Hospital at Home

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Introduction

Hospital at Home is an innovative care model that provides patient evaluation and management services usually performed in the traditional acute inpatient hospital setting, in a patient's home [1]. In this chapter, we will describe the problems that Hospital at Home aims to address, define the Hospital at Home model, provide an overview of the robust underlying evidence base for Hospital at Home care, and then focus on several key issues related to developing and disseminating Hospital at Home into the US health care system.

Why Bother with Hospital at Home Care? The Problems Addressed by Hospital at Home

Hospital Care Is Expensive

Health care is expensive and hospital care represents a significant proportion of that expense. In 2012, Medicare spent $133 billion for inpatient hospital care among fee-for-service beneficiaries [2].

Hospital Care Is Not Always Safe for Older Adults

However, despite these massive and ever increasing expenditures, the quality and safety of care provided in hospitals is concerning. The seminal reports from the Institute of Medicine, "To Err is Human, Building a Safer Health Care System" and "Crossing the Quality Chasm" highlight the challenges of providing safe, patient-centered care in the inpatient setting. These Institute of Medicine reports launched the hospital safety movement. However, recent studies suggest that the rates of hospital-associated adverse events have not changed significantly over the past 15 years [3]. Whether this is due to an inability to change the safety and quality culture of the traditional inpatient setting, the increasing use of technology, or a patient population with a higher burden or chronic illness, or some combination thereof, the need to provide safer care to acutely ill persons remains paramount.

Hospitals can be especially problematic environments for older adults. Loss or diminution of homeostatic reserve is a hallmark of the aging process. While the usual aging process may not cause problems under ordinary circumstance, the physiological stresses associated with illness, combined with the challenges posed by the hospital environment can exhaust the physiologic reserves of older patients and lead to iatrogenic complications [4, 5].

Such iatrogenic events are common in hospitalized patients. The Harvard Medical Practice Studies found that approximately 4 % of hospitalized patients suffered an adverse event; more than two-thirds of these were due to errors. These events were more common among older patients, even after adjustment for comorbid medical conditions; at least 44,000 people die in US hospitals each year due to medical mistakes at a cost of tens of billions of dollars [6, 7].

Several iatrogenic events are especially common and troubling. Functional decline and disability is common. It affects approximately one-third of patients older than 70 and results in subsequent inability to live independently and manage basic activities of daily living. Such disability can occur even when the underlying illness that precipitated hospitalization is treated successfully. Development of disability following hospitalization is also associated with mortality. Delirium or acute confusional state is also a common complication associated with hospitalization. Although estimates vary, approximately 20–25 % of adults develop incident delirium while hospitalized; many cases go unrecognized. Symptoms of delirium may persist for months and long-term cognitive sequelae are common.

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M.L. Malone et al. (eds.), *Geriatrics Models of Care: Bringing 'Best Practice' to an Aging America*,
DOI 10.1007/978-3-319-16068-9_14, © Springer International Publishing Switzerland 2015

Additional common iatrogenic events include incontinence, pressure sores, nosocomial infections, and falls. In addition, preventable adverse events also occur during the transition from hospital to home at hospital discharge, the result of deficiencies in health system design and poor communication [8–10].

Trends That Favor Alternatives to Traditional Hospital Care

Several key trends have begun to favor alternatives to traditional hospital care, especially since the passage of the Affordable Care Act. The expectation of patients as consumers of health services for more personalized and safer care is accelerating and pushing the health care marketplace to be more consumer-friendly. Advances in the development of safe portable advanced hospital-type technologies allows health care providers to provide services and technologies that were previously available only in hospitals. In the context of increasing interest in approaches to population health, there is increased recognition on the importance to move care out of facilities such as hospitals, and into the community. Finally, payers of health care services are increasingly interested in models that are provide high-quality care at lower cost, and have been experimenting with new payment models such as traditional capitation, bundled payments, and functional capitation models, such as the case with accountable care organizations [9, 11].

What Is Hospital at Home?

A variety of health care delivery models have been included under the rubric of Hospital at Home in the international literature; some models substitute entirely for an inpatient hospital admission, while others, by providing ongoing hospital-level services in the home, facilitate early discharge from the acute hospital. Some models have targeted patients with medical conditions and others have focused on patient's following surgery or those needing rehabilitation services. In most models, nurses deliver much of the care. Relatively few models have included substantial physician inputs. Some models have focused on distinct populations such as children or on patients with psychiatric conditions. This variety of models may reflect the evolution of Hospital at Home models that have been developed chiefly in countries with single payer systems where Hospital at Home models fill a particular clinical niche [9].

In the context of the US health care delivery system there are two main models of Hospital at Home care to consider. The first is "substitutive" Hospital at Home that delivers acute hospital-level care in a patient's home in lieu of acute hospital admission. In this model, patients who require acute hospital care and appropriate for Hospital at Home are usually identified in the emergency department or ambulatory setting and taken directly home to receive Hospital at Home care. If the underlying rationale for Hospital at Home is to avoid hospital-associated complications, honor patient wishes regarding care, and reduce health care costs, the substitutive model, by avoiding the inpatient environment completely, best satisfies that rationale [12].

The other main Hospital at Home model described in the literature goes by term "early-discharge" Hospital at Home. This is unfortunate nomenclature as it implies that the patient no longer requires hospital-level care. In the US context, this terminology risks the model being confused with patients who are discharged from the hospital who no longer require hospital-level services but who are discharged and receive skilled home health services following discharge to facilitate a smooth discharge transition.

A more appropriate name for this model would be a "transfer" model of Hospital at Home. Much in the same way that patients who are hospitalized in an intensive care setting may be transferred to a regular medicine ward bed once their clinical condition is stabilized, a patient who is in a regular medicine ward bed, but who still needs hospital-level care and services, may transfer to a Hospital at Home bed and receive those services in the home. Once discharged from Hospital at Home such a patient may require and receive post-acute skilled services in the home.

Substitutive Hospital at Home and "transfer" Hospital at Home models are consistent with the previously defined "Clinical Unit" model of Hospital at Home. In the Clinical Unit model, Hospital at Home operates as a distinct or virtual, but integrated ward of a hospital, but without the usual bricks and mortar surrounding the hospital bed. Thus, in this construct, Hospital at Home provides treatment at home of an acute condition of a severity that normally requires hospitalization and provides treatment that requires hospital-type technologies or hospital-level care. The hospital or health system retains responsibility for the acute care episode, and Hospital at Home patients retain inpatient status. Funding, provision of pharmaceuticals, diagnostic, radiology, therapeutics, and other services are delivered according to standards commensurate with inpatient status and appropriate to the patient's level of medical acuity. Direct nursing care is provided at home with 24-h coverage. Physician care is provided by Hospital at Home doctors, with 24-h coverage. Hospital at Home care is provided in a coordinated manner similar to an inpatient hospital ward and patients consent to treatment [9].

The Hospital at Home Model

Conditions and Patients That Can Be Treated in Hospital at Home

Hospital at Home care is appropriate for certain conditions and for certain patients with those conditions. Suitable conditions for Hospital at Home treatment may vary between substitutive and transfer Hospital at Home models. For substitutive Hospital at Home-appropriate conditions a key feature is that the condition is one that can be diagnosed with high degree of certainty at the time of hospital admission either in the emergency department or ambulatory site. In the substitutive model, the patient will move from the emergency department or ambulatory site directly to the home. Thus, it is critical to know with a high degree of certainty what condition the patient is suffering with, as this will be the major driver of the plan of care. In addition, for both substitutive and transfer type of Hospital at Home patients, the condition occurs relatively frequently in order to provide the needed patient volume to support a Hospital at Home program. Further, the treatment of the condition is relatively well defined and can be feasibly provided to the patient in a safe and efficient manner in the patient's home.

A number of medical conditions meet these conditions and have been treated in Hospital at Home. Hospital at Home models have addressed community-acquired pneumonia, chronic obstructive pulmonary disease, chronic heart failure, cellulitis, sepsis due to urinary tract infection and complicated urinary tract infection, ischemic cerebrovascular accident, pulmonary embolism, deep venous thrombosis, pancreatitis, Parkinson's Disease, volume depletion and dehydration, febrile neutropenia, ulcerative colitis, decompensated liver disease, multiple sclerosis, acute pancreatitis, and infections requiring long-term antibiotics such as endocarditis, osteomyelitis, infected prostheses. Hospital at Home has also been employed as a substitute for facility-based rehabilitation and as a transfer model for surgical conditions such as total knee arthroplasty, total hip arthroplasty, and vascular surgery procedures. In addition, Hospital at Home has been used for psychiatric conditions [9, 13].

Selecting appropriate patients with the above noted conditions is critical to the success of Hospital at Home in terms of ensuring safe and high-quality care. Patient selection should focus on the construct of selecting patients with the Hospital at Home-qualifying condition that can be safely cared for in the home. Such patients should have a relatively low risk of unanticipated decompensation requiring transfer to the traditional acute inpatient hospital environment and should be able to receive an appropriate course of treatment without a high need of hospital-based high-tech types of treatments. For example, if heart failure is to be treated in Hospital at Home, selection criteria should identify heart failure patients who are not having active cardiac ischemia and who are not likely to need cardiac diagnostic or therapeutic procedures that are impossible or difficult to accomplish in the home, such as percutaneous coronary intervention.

Such Hospital at Home eligibility criteria have been described in the literature for certain conditions such as community-acquired pneumonia, exacerbations of heart failure or chronic obstructive pulmonary disease, and cellulitis. These eligibility criteria can be used in real time with the clinical dataset that is commonly obtained in the emergency department or ambulatory setting allowing for a patient selection process that does not impede the usual clinical workflow of the those care sites [14].

A key issue is that Hospital at Home care should only be provided to patients who truly require hospital-level care. Patients who are admitted to a substitutive model of Hospital at Home are those that but for the ability to provide Hospital at Home care, would have been admitted to the traditional acute care hospital, and not sent home from the emergency department with a prescription for an oral antibiotic, a recommendation to increase the dose of a diuretic, or other clinical recommendation or plan. In the context of a transfer Hospital at Home model, but for the existence of Hospital at Home, the patient would be staying in the acute care hospital and would not be discharged to home.

Over time, as Hospital at Home becomes an increasingly mainstream care delivery model, and as mobile and telemedical technologies improve, the scope of conditions and the severity of illness that can be safely cared for in the home will continue to expand.

How the Hospital at Home Model Works

In substitutive Hospital at Home, a patient with a Hospital at Home-qualifying condition (detailed above), who requires admission to the hospital for that condition, is identified in the emergency department or ambulatory site, or at home, e.g., by a house call physician or home care nurse. The patient eligibility for Hospital at Home care is assessed. In the example below, we focus on a patient admitted from the emergency department, the most common pathway in most programs. A first pass assessment of Hospital at Home medical eligibility can usually be made by an emergency department physician using broad Hospital at Home eligibility criteria that they would have been previously instructed in. The final assessment of eligibility, using the full set of eligibility criteria, is made by a Hospital at Home staff asset, usually a nurse.

At this point, the patient's home environment is also assessed through a brief series of questions that assure that

the home is a suitable environment for care provision. This assessment focuses on general level of cleanliness, whether appropriate needed climate control is present, i.e., air conditioning in the event of warm weather, heat in winter, as well as presence of running water and basic household infrastructure. It is not necessary for the patient to have phone service; disposable cell phones can be provided at low cost to a patient if needed. Once the patient's eligibility is confirmed, the patient is offered treatment in Hospital at Home and consented for treatment in Hospital at Home.

Once the patient consents to Hospital at Home care, Hospital at Home staff mobilizes the full Hospital at Home team and initiates orders for needed medications, durable medical equipment, and providers that will be needed to provide care. These may include oral and intravenous medications (antibiotics, corticosteroids, antiviral, anticoagulation, blood products, chemotherapy), basic radiology (chest and abdominal radiographs, echocardiogram, ultrasound, venous Doppler), oxygen, nebulizer equipment, wound care supplies, assistive devices, bedside commode. Hospital beds are rarely required.

All health care is local; the specifics of how the Hospital at Home system will be set up in a particular health system depend greatly on how that particular health system has decided to implement Hospital at Home in the context of the available health care assets in its local environment. For instance, patients treated in Hospital at Home often require intravenous medications. There are a variety of ways to provide intravenous medications in the home. Such medications could come from a hospital pharmacy, an infusion pharmacy of a home health agency affiliated with the health system, an independent contracted home infusion pharmacy, among others. The specific choice made by a health system to implement this important piece of the Hospital at Home model will depend greatly on the characteristics of the local health care market in which Hospital at Home is implemented, and on payment practices in the particular context of the Hospital at Home implementation.

As these arrangements are being made and coordinated, the patient may be evaluated in the emergency department briefly by the Hospital at Home nurse or physician, depending on some of the details of staffing, as well as the relationship between the emergency department and the Hospital at Home program. In some systems, this initial non-emergency department evaluation may be made by a hospitalist associated with the Hospital at Home program. The patient is then sent home. Transportation is usually accomplished by an ambulette, especially if the patient requires oxygen during transfer. Ambulance transfer is usually not required. Transportation for some patients can be accomplished by the patient and their family, e.g., a patient being admitted to Hospital at Home for cellulitis may be taken home by the patient's family member by car.

The patient arrives at home and is met by the Hospital at Home nurse, who begins to implement the care plan. In some Hospital at Home research studies in the USA, the Hospital at Home nurse was required to stay with the patient continuously for the first 24 h of care [15]. This was found not to be necessary. In fact, many patients did not like having a nurse present for such an extended period of time. In more recent Hospital at Home implementations, the Hospital at Home nurse conducts in initial extended visit that lasts between 2 and 4 h. The nurse completes a full evaluation of the patient and the home. The nurse ensures that all ordered equipment is delivered to the home. In addition, the nurse educates the patient and, if present, family, on the Hospital at Home care model and what to expect in terms of how care will be provided, how to communicate effectively with the care team, and how to notify the care team in the case of urgent or emergent events.

The Hospital at Home physician visits the patient at home and performs her assessment of the patient and refines the care plan with the Hospital at Home nurse. Plans for ongoing intermittent nursing visits are made based on the patient's condition and care plan needs. The Hospital at Home physician will then visit the patient at least daily. The Hospital at Home nurses will usually visit the patient at least daily. Illness-specific care plans guide the provision of care. The Hospital at Home team is available at all times in the event that the patient requires urgent or emergent evaluation and or treatment.

Treatment in Hospital at Home proceeds and, as the patient improves, discharge planning begins. The acute phase of Hospital at Home is designed to be a brief intervention. Average lengths of stay are in the 3–4 day range, similar or slightly less than the length of stay in the traditional acute care hospital. However, discharge from Hospital at Home offers advantages over traditional hospital discharge. The relationship between Hospital at Home staff and the patient and family members and the teaching and education that was provided to the patient during the Hospital at Home admission contribute to robust patient understanding of their condition and issues related to self-management. The knowledge obtained by the Hospital at Home staff, by being in the patient's home for several days can help optimize discharge planning and the planning for any post-discharge services such as skilled home health care. This and the ability to perform medication reconciliation in a patient's home "at the kitchen table" may contribute to a smoother care transition.

The physician's role in Hospital at Home has varied widely. As noted, early discharge models usually involve physicians in supervision at a distance; substitutive Hospital at Home models also report varied physician roles. In some substitutive models community-based general practitioners are available for home visits to Hospital at Home patients but make few visits. Other models require that physicians visit

the patient at home every day on the premise that Hospital at Home patients require the same care that they would have received inside hospital walls. There appears to be a relationship between clinical benefits obtained and the degree of physician participation in providing Hospital at Home care.

The role of caregivers has varied in different Hospital at Home models. Some models will only accept patients into Hospital at Home if a caregiver is present in the home and may use the caregiver to supervise the patient or deliver care. Other programs have not maintained such a requirement on the theory that it may not be appropriate to shift the burden of care provision to the patient's family. Such programs will also accept patients who live alone for Hospital at Home admission. If a patient who lives alone requires assistance with activities or additional supervision, then a nurse aide can be provided to that patient. As will be noted below, caregiver strain and stress has been found to be lower in Hospital at Home compared with usual hospital care, even in Hospital at Home models where caregivers provide some level of care to the patient.

Outcomes of Hospital at Home: The Evidence Base

Hospital at Home is one of the best-studied care delivery models in the medical literature; the evidence base is robust and several meta-analyses have been performed. We review the meta-analytic data and then focus on several programs in detail.

The meta-analyses of Hospital at Home have focused on different Hospital at Home model types and have used somewhat varying definitions for study inclusion.

Shepperd et al. conducted the most recent systematic review that focused on admission avoidance Hospital at Home, i.e., substitution Hospital at Home. They included randomized controlled trials that compared programs aimed at avoidance of admission through provision of hospital care at home with inpatient care in acute care hospitals for patients 18 years and older. Hospital at Home care had to substitute for care that would have required inpatient admission, i.e., if the Hospital at Home program had not been available, the patient would have been admitted to the acute care hospital. Early discharge Hospital at Home was excluded, as were pediatric, obstetric, and mental health patients. Ten randomized controlled trials met the study definition with total of 1,327 patients studied across the ten trials. Seven of the trials were eligible for meta-analysis of individual patient data. Of the ten trials, two trials focused on patients with chronic obstructive pulmonary disease, two recruited patients with acute stroke, three recruited patients with acute medical conditions who were mainly elderly, one for patient with cellulitis, one for patients with community acquired pneumonia, and one for frail patients with dementia. There was a non-significant reduction in mortality at 3 months favorable to Hospital at Home (hazard ration 0.77, confidence interval 0.54, 1.09) and a significant reduction in mortality favorable to Hospital at Home after 6 months (HR 0.62, CI 0.45, 0.87). Patients receiving Hospital at Home care reported greater satisfaction with care than those who received care in the traditional acute care hospital across a range of medical conditions. Clinical outcomes such as bowel or urinary complications, delirium, and others, when reported, were favorable to Hospital at Home. Length of stay was generally shorter for Hospital at Home patients, and Hospital at Home was less expensive than traditional care [16].

A Cochrane systematic review and meta-analysis of early discharge Hospital at Home identified 26 trials ($N = 3{,}967$). The trials were of adults aged 18 and older; obstetric, pediatric, and mental health Hospital at Home trials were excluded. If the early discharge Hospital at Home were not available, the patient would not have been discharged from the hospital and would remain on the acute care unit of the hospital. The types of conditions that these models focused on included: patients following surgery for hernia varicose veins, coronary artery bypass grafting surgery, hip fracture, or total knee replacement. Other target conditions included patients recovering from stroke, patients with a mix of acute medical conditions such as chronic obstructive pulmonary disease and others. For patients recovering from stroke and elderly with a mix of medical conditions, there was insufficient evidence of a difference in mortality between groups (HR 0.79, CI 0.32, 1.91). Readmission rates were higher for Hospital at Home elderly patients with a mix of conditions (HR 1.57, CI 1.10, 2.24). For patients recovering from stroke (HA 0.63, CI 0.40, 0.98) and elderly patients with a mix of conditions (HR 0.69, CI 0.48, 0.99), fewer Hospital at Home patients were admitted to nursing home care at follow up. Patients reported greater satisfaction with early discharge Hospital at Home. Evidence on cost savings was mixed [17].

In 2012, Caplan et al. published a systematic review of "hospital in the home." They adopted a definition of Hospital at Home that "significantly substitute for in-hospital time" and hypothesized that replacing inpatient care with home-based care for at least 7 days or for at least 25 % of the duration of the control hospital admissions would produce different clinical outcomes such as mortality, readmission rates, patient and carer satisfaction, and lower costs of care. This broader model definition encompassed substitution and early discharge type models. This systematic review reported on 61 randomized controlled trials and included medical, surgical, rehabilitation, and psychiatric models. Overall, care at home, compared with usual hospital care, resulted in reduction in mortality at 6 months (odds ratio 0.81, CI 0.69, 0.95), readmission rates (0.75, CI 0.59, 0.95), and reductions in costs. Patient satisfaction was higher in Hospital at Home,

as was carer satisfaction. Carer burden was lower compared with usual hospital care. The authors suggested that these outcomes were likely to be generalizable given the range of types of studies and patient populations examined [13].

In the USA, development of Hospital at Home was spearheaded by investigators at Johns Hopkins. They focused on development of a substitutive model of Hospital at Home with a robust physician component. Initial work focused on the identification of acute medical conditions that were appropriate for Hospital at Home care. Clinical eligibility criteria to select appropriate Hospital at Home patients were developed and validated [14]. The initial set of Hospital at Home conditions were community acquired pneumonia, chronic heart failure, chronic obstructive pulmonary disease, and cellulitis. Pilot studies demonstrated clinical and economic feasibility of this Hospital at Home model [18]. Because of a lack of payment mechanisms for Hospital at Home in fee-for-service Medicare, larger studies were performed in integrated healthcare delivery systems such as Medicare managed care and the Veterans Affairs health systems. The model studied by Hopkins in its research phase employs continuous nursing care, followed by intermittent nurse visits, and at least daily physician home visits. A randomized controlled trial was forbidden by the Center for Medicare and Medicaid services because of regulations governing Medicare managed care plans. Using a quasi-experimental design with a conservative intent-to-treat analysis, Hospital at Home care was shown to be feasible and efficacious. Patients received timely hospital-level care at home that met quality standards. Compared with patients treated in the acute hospital, those treated in Hospital at Home suffered fewer important clinical complications including mortality, sedative medication use, chemical restraints, and incident delirium [19]. Patient and family member satisfaction was higher [20]. Although patients were not required to have a caregiver (30 % lived alone), caregiver stress was lower [19]. Hospital at Home patients improved in the ability to perform IADLs compared with usual care patients [21]. Health care provider satisfaction with the model was high [22]. The average amount paid for Hospital at Home patients was lower; savings resulted from reduced use of laboratory and high tech procedures [23].

Dissemination of Hospital at Home

Everett Roger's framework for diffusion of innovations is useful to consider in the context of Hospital at Home. Rogers described several features of the innovation that favored adoption and dissemination. These are: (1) relative advantage of the innovation compared to current practice; (2) compatibility of the innovation with the values, beliefs, needs, and culture of the adopter; (3) complexity of the innovation—the simpler the better; (4) trialability, or how the innovation can be tested easily before investing in the innovation; and (5) observability, that is, the ability of an adopter to see others try it first with visible benefit

In this Rogerian framework, several key recent trends are working in favor of Hospital at Home dissemination. There has been growing awareness of the hazards of hospitalization (especially for older adults), the high costs of health care for older adults, and the robust evidence base for Hospital at Home, establishing properties of relative advantage for Hospital at Home. The rapid evolution of the US health care system in the wake of the Affordable Care Act into a system that is capitated or functionally capitated has elevated the compatibility of Hospital at Home significantly with regard to payment, a key driver in health service adoption and dissemination. As health systems try to move care to less expensive cost centers, i.e., the community, and community-based systems of care improve, and as the capacities of technologies such as telehealth improve, Hospital at Home has and will continue to become a less complex model to develop

Dissemination Experience to Date

Implementing the Hospital at Home model at a hospital or within a health system, at a high level, requires alignment of the payer, hospital, health care providers (including those who will provide care to the patient in the home as well as key hospital-based providers, notably hospital emergency department personnel and, sometime, hospitalists), and home health service delivery assets. In the current health care environment to date, the environments in which it is easiest to create such alignment have been in integrated delivery systems, Medicare managed care, and the Veterans Affairs (VA) health system [24].

To date, Hospital at Home has been adopted by several VA medical centers and integrated delivery systems. In each case, substitutive Hospital at Home care is provided; adopters have also implemented early discharge, i.e., transfer type Hospital at Home, as well. VA adoptions of Hospital at Home have used their robust home-based primary care model as a substrate on which to build Hospital at Home.

For example, the Portland, Oregon VA medical center adopted Hospital at Home as a service offering after participating in the Hopkins Hospital at Home National Demonstration. Portland adapted the model to the VA environment; rather than focus exclusively on older adults, they allowed adults aged 18 and over to receive care. They implemented an early discharge, i.e., transfer component to the model, as well. Portland has had substantial success with the model. In 2008, Portland reported a case series on their experience with 290 patients; 23 % were admitted to Hospital at Home directly from the emergency department, 23 % were admitted directly from outpatient clinics or home care, and

56 were transfers from the inpatient service. Hospital at Home was integrated into the VA electronic medical record. The average length of stay was 3.2 days, 37 % of patients were under the age of 65, and 30 % lived alone. The program produced cost savings by diverting patients to the lower cost Hospital at Home; they estimated that the program needed to save 235 inpatient bed days of care per year to cover the costs of the Hospital at Home infrastructure, which included a 0.5 full-time equivalent physician, 1.0 full-time equivalent home care registered nurse, and 0.5 full-time equivalent clerical support, on top of the standard home-based primary care infrastructure [25]. The VA has also implemented Hospital at Home in New Orleans, LA, Honolulu, HI, Philadelphia, PA, and Cincinnati, OH.

In the Medicare managed care and integrated delivery system context, Presbyterian Health Systems (PHS), in Albuquerque, NM, adopted Hospital at Home. PHS is the largest health care system in NM. Hospital at Home was adopted in the context of capacity issues at their main hospital and a culture that was open to disruptive innovation. PHS developed and made Hospital at Home available to patients insured by their Medicare Advantage product, insuring cost savings to their system. In addition to providing in-person daily physician visits, the PHS version of Hopkins Hospital at Home also included a telehealth component in which nurses provided additional remote support by monitoring for important clinical changes via daily telehealth encounters. The telehealth unit consists of a blood pressure monitor, stethoscope, oximeter, glucometer, and video connection allowing communication for assessments and teaching. In 2009 and 2010, the program experienced 323 admissions, patients had similar or better clinical outcomes, satisfaction with Hospital at Home was better than for similar patients admitted to their traditional acute care hospital, and Hospital at Home saved 19 % costs when compared to similar inpatients. The savings were derived principally from lower average length of stay and use of fewer lab and diagnostic tests compared to similar inpatients [26].

Dissemination of Hospital at Home into the traditional Medicare fee-for-service environment has been difficult, as there is no established payment mechanism for it. Certain services provided in the context of Hospital at Home can, in theory, be paid for under various established Medicare payment codes. For example, physician home visits can be reimbursed under Medicare Part B evaluation and management payment codes. Certain home health services can be provided under Medicare Part A skilled home health care prospective payment. However, certain services, such as infusion services are difficult to obtain reimbursement for, and the intensity of services provided in Hospital at Home do not allow for Hospital at Home full costs to be covered appropriately by current mechanisms.

There have been some recent developments in developing a payment model for Hospital at Home in fee-for-service Medicare. In 2014, Mount Sinai Medical Center, New York, received a 3-year Innovation Challenge Grant from the Center for Medicare and Medicaid Innovation of the Center for Medicare and Medicaid Services [27]. The goal of this work will be to implement the Hospital at Home model at hospitals in the Mount Sinai system and to develop data to inform the development of a 30-day bundled payment model for Hospital at Home that could be implemented in the Medicare fee-for-service system. If such a payment model could be developed and implemented, it would likely spark substantial dissemination of the Hospital at Home model in the US health care system.

Barriers to Dissemination

In addition to the payment and structural challenges noted above, several additional barriers to Hospital at Home dissemination are worth considering. Health system leaders are often concerned about the risk for malpractice lawsuits and litigation with Hospital at Home. To date, litigation has been relatively non-existent in Hospital at Home. The malpractice literature suggests that lack of effective patient/family–physician communication is a basic cause of many malpractice actions. There are reasons to believe that in Hospital at Home, as in other home-based models, communication between providers and patients, in general, may be more effective and of higher quality than that which occurs in the hospital or other facility-based care. By virtue of being present and a guest in a patient's home, providers must communicate well, enhancing trust between patients and health care providers, thus reducing the risk of malpractice litigation. Further, to date, admission to Hospital at Home, to date, has always been a choice made by a patient, which also mitigates risk.

Currently, Hospital at Home lacks a regulatory home. It provides hospital-level care in the home, but does not entirely replicate the hospital environment. It provides a level of care significantly more intense and timely than that provided in typical skilled home health care. To date, most adopters have situated Hospital at Home within their home health administrative structure, sitting under the larger umbrella of the hospital and health system. If Hospital at Home does become more widely disseminated, it will need to develop a quality regimen more appropriately specific to its needs. Some programs, to date, have been accredited under the home health realm of The Joint Commission.

Attitudinal barriers and clinical inertia can also be substantial barrier to Hospital at Home dissemination. Hospital at Home is one of the best studied health service delivery models; the evidence base is robust, but dissemination has been modest. Stein et al. reported on the modest response in

translation to home management of deep venous thrombosis despite the demonstration of the safety and efficacy of such home treatment. They hypothesized that attitudinal barriers may be one of several factors inhibiting widespread dissemination of the model [28].

The Future State

There are examples of Hospital at Home models that have scaled. In Victoria State, Australia, Hospital at Home has been reimbursed at the same rate as traditional hospital care since the mid-1990s. By 2009, Hospital at Home accounted for 2.3 % of all inpatient admissions, 5.3 % of all multiday admissions, and 5 % of all hospital bed days. There was high satisfaction with the model. But for the existence of Hospital at Home, health authorities note that they would have had to build another 500-bed inpatient facility [29].

Changes in health service delivery and payment occurring under the Affordable Care Act will likely serve to promote Hospital at Home adoption and dissemination. Medicare managed care in the form of Medicare Advantage plans continue to grow and will provide a favorable payment environment for Hospital at Home. The development and increasing presence of Affordable Care Organizations will also provide a permissive environment for Hospital at Home. Improvement in telehealth and other remote monitoring and service delivery technology will make home-based care safer and easier to administer. The demographic trends associated with an aging population, an increase in the prevalence of chronic illness, and trends towards the increasingly high-tech environment of the traditional acute hospital will put pressure on health systems to move more care to the community as hospitals become cost centers, rather than profit centers.

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