

Review Article

Hospital at Home: An Evolving Model for Comprehensive Healthcare

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Source of Support: None. Conflict of Interest: None.

Received: Feb 23, 2021; Revision Received: Jul 7, 2021; Accepted: Jul 14, 2021

Patel HY, West DJ. Hospital at home: an evolving model for comprehensive healthcare. *Glob J Qual Saf Healthc*. Published online. DOI: 10.36401/JQSH-21-4.

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ABSTRACT

Hospital at Home (HaH) is a sustainable, innovative, and next-generation model of healthcare. From the healthcare management point of view, this model provides cost benefits and quality improvement, and from the physicians' point of view, it helps in providing patient-centered medical care and keeps patients away from hospital admission and its complications. The HaH model was first introduced at John Hopkins in the United States in 1995, which showed very promising results in context to the length of stay, readmission rates, patient satisfaction, and hospital-acquired infections. The HaH model of care provides acute critical care to patients at home and reduces unnecessary hospitalization and related complications. The identified patients for this model of care are elderly patients with chronic conditions and multiple comorbidities. The emergence of technology in today's world and the impact of coronavirus disease 2019 (COVID-19) have increased the demand for the HaH model of care. Although there are many benefits and advantages, the HaH model of care has significant barriers and limitations, such as reimbursement for payment, physician and patient resistance, patient safety, and lack of quantifying research data to support the use of this model. Specific training for the physician, nursing, and other members of the HaH multidisciplinary team is necessary for HaH treatment protocols, along with patient and family caregiver education for those who elect the HaH model of care. HaH is the future of comprehensive healthcare services and helps in achieving the triple aim of access to healthcare, improved quality of care, and reduced cost for healthcare.

Keywords: Hospital at Home, multiple comorbidities, 30-day readmissions, triple aim, comprehensive healthcare

INTRODUCTION

The first reference to “hospital at home” (HaH) was during the late 1970s in the United Kingdom, and since then, other countries with government-run health systems, such as Australia, Israel, and Canada, have successfully implemented HaH programs as a way of reducing cost, improving access, and addressing the quality of care.^[1] In the United States, the HaH concept was introduced by Bruce Leffin in 1996.^[2] Patients age 65 and older with conditions such as community-acquired pneumonia, cellulitis, heart failure exacerbation, or chronic obstructive pulmonary disease (COPD) that requires hospitalization were chosen to receive acute care at home.^[2] Selection criteria for the HaH model of care are listed in Table 1.^[3]

Along with medical criteria, other measures such as social and environmental factors are also taken into consideration while selecting patients for HaH care.^[3] HaH care is an emerging model for comprehensive

healthcare delivery and requires more attention through qualitative and quantitative research. The merits and limitations require additional research and documentation of patient outcomes and safety.

MODEL OF CARE

The HaH model of care is also known as “home hospitalization.” “Hospital in the home” (HITH) and “early supported discharge” provide a substitution for in-hospital care. The model provides acute and subacute treatment for conditions normally requiring hospital admission in a patient's residence. This model helps to reduce inpatient admissions, shortens the length of stay, and facilitates early discharge with accurate care at home. The care is coordinated by nurses, physicians, and allied health professionals. The HaH model of care focuses on a variety of conditions, including infectious diseases; chronic medical conditions requiring respiratory and cardiac support; postsurgical care; geriatric care;

Table 1. Selection criteria for hospital at home (HaH) model of care

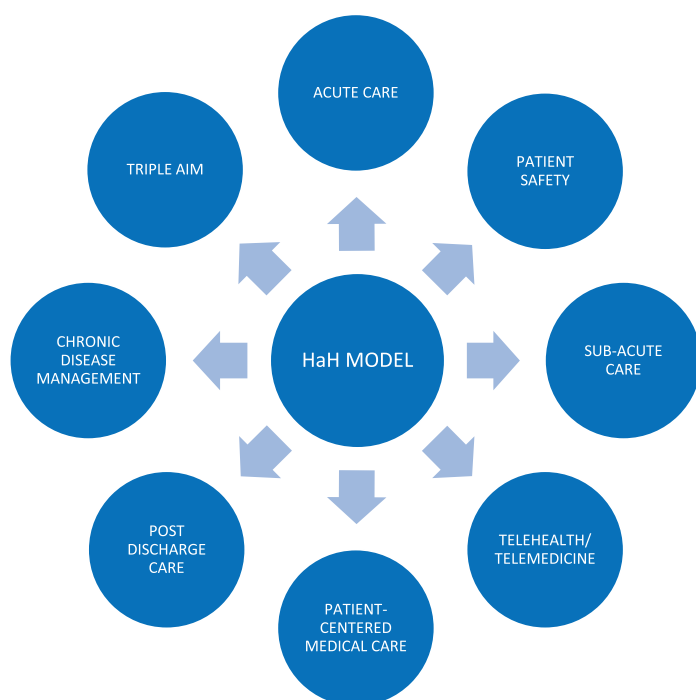
Inclusion Criteria	Exclusion Criteria
<ul style="list-style-type: none"> Age 65 years or older with multiple comorbid conditions. Increased probability for functional decline, iatrogenic complications. Increased risk of delirium, significant adverse reactions, and falls in the hospital setting. 	<ul style="list-style-type: none"> More severe acute condition such as shock or myocardial infarction. Patients requiring multiple complicated testing, such as several MRIs and CT scans, and procedures such as multiple biopsies and lumbar puncture. Patients admitted to the ICU and unstable patients who might require ICU attention.

Note: Criteria are from [3]. MRI: magnetic resonance imaging; CT: computed tomography; ICU: intensive care unit.

rehabilitation medicine; psychiatric care; orthopedic care; and diagnostic medicine. The clinical dimensions of the HaH model of care are illustrated in Figure 1. Concerns regarding safety, availability, and cost of inpatient care have increased the popularity of the HaH model of care as a viable medical option.^[4]

At John Hopkins, the HaH program was introduced for managing and treating older patients who refused hospital stay or those who were at higher risk of hospital-acquired infections. It was evident in the early phase of the HaH model that the total cost of care at home was 32% less than traditional hospital care (\$5081 vs \$7480), the mean length of stay for patients was shorter by one-third (3.2 days vs 4.9 days), and the occurrence of delirium was noticeably lower (9% vs 24%).^[5] Researchers noticed higher patient and family member satisfaction in the home setting compared with hospital care, which showed that the model was well received.^[5]

Presbyterian Healthcare Services adapted the HaH model developed by the Johns Hopkins University

**Figure 1.** Clinical dimensions of the hospital at home (HaH) model.

Schools of Medicine and Public Health, and the clinical outcomes observed were better compared with similar inpatients along with an increase in patient satisfaction.^[6] The rate of falls was lower in HaH patients (0% vs 0.8%) and the 30-day readmission to the hospital was 10.8% for HaH patients versus 10.5% for the comparison group.^[6] The mortality rate was 0.93% for HaH patients and 3.4% for the comparison group.^[6] Mean HaH patient costs were 19% lower than mean hospital costs for comparison-group patients, predominantly due to lower average length of stay and less use of clinical testing.^[6]

The Icahn School of Medicine at Mount Sinai was awarded a Health Care Innovation Grant by the Center for Medicare and Medicaid Innovation in 2014 to demonstrate the clinical effectiveness of HaH care bundled with a 30-day post-acute period of home-based transitional care.^[7] The outcomes of patients ($n = 507$) participating in the demonstration project and concurrently admitted inpatients who were HaH eligible but refused participation were compared. The readmission rates, emergency department revisits, skilled nursing admissions, and length of stay in HaH ($n = 295$) and inpatients ($n = 212$) were compared, and the results are depicted in Table 2.^[7]

The physician at the emergency department or ambulatory site assesses the situation of the patient and identifies whether the acutely ill patient is sick enough for inpatient hospitalization or stable enough to be treated at home. Patients with conditions such as congestive heart failure, COPD, community-acquired pneumonia, and many other chronic conditions with properly defined treatment protocols are appropriate for at-home management.^[8] The program is discussed with the patient and their consent is obtained, after which transportation of the patient is arranged by ambulance along with biometric and communication devices needed to supervise care. In the hospital, the family/primary caregiver is assessed for their willingness and capacity to provide prescribed and safe care in the home. The HaH physician evaluates the patient either in the emergency department or shortly after arriving at home.^[8] At this point, assessment of the home environment, which includes ensuring proper air conditioning and heating, suitable electricity and water supply, wiring, and bathroom and bedroom conditions, is done by a case manager or social worker to make sure the home environment is suitable and safe for the patient. Once

Table 2. Comparison of outcomes for hospital at home (HaH) patients versus inpatients

	Readmission Rates, %	Emergency Department Revisits, %	Skilled Nursing Facility Admissions, %	Length of Stay, d
HaH (<i>n</i> = 295)	8.60	5.80	1.70	3.2
Inpatients (<i>n</i> = 212)	15.60	11.70	10.40	5.5

Note: Data are from [7].

the patient is transferred to home, extended nursing care is immediately provided for the preliminary portion of the admission, along with daily nursing visits according to the clinical need. All the orders are documented, and caregivers administer intravenous fluids and medications; provide nebulizer treatments; and conduct tests, including ultrasounds, X-rays, and electrocardiograms.^[8] Vitals are monitored electronically. Physicians visit the patient daily or through telemedicine and they make sure that the patient's condition is stable. The HaH care team provides a pathway of care by including disease-specific care maps, clinical outcomes evaluation, and discharge planning criteria. Any adverse effects are monitored by HaH physicians, and once the patient is stabilized enough to return to activities of daily life, the care is transferred to the patient's primary care physician.^[8]

Physician's Role and Multidisciplinary Team

The physician's role in HaH varies widely. The appropriate competencies and clinical skills required to deliver HaH depend on the service delivery model of the program along with the range of clinical duties concomitant with the provision of care.^[9] Different models of HaH, such as the early discharge model and admission avoidance model, have different roles for the physicians involved.^[9] Physicians ranging from community-based general practitioners to different clinical specialty physicians are involved in providing HaH care. The need for

further development of specialty training for HaH has been acknowledged and there is a dire necessity for qualitative and quantitative literature to support the need for this model.^[9] HaH physicians should have specific training similar to that of a hospitalist for inpatient care. The hospitalist integrates and coordinates care for patients assigned to them, which includes generating and reviewing clinical data; performing necessary tests, procedures, and treatments; along with paying attention to all routine medical needs of the patient.^[10] Throughout the course of hospitalization, a HaH physician should be able to perform similar duties for at-home care and management of patients. The 24/7 on-call availability of the HaH physician would ensure that a dedicated provider is readily available to answer questions, monitor the patient, and respond during acute medical crises.^[10] A similar kind of specific training for HaH patients is required for all other members of the HaH multidisciplinary team. Figure 2 shows in detail all members of the HaH multidisciplinary team. Also, specific education and training should be provided to patients and families for care at home by a physician and other members of the multidisciplinary team.

Social Determinants of Health and Patient Safety

One of the important considerations for an HaH model of care is addressing the social determinants of health (SDOH), which includes social, environmental, and economic factors. The socioeconomic status, which is assessed by an individual's wealth, education, and occupation, is the most important SDOH affecting health outcomes. Environmental factors, such as housing, community, and access to food, play a big role in the health outcome of HaH patients. Unsafe or poor housing conditions can cause exposure to toxins and asthma triggers, such as dust, mold, moisture, and rodents; and injuries.^[11] Also, overcrowded living conditions can instigate the spread of airborne diseases, such as respiratory infections or pneumonia. The unsafe community can expose the patient to societal violence and social isolation. While taking care of patients at home, good nutrition plays a pivotal role in positive health outcomes, which would require access to a healthy and adequate supply of food and nutritional counseling.^[11]

Technology

With the recent advancement in telecommunication technology, telemedicine/telehealth helps in achieving remote diagnosis and treatment and expanding the level

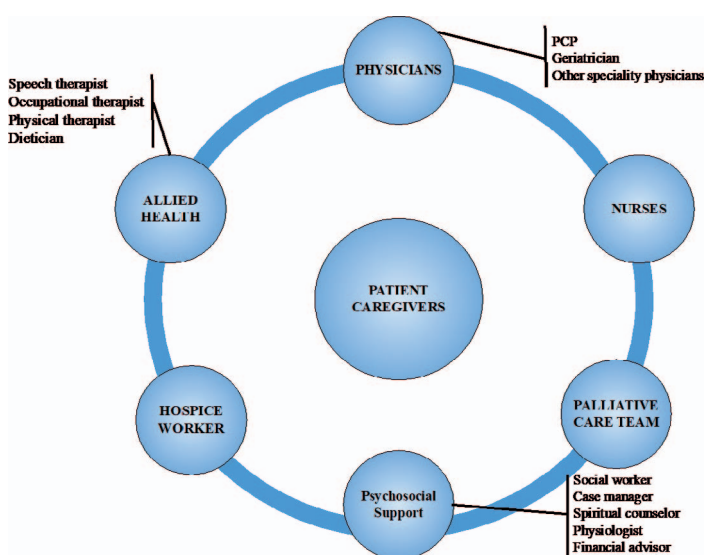


Figure 2. Multidisciplinary team for hospital at home (HaH) care. PCP, primary care provider.

Screening	Identify	Refer	Access	Managing	Monitoring
<ul style="list-style-type: none"> • Patients with COVID-19 • Providing appropriate referral 	<ul style="list-style-type: none"> • Non COVID patients requiring low-risk urgent care 	<ul style="list-style-type: none"> • Patients to appropriate care 	<ul style="list-style-type: none"> • To PCP and specialists for chronic health conditions and medication management 	<ul style="list-style-type: none"> • Patients with chronic health conditions • Providing coaching and support along with weight and nutrition management 	<ul style="list-style-type: none"> • Clinical signs • Vitals such as blood pressure, glucose etc. remotely

Figure 3. Benefits of telemedicine and telehealth during the COVID-19 pandemic. Note: Data are from [13]. COVID-19, Coronavirus disease 2019; PCP, primary care provider.

of care for patients in the HaH model. Initially, the main thrust of telemedicine was used to enhance access to healthcare for those living in remote locations. Currently, the advancement of technology helps to provide proper follow-up care, reduce costs of care, enable remote monitoring of vitals, along with monitoring of clinical biomarkers. Telemedicine saves time for both patients and doctors and also allows doctors to focus more on complex patients.^[12]

Impact of COVID-19 Pandemic

The COVID-19 pandemic has changed the dynamics of telemedicine and telehealth. Some of the areas where these services can be used for care at home are shown in Figure 3.^[13]

Along with all these advantages, there are some potential limitations of telehealth, such as challenges related to interstate licensure; urgent situations requiring adequate physical examination; patient's discomfort with certain sensitive topics, which would create concern for privacy; limited access; and complicated nature of technology devices along with connectivity issues, and cultural acceptance.^[13]

CHALLENGES

Many challenges and limitations are hindering the impact and effectiveness of the HaH model of care. Challenges such as physician and patient resistance, patient safety, and payment for the services provided act as barriers to the success of the HaH model of care. Additional scientific studies and data to support the effectiveness of this model remain a concern for health services researchers.

Physician Concerns

According to Lisa Sprinkel, the senior director of home care and hospice services, Carilion Clinic,

Roanoke, Virginia, physicians in the community and hospital emergency departments support the concept of HaH in principle but are hesitant to refer patients.^[5] Physicians are worried about the efficiency of care delivered. Another reason for reluctance is also the legal aspects, such as malpractice risks. Another barrier for physicians is time constraints.^[5] Physicians referring the patients to the HaH program must screen patients and introduce the concept of at-home hospital care. This process is very time-consuming, which makes it easier and more convenient to directly admit to the hospital. Along with time constraints, the financial aspect of the HaH also remains a challenge. It is difficult to convince the chief financial officers of hospitals that the beds left empty by treating patients at home will be filled by patients who would need more complex and intensive care.^[5]

According to one of the studies of the Mount Sinai Visiting Doctors Home-Based Primary Care program, 20.5% of providers' time was spent outside of quiet home visits in the form of care coordination activities.^[14] Another study reports that 2.4 hours each week were not reimbursed.^[14] Providers were unable to obtain reimbursement for nearly 4 to 8 hours of care coordination each week while working weekend hours, late nights, or on-call.^[14] Increasing demands of providers and the emotional toll of caring for seniors contribute to provider burnout in at-home care. These challenges strongly suggest the need for additional medical school training and residency training on home-based medical care. Such training would help the physicians to make better decisions and improve the efficiency of care, along with improved physician-patient communication. Some practices are creating opportunities to train fellows for medical home-based care, encouraging new geriatric and family physicians to offer home-based primary care visits for homebound patients.^[14]

Patient Resistance and Reimbursement

It is hard to convince patients to select HaH care, especially the older senior citizen group, as these patients tend to assume that hospital care is safer and that providing acute care in the home setting is fundamentally inferior.^[6] Traditional payment models act as barriers to new care delivery methods such as HaH, due to complex standards and sometimes restricted coverage policies. There is no payment mechanism by fee-for-service Medicare Parts A and B for an HaH admission. At present, the economic incentive for many health systems in a fee-for-service model is to fill hospital beds to generate revenue.^[6] Alternative models of care are considered “supplemental” and not reimbursed by Medicare.

Patient Safety

Many safety concerns need to be addressed and taken care of in the HaH model of care. One of the leading concerns is medication management. Polypharmacy and inappropriate medications are significant factors causing medication errors or drug therapy problems in approximately 70% of home care patients, especially patients with chronic conditions.^[15] Other medication safety issues include errors in dosing, confusion regarding medication orders and names, and poor medication compliance. Treatment at home is also challenged with infection control. The age of the patient, the complexity of illness, and the condition of the living environment together play a role in the transmission of infection. Patients receiving invasive interventions, such as catheter insertion, hemodialysis, or intravenous lines, are also exposed to increased risk of infection at home.^[15] One of the growing safety concerns in a home setting is the risk of falls. Increased events of falls in elder individuals in the home setting leads to increased healthcare costs. In 2014, the Medicare expenses related to falls had exceeded \$31 billion, causing it to become the leading cause of accidental injury and death in older patients.^[15] Patients receiving home care are frequently subject to malnutrition due to challenges faced with food preparation and food selection. This causes various problems, such as gastrointestinal, cardiac, and respiratory problems, and other medical issues leading to frequent readmissions.^[15]

Communication

A significant factor related to patient safety in-home care is the lack of communication between clinicians and patients and family along with provider-to-provider communication. In a hospital setting, there is a stronger chain of communication and a proper system for information sharing across physicians. The same can be more challenging to carry out in at-home settings. Environmental factors, such as the physical layout of the home, home infrastructure, social factors, and unsanitary conditions, also play a significant role in patient safety during home care.^[15]

FUTURE DIRECTIONS

With the expanded use of telemedicine and telehealth, along with the increase in access to technology and artificial intelligence, HaH is definitely the next-generation model of care. The COVID-19 pandemic has challenged our healthcare system in many ways. While hospitals are busy fighting the pandemic, one of the biggest challenges has been to keep other patients isolated from exposure to the virus. Patients wanted to receive treatment away from the hospital and at a location where they can feel comfortable and safe. HaH programs are gaining popularity amidst the pandemic due to the advanced communication technologies; portable medical equipment; and teams of physicians, nurses, X-ray technicians, and paramedics.^[16] These advanced technologies have helped in linking patients to 24/7 command centers via video and monitoring devices that record their vitals. Patients are receiving daily home visits from medical teams and are also provided with emergency buttons that help them to get immediate attention when needed.^[16]

With the increasing prevalence of the pandemic, the Centers for Medicare and Medicaid Services and many private insurers took care of hospital bills for patient care at home. This has increased the focus on HaH care and now the hospital groups are demanding that Congress make these new changes permanent.^[16]

HaH care can help to reduce the collateral damage caused by COVID-19 by giving attention to patients requiring hospitalization for other morbid conditions.^[17] However, with increasing evidence of successful care at home, individuals with COVID-19 who are at lower risk are also opting for at-home care. Critical clinical staff, such as respiratory therapists and physical therapists, are made available for patients with COVID-19, along with enhanced respiratory remote monitoring to take care of the vitals of the patient. HaH turned out to be a safe escape route for patient care to avoid already congested hospitals and to provide patient-centered care.^[17]

Organizations facing a lack of hospital capacity can adopt this HaH model of care by adjusting their health system—established home healthcare delivery capabilities. Healthcare facilities should have physicians who are interested and have the ability to care for patients in a home environment setting. The HaH model is also helpful if the health system is experiencing a large volume of Medicare admissions for problems such as heart failure, COPD, and pneumonia.^[3]

LIMITATIONS

There are some limitations with this HaH model, such as patient safety issues and medical liability. Improved physician training is required specifically for an HaH model, which can be achieved by training physicians in their residency period and having rotations for at-home care. There are issues related to appropriate reimburse-

ment and physicians putting in more hours. This model also needs a proper chain of command to avoid any communication error. The social and environmental factors associated with the patient's care at home is also very important. A hostile home environment and unhygienic home conditions can worsen the medical condition of the patient. Although there are certain limitations to this model, the popularity of the HaH model has increased due to the pandemic and demand for home care. Unquestionably, more studies and research need to be done to make this model more successful and adaptable in improving the patient's care in familiar surroundings. Providing stronger empirical evidence on patient outcomes should increase the use of the HaH model.

CONCLUSION

The HaH is an innovative model of healthcare that has many benefits in delivering efficient care to patients, especially for older individuals with chronic medical conditions. This model helps in fulfilling the triple aim by improving access to care, reducing costs, and improving the quality of care. The feasibility and usefulness of the model have increased due to the COVID-19 pandemic, as the model helps patients and physicians to work in a safe environment. The physician-patient relationship can be enhanced and improved with this model of care, which could lead to an increase in patient satisfaction. Hospital-acquired infections, which are one of the major issues in hospital settings, can be reduced and minimized in the HaH acute care delivery model given the advancement of technology. This model is beneficial in reducing readmission rates and length of stay, which in turn has a great effect in reducing mortality and healthcare costs.^[7,8]

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