <ul style="list-style-type: none"> <li>At least 19 years old</li> <li>Living within geographic catchment area</li> <li>Caregiver in home</li> <li>Safe home environment</li> <li>Phone and refrigerator in home</li> </ul> <p><b>Clinical Characteristics</b></p> <ul style="list-style-type: none"> <li>Requiring hospital-level care</li> <li>Known diagnosis</li> <li>Clinically stable</li> <li>Expected length of stay less than 10 days</li> <li>Unlikely to require multiple in-hospital tests, treatments or consultations</li> <li>Ambulatory to bathroom</li> <li>Able to provide self-care</li> <li>No community-based services in place</li> <li>No pain crisis</li> </ul>	Pharmacy as major stakeholder due to distribution of medication at home	Team comprised of two family-medicine hospitalist physicians, two clinical nurse leaders, two clinical pharmacists and six registered nurses. After the first few months of implementation, an occupational therapist and rehabilitation assistant were also added to the team.	<ul style="list-style-type: none"> <li>Hospital at Home will supply a kit containing a tablet, vital sign devices, medications, information binder and set it up in the patient's home.</li> <li>The nurse will teach the patient and family caregivers how to use the equipment.</li> <li>Patients use a Samsung tablet and Home Health Monitoring kit to measure their vital signs several times a day.</li> <li>These interactions may take place over the phone, during in-person home visits, or virtually using a tablet.</li> <li>Blood samples are collected by nurses in the home, and they are taken to the hospital laboratory for processing.</li> <li>Patients have priority access to onsite diagnostics such as medical imaging.</li> <li>The program provides transport services from hospital to home as needed.</li> </ul>	<p>Between Oct 2021 and March 2022: 247 patients discharged from home</p> <p>Survey of 75 patients and 57 caregivers: -57% older than 70 years</p> <p><b>Overall experience:</b> 100% of the patients, and 95% of FCGs, had an overall positive (6-10 rating) experience. The majority would choose HaH instead of receiving care in a hospital building.</p> <p><b>Responsiveness:</b> 100% of patients and 97% of FCGs reported that they were 'always' or 'usually' able to reach a HCP when they had a question or concern.</p> <p><b>Quality of Care</b> 99% of patients reported that they felt safe receiving care</p> <p><b>Quality of information/training provided</b> (92 - 97% of patients and FCGs (94 - 100%) reported that they had an adequate level of information and training to use the different technological tools. Furthermore, 94%</p>	<ul style="list-style-type: none"> <li>Change management, stakeholder buy-in</li> <li>Constantly changing technology</li> </ul>

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
		<ul style="list-style-type: none"> <li>• No acute stroke</li> <li>• No active psychiatric disorder</li> <li>• No active substance use disorder</li> </ul> <b>Consent</b> <ul style="list-style-type: none"> <li>• Patient/Substitute Decision Maker consent</li> <li>• Caregiver consent</li> </ul>					<p>of patients reported that they were 'always' (87%) or 'sometimes' (7%) able to complete their twice daily vital sign measurements on time</p> <p>Patients reported that the level of written information given to the patients regarding their medication and some aspects of post-discharge care, are areas where improvements can be made</p> <p><b>Patient-centredness</b></p> <p>99% of patients felt respected and treated with courtesy and compassion; 100% felt that HCPs listened carefully; and 100% felt their homes, cultural values and practices were respected.</p>	
Lanarkshire, (Scotland, 2011)	6-7 years, phased approach	<ul style="list-style-type: none"> <li>• Substitutive hospital-at-home care for primarily those aged ≥ 65 years (but frail patients aged &lt; 65 years also admitted), frail older patients, multiple comorbidities, functional problems, best managed in usual environment (home/care home).</li> <li>• It is intended to assist in local and regional planning for acute and specialist services to support people, who would ordinarily require admission to acute</li> </ul>	<p>Primarily patients ≥ 65 years with some selected cases under 65 years.</p> <p>Nursing home patients of any age.</p> <p>Majority are older people with multi-morbidity and functional or cognitive impairment.</p> <p>Patients excluded include stroke, acute coronary syndrome, lower limb orthopaedic problem, and acute surgical presentations.</p>	<p>Referral made by GP or SAS through central bed bureau.</p> <p>Referrals also from ED, Medical Receiving units and wards where appropriate.</p>	<p>Spread across three geographical hubs.</p> <p>Consultant physicians, advanced practitioners, team leads (Band 7), Band 6 nurse and therapy practitioners, paramedics, Band 5s and assistant practitioners for rehab and one GP Trainee</p>	<p>Daily consultant-led multidisciplinary 'ward round'.</p> <p>Daily contact with patient or carer as appropriate to assess needs, therapy or psychiatric assessments where indicated</p>	<ul style="list-style-type: none"> <li>• 3000 referrals per year</li> <li>• 145 older patients' beds closed</li> <li>• Patient and carer feedback is very positive.</li> <li>• Safety outcomes, including mortality and readmissions are comparable with acute care.</li> <li>• Length of stay is shorter than acute.</li> <li>• Low levels of homecare requested.</li> </ul> <p>Nursing Home admissions have been avoided. Patients are supported to die in their preferred place of care.</p> <ul style="list-style-type: none"> <li>• It has contributed to hospital bed closures.</li> </ul>	<ul style="list-style-type: none"> <li>• Capacity in services (such as homecare) can be challenging.</li> <li>• Integrating and dovetailing with existing services</li> <li>• Initial perceptions around the role and potential unintended consequences of the service on community.</li> </ul> <p>Staffing:</p> <ul style="list-style-type: none"> <li>• shortage of doctors and GPs (latter often called back into their practice)</li> <li>• need to ensure core staff able to progress to help recruitment and retention</li> <li>• Nursing staff need to be highly specialised practitioners (some will</li> </ul>

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
		<p>hospital, to receive treatment at their home.</p> <ul style="list-style-type: none"> <li>Partially supported by virtual care technologies</li> </ul>						<p>leave).</p> <ul style="list-style-type: none"> <li>Volume of referrals increasing without corresponding increase in staffing.</li> <li>Recruitment and retention of highly skilled staff in a workforce market that offers many opportunities for advanced practice clinicians.</li> </ul>
Hertfordshire Community NHS Trust's Prevention of Admission, (UK, Mar. 2020)		<ul style="list-style-type: none"> <li>Either preventing avoidable admissions into hospital or supporting early discharge out of hospital</li> <li>Actively supported by virtual care technologies (Doccla)</li> </ul>	<ul style="list-style-type: none"> <li>Abnormal bloods</li> <li>Bowel management</li> <li>Cancer</li> <li>Cardiac conditions</li> <li>Cellulitis</li> <li>COVID-19</li> <li>Dehydration</li> <li>Delirium</li> <li>Diabetes/endocrine disorders,</li> <li>End-of-life care</li> <li>Falls</li> <li>Frailty</li> <li>Heart failure</li> <li>Infection</li> <li>Musculoskeletal problems</li> <li>Mobility</li> <li>Neurological problems</li> <li>Other infection</li> <li>Pain and symptom control</li> <li>Post-operative care</li> <li>Renal problems</li> <li>Respiratory conditions</li> <li>Triage</li> </ul>	Referrals can be made by any healthcare professional who has assessed the patient as suitable for the service.	Multidisciplinary team of doctors, nurses, therapists and pharmacists	<p>Remote monitoring using a mobile phone to check weight, oxygen levels, pulse rate, temperature, and blood pressure (kit and instructions for use are provided)</p> <p>The service also has six community teams who can go out to patients' homes if a "red flag" is raised on the system.</p>	<p>Excellent patient feedback</p> <p>The service currently has 90 patients "that would otherwise be in hospital".</p>	

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
			<ul style="list-style-type: none"> <li>• Wound care infection</li> <li>• Urinary tract infection (UTI)</li> </ul>					
New South Wales, NWS (Australia, 20+years ago)		<ul style="list-style-type: none"> <li>• Substitutive hospital-at-home care patients who would have been admitted to the hospital and post-discharge acute care after a patient is formally discharged from the hospital.</li> </ul>	To be eligible for HITH care in NSW, a patient must: <ul style="list-style-type: none"> <li>• consent to HITH treatment (or have consent from a substitute decision maker)</li> <li>• not require continuous 24 hour assessment, treatment or observation</li> <li>• be competent in managing their condition and know when to escalate their care or have a live-in carer who takes this responsibility</li> <li>• have a suitable and safe location for care outside the hospital (subject to a home visit risk assessment including a domestic violence screen)</li> <li>• have access to a reliable landline or mobile telephone</li> </ul>		HITH services may work alongside ambulatory care, acute review, short stay and infusion clinics.	<ul style="list-style-type: none"> <li>• Clinical review should occur within 24 hours of admission or transfer to HITH by the designated HITH clinician.</li> <li>• The admitting clinician establishes subsequent medical reviews depending on the patient’s condition, acuity and requirements.</li> <li>• Medical review may be in the patient’s home, via telehealth or in a clinic.</li> <li>• HITH patients should be clinically reviewed in person every day by a clinician. This is usually an allocated nurse or allied health care professional.</li> <li>• A complete set of vital observations should be done at a minimum once per day and documented on a standardised observation chart</li> <li>• Monitoring vital signs is essential to assess the treatments and identify early signs of any clinical deterioration.</li> <li>• In some cases, telehealth may be appropriate for daily clinical review</li> <li>• Structured multidisciplinary team reviews should occur</li> </ul>		
UMass Memorial Health (US,	6 months	<ul style="list-style-type: none"> <li>• Substitutive hospital-at-home care patients who</li> </ul>	<ul style="list-style-type: none"> <li>• Hospital at Home is for patients who have acute conditions or</li> </ul>	<ul style="list-style-type: none"> <li>• A physician and a nurse in the</li> </ul>	<ul style="list-style-type: none"> <li>• Medical doctor will oversee patient care and check in</li> </ul>	<ul style="list-style-type: none"> <li>• UMass Memorial Medical Center nurses will deliver medications and in-home care twice a day</li> </ul>	<ul style="list-style-type: none"> <li>• 7-9 patients daily census</li> <li>• Average age: 63</li> <li>• Average LoS: 5.6 days</li> </ul>	



Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
Aug. 2021)		<p>would have been admitted to the hospital and post-discharge acute care</p> <ul style="list-style-type: none"> <li>In addition to better serving an under-bedded population, the UMass team also identified the need for a value-based solution and more flexible inpatient capacity</li> </ul>	<p>illnesses with low complication rates. This includes:</p> <ul style="list-style-type: none"> <li>Certain skin infections</li> <li>Urinary tract infections (UTI)</li> <li>COVID-19</li> <li>Flu</li> <li>Congestive heart failure exacerbation (when heart failure gets worse)</li> <li>Acute kidney injuries</li> <li>Other problems unlikely to have complications</li> </ul>	<p>emergency department evaluate a patient's conditions. If eligible, patients will be admitted to the Hospital at Home program</p>	<p>daily, either in-person or virtually.</p> <ul style="list-style-type: none"> <li>A registered nurse will visit the patient in home at least twice a day.</li> <li>A specially trained paramedic may visit the patient during Hospital at Home stay, depending on the care plan.</li> <li>Occupational therapists, physical therapists and speech language pathologists will be scheduled as needed</li> </ul>	<p>using state-of-the-art digital devices.</p> <ul style="list-style-type: none"> <li>Doctors will visit with patients via telemedicine at least once a day.</li> <li>Remote vital signs will be monitored 24/7 in the command unit.</li> <li>Patients are provided with a call button in their home. Providers will be on call and can send paramedics/EMS in cases of emergency</li> </ul>	<ul style="list-style-type: none"> <li>Falls resulting in injury: 0</li> <li>30-day readmission rate: 4.7%</li> </ul>	
<b>Post-discharge transition care</b>								
Jewish General Hospital, (Montreal, Canada, 2021)		<ul style="list-style-type: none"> <li>Originally developed as the COVID@Home program, it enables early discharge and transitional care for certain hospitalized patients who otherwise would have remained in the hospital to continue their hospitalization at home.</li> <li>Actively supported by virtual care</li> </ul>	<ul style="list-style-type: none"> <li>Clinically stable</li> <li>Has necessary support</li> <li>Caregiver can help with communication</li> <li>Patient/caregiver can manage the technology</li> <li>Can manage medications</li> <li>Patient/Substitute Decision Maker consent</li> <li>Able to comply with medical care</li> </ul>	<p>MD or / nurse identifies potential patients and validates eligibility criteria</p>	<p>Multidisciplinary team of doctors, nurses and other healthcare professionals who combine hospital and community expertise</p>	<ul style="list-style-type: none"> <li>The patient is monitored remotely by digital devices that are linked to the virtual care team, with the frequency of monitoring adjusted according to the patient's needs for care.</li> <li>Multidisciplinary virtual monitoring team done via TEAMS calls at predetermined times</li> <li>Remote monitoring of vital signs 24/7</li> <li>3xday follow-up calls on TEAMS</li> <li>Virtual rounds</li> <li>Medication delivery</li> <li>At-home visits, as needed</li> </ul>	<ul style="list-style-type: none"> <li>207 cases = 1454 patient days</li> <li>17 readmissions</li> </ul> <p><b>User Experience</b></p> <ul style="list-style-type: none"> <li>Care satisfaction: 100%</li> <li>Physical comfort: 89%</li> <li>Easy recovery: 100%</li> </ul> <p><b>Caregivers</b></p> <ul style="list-style-type: none"> <li>85% would recommend</li> </ul> <p><b>Human Resources</b></p> <ul style="list-style-type: none"> <li>46% less staff required</li> </ul> <p><b>Cost</b></p> <ul style="list-style-type: none"> <li>1.3M recurring savings in operations when compared to 25-bed unit</li> <li>\$70,000 savings in nosocomial infections</li> </ul>	<ul style="list-style-type: none"> <li>Remote monitoring technology market in Canada</li> <li>Absence of Electronic Health Record covering the entire continuum of care</li> <li>Preparing future healthcare workers</li> <li>Standardization of quality indicators to measure virtual care</li> <li>Change management</li> </ul>

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					
			Patient eligibility	Referral process	Staff	Follow-up	Results	Barriers to implementation
		technologies						
Jewish General Hospital and Herzl Family Practice Centre, (Montreal, Canada, 2015)	12 months	<ul style="list-style-type: none"> <li>• Targets older, more vulnerable patients at high risk of ED visit or hospital readmission</li> <li>• Begin hospital discharge planning while patients are still in the acute care setting</li> <li>• Provide better continuity of care by coordinating with the patients' family physician</li> </ul>	<ul style="list-style-type: none"> <li>• registered to a family physician practicing in the FMG;</li> <li>• planned for discharge to their home or to a semi-autonomous residence in the coming days; and</li> <li>• achieved a LACE score of 10 or greater, indicating a high risk of ED visit or readmission. The most common conditions of patients admitted to the VW included heart failure, chronic obstructive pulmonary disease, gastro-intestinal bleeding, dementia, and diabetes complications (type 1 or type 2).</li> </ul>	The VW nurse case manager conducted daily rounds of the hospital family medicine units to identify potential candidates for the program. She evaluated the patient's risk of ED visit and readmission using the LACE index, through a combination of the following variables: length of stay, acuteness of their condition, comorbidity, and ED visits in the last 6 months.	a Virtual Ward (VW) family physician, a nurse manager, a VW nurse case manager, a VW nurse practitioner, a VW resident, a social worker, and a pharmacist. The roles of each VW team member were clearly defined.	<ul style="list-style-type: none"> <li>• The entire team participated in weekly multidisciplinary rounds and home care planning.</li> <li>• The VW nurse case manager provided care coordination among members of the virtual-ward multidisciplinary team, the patients' usual family physicians, home care services from community health centres (Centre local de services communautaires - CLSC), and patients/caregivers. She also functioned as the primary point of contact for the patients and their family after discharge and monitored the patients' progress closely, mainly through telephone evaluations.</li> <li>• The VW nurse practitioner conducted physical evaluations and adjusted treatment plans in collaboration with the VW medical resident and VW family physician.</li> <li>• The pharmacist oversaw medication adjustments and made recommendations for optimal pharmacological management.</li> <li>• The social worker played an important role in evaluating patients' social and family</li> </ul>	Throughout the first year since its initial implementation (2015 to 2016), over one hundred patients were received for care in the VW. Once processes were sufficiently refined, the ward could handle a concurrent load of around 20 patients.	<ul style="list-style-type: none"> <li>• No bi-directional exchange between the discharging ward and CLSC home care services</li> <li>• CLSC home care services did not systematically provide the hospital ward or the family medicine group written documentation indicating any changes in the patient's status, results of examinations, or changes to their medications.</li> <li>• Funding and care coordination: Having an established home care programme was a facilitator</li> </ul>

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
Montfort Hospital, Ottawa, (Canada, 2022)	9 months (launched in mid-April 2022)	<ul style="list-style-type: none"> <li>Post-surgical remote care monitoring (STRCM) program</li> <li>Offers acute care 24/7 for 14 days post-surgery in partnership with community paramedics</li> </ul>	<ul style="list-style-type: none"> <li>Post-urology, gynecology, arthroplasty, hips, knees, and shoulder surgeries</li> </ul>	Transfer of care from hospital to home	<ul style="list-style-type: none"> <li>Community paramedics and Prescott-Russell Community Paramedics</li> <li>Escalation pathway with Montfort staff: surgical day care nurse and surgeons</li> </ul>	<p>environment, ensuring that patients and caregivers have adequate resources for home recovery.</p> <ul style="list-style-type: none"> <li>The VW family physician and/or resident admitted patients to the VW, reviewed the case, performed home visits to assess the patient’s recovery, regularly assessed patients’ needs, provided guidance to the VW nurse case manager, and adjusted medications when needed.</li> <li>Finally, an administrative coordinator provided administrative support and scheduled appointments</li> </ul>		
						<ul style="list-style-type: none"> <li>For the Surgical Remote Care Monitoring (STRCM) Program, patients bring their own device (BYOD) and download the application on their chosen device, or use the web version to access the remote care-monitoring platform.</li> <li>The data monitoring frequency is determined by the clinical pathway and resource allocation for the program. For example, for the STRCM program, patients are instructed to complete the health questionnaire daily/PRN, and have the possibility of submitting the form more than once, 24/7 within the application</li> </ul>		

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Results	Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results		
						and are monitored by the Community Paramedics 24/7, 7 days a week			
<b>Long term monitoring of chronic conditions</b>									
University of Ottawa Heart Institute's Telehome Monitoring Program (THM), (Ontario, Canada, 2008)	1.5-2 years	<ul style="list-style-type: none"> <li>Remote monitoring for acute cardiac patients who require assistance with medication management, fluid volume regulation, vital sign monitoring and patient education, to prevent readmissions</li> <li>Nurse-led program</li> <li>5-day a week service, not 24/7</li> <li>Patients are monitored for 3 months</li> </ul>	<ul style="list-style-type: none"> <li>HF patients with 1 readmission /1 month or 2 / in 6 months (NYHA III/IV)</li> <li>Patients with new HF diagnosis</li> <li>Patients recovering from cardiac surgery</li> <li>Patients requiring VS, arrhythmia monitoring</li> <li>Any cardiac patient requiring frequent monitoring or trending of information to facilitate optimal clinical management</li> </ul>	All University of Ottawa Heart Institute HCP can refer	<ul style="list-style-type: none"> <li>Expert cardiac RNs provide care</li> <li></li> </ul>	<ul style="list-style-type: none"> <li>Early discharge program for patients who require daily monitoring, where patients send vitals once a day and answer a few questions, nurse looks at data, gives daily report to Most Responsible Physician (MRP).</li> <li>Nurse does all interventions e.g. send patient for blood work.</li> <li>Provides medication management, maintaining a dry weight, self-care education</li> <li>Nurses contact pts 3 times a week.</li> <li>CloudDX sets up the patients: CloudDX nurse will call at home to set up with Wi-Fi/cell. Data on dashboard are colour coded (red/yellow/green) data. Red alerts results in lots of education</li> <li>Currently, nurses have 2 screens: a CloudDX dashboard for RPM and a screen with EPIC. Nurses have to manually enter data/files/images from CloudDX to EPIC. Once CloudDX is integrated with EPIC, it will all be in one place.</li> </ul>	<ul style="list-style-type: none"> <li>In 2016, 259 patients followed via <b>Telehome Monitoring Program</b></li> <li>The largest acute home monitoring program of its kind in Canada, it has reduced hospital readmission of heart failure patients by 54%, saving up to \$20,000 in health care costs for every patient diverted from an emergency room visit or hospital stay.</li> </ul>	<ul style="list-style-type: none"> <li>Connectivity</li> <li>New tech—Constantly bombarded with new vendors</li> <li>Staffing: Need for expert nurses</li> </ul>	

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
Centres intégrés de santé et services sociaux (CISSS) du Québec (Gaspésie, Chaudière-Appalaches et Outaouais, Fall 2023)	Planned for fall 2023	In each region, 25 patients suffering from heart failure will receive devices at home and monitored in real-time remotely by healthcare staff using Virtuose Technologies	Heart failure patients					
Michael Garron Hospital, Toronto, Canada, 13 years ago, initially through telephone-based systems)		The Virtual Ward provides support and care for patients in their homes after they've been discharged from hospital				<ul style="list-style-type: none"> <li>• They use an application called SeamlessMD that guides patients before, during and after hospitalization via smartphone, tablet or computer</li> <li>• Biometric data is not automatically transmitted to SeamlessMD. Through their assessment, the nursing team may determine that monitoring of blood pressure or oxygen saturations is required. In this case, the hospital will deliver a blood pressure cuff or oxygen saturation level monitor to the patient via courier.</li> <li>• Patients use the application to answer health survey questions. The system actively monitors the survey responses, and if any of the patients' health information falls outside the normal limits, it triggers an alert.</li> <li>• Upon receiving an alert, the nursing team promptly reaches out to the patient via phone call.</li> </ul>		

Centre (Country, Year established)	Timeline	Main Features	Hospital at Home Process					Barriers to implementation
			Patient eligibility	Referral process	Staff	Follow-up	Results	
Hôpital Montfort, Champlain Home and Community Care Support Service, Ottawa Community Paramedics and Prescott-Russell Community Paramedics, (Canada, 2022)	4 months (launched in January 2022)	<ul style="list-style-type: none"> <li>Enhanced in-home remote care monitoring (RCM) program for COPD, CHF, ALC, DM type1 and 2, cellulitis and osteomyelitis patients</li> <li>Patients continue to be remotely monitored for up to 6 months x 7 days a week.</li> </ul>	<ul style="list-style-type: none"> <li>Patients with primary or secondary diagnosis of COPD, CHF, DM type1 and 2, cellulitis and osteomyelitis.</li> <li>Alternative levels of care patients</li> <li>Patients who are Ontario residents, (1) waiting for or considering placement; or returning home (including retirement homes); (2) have functional mobility for a return home, or well supported by caregiver, family member, or community; (3) able to communicate in English or French, or accompanied by translator; (4) reside in the Champlain Home and Community Care Support Service catchment area (Ottawa and/or Prescott-Russell regions).</li> </ul>	<ul style="list-style-type: none"> <li>A referral form is completed by physicians and members of the interdisciplinary team</li> </ul>	<ul style="list-style-type: none"> <li>Community paramedics</li> <li>Escalation pathway with Montfort staff: Behavioral Support Ontario Registered Nurse and Chronic disease management care coordinator (RN)</li> </ul>	<ul style="list-style-type: none"> <li>Patients referred by members of the interdisciplinary team will get a kit and a tablet with Wi-Fi integrated. Aetonix provides remote care technology including kits and Bluetooth-enabled devices (BP cuff, oximeter, scale).</li> <li>Patients remotely monitored for 24/7 for 14 days post-discharge and up to 6 months x 7 days a week.</li> <li>The community paramedics provide coverage for the RCM program from 8:00 pm to 8:00 am x 14 days following hospital discharge</li> <li>HCCSS Rapid Response Nurses will escalate to community paramedics from 8:00 am to 8:00 pm 7 days a week if a patient becomes unstable or requires further evaluation and management.</li> </ul>	<ul style="list-style-type: none"> <li>Patients without access to technology (SeamlessMD) receive scheduled phone calls from our nursing team who answer the survey questions with the patients on their behalf.</li> </ul>	

**APPENDIX B: HEALTH TECHNOLOGY ASSESSMENTS**

Table B-1: Health Technology Assessments of Remote Patient Monitoring Technologies

Healthcare system/HTA	Description	Conclusions
CADTH (Canada)	<ul style="list-style-type: none"> <li>Overview on the state of remote monitoring in Canada for patients with cardiac conditions (March 2021)</li> </ul>	<ul style="list-style-type: none"> <li>Currently, no Canadian guidelines for remote monitoring of patients with chronic cardiac conditions or cardiac rehabilitation are available</li> <li>Remote monitoring programs are used in BC, Ontario, Prince Edward Island, Newfoundland/Labrador and New Brunswick</li> <li>Funding and resourcing are the most common limitations to implementing and maintaining remote monitoring programs</li> <li>Patient's engagement and positive experience are amongst the main facilitators to implementing and maintaining remote monitoring programs</li> </ul>
CADTH (Canada)	<ul style="list-style-type: none"> <li>Rapid review on the effectiveness, cost-effectiveness and guidelines of telehealth compared to standard care for patients with heart failure (December 2015)</li> <li>Evidence based on English articles published between January 2013 and November 2015</li> </ul>	<ul style="list-style-type: none"> <li>Telehealth intervention was heterogeneous and could include video conferencing, home health monitoring, health phone lines, digital devices</li> <li>Comparator group was standard care</li> <li>Based on 3 studies (2 SRs and 1 review of SR), telehealth generally reduced hospitalisations and mortality, improved QoL</li> <li>No guidelines were identified for patients requiring cardiac care</li> </ul>
NICE (UK)	<ul style="list-style-type: none"> <li>Technology assessment guidance on virtual ward technologies for patients with acute respiratory infections</li> <li>HTA report on virtual ward platform technologies for patients with acute respiratory infections</li> </ul>	<ul style="list-style-type: none"> <li>Guidance and report are expected to be available in September and October 2023, respectively</li> </ul>
NHS (UK)	<ul style="list-style-type: none"> <li>Guide to implementing virtual wards (December 2021)</li> <li>Guide to support clinical leaders in creation of virtual wards (February 2023)</li> </ul>	<ul style="list-style-type: none"> <li>Chosen digital platform should meet the "Digital Technology Assessment Criteria" (DTAC)</li> <li>DTAC ensures that the platform meets the clinical safety, data protection, technical security, interoperability and usability and accessibility standards of NHSX</li> <li>Other considerations when choosing technologies are: <ul style="list-style-type: none"> <li>Level of monitoring (continuous or spot check)</li> </ul> </li> </ul>

Healthcare system/HTA	Description	Conclusions
		<ul style="list-style-type: none"> <li>○ Level of patient support</li> <li>○ Equality impact assessment</li> <li>○ Clinical pathway development</li> <li>● Standard operating procedures should describe step by step instructions for clinical teams</li> <li>● Staff working in the virtual ward should receive appropriate training</li> <li>● Data protection impact assessment (DPIA) should be completed to identify and minimise data protection risk</li> <li>● A clinical safety officer should evaluate the risk of virtual services to patients</li> </ul>
Alberta Heritage Foundation for Medical Research (Canada)	<ul style="list-style-type: none"> <li>● HTA report on benefits of telecardiology applications (October 2004)</li> </ul>	<ul style="list-style-type: none"> <li>● Telecardiology intervention was heterogeneous and could include home monitoring with nurse supervision, phone calls, devices measuring vital signs or ECG, video calls, home visits</li> <li>● Comparator group was heterogeneous</li> <li>● Assessment of telecardiology was not limited to usage in homecare but included usage in pediatric care, emergency care, hospital/clinics</li> <li>● 13 studies assessed telecardiology application in homecare, mostly for patients with chronic medical condition</li> <li>● Overall, telecardiology applications were beneficial and reduce heart failure hospitalisations or readmissions</li> <li>● 6/13 studies were considered as good quality, while the remaining were poor to fair quality</li> </ul>
AHRQ (USA)	<ul style="list-style-type: none"> <li>● HTA report on remote cardiac monitoring (December 2007)</li> </ul>	<ul style="list-style-type: none"> <li>● Report was based on research performed by ECRI Evidence-based practice centre under contract to AHRQ</li> <li>● Thus, the findings and conclusions are from the authors of that research and are not considered to be the official position of AHRQ</li> <li>● Authors mentioned that there is insufficient evidence (small number of studies and several quality flaws) to conclude whether remote cardiac monitoring devices improve clinical outcomes compared to standard monitoring</li> </ul>