



Reducing Readmissions
Top Ways Information Technology Can Help

The Hospital Readmission Workgroup
Management Engineering–Process Improvement Committee

INTRODUCTION

Effective with the 2012 federal fiscal year, Medicare is reducing reimbursement to hospitals for avoidable readmissions related to three diagnoses—Acute Myocardial Infarction (AMI), Heart Failure (HF), and Pneumonia (PN). Here are some of the top information technology strategies hospitals and health systems can employ to reduce avoidable readmissions, and avoid reimbursement adjustments. The strategies we discuss include:

- [Case Management](#)
- [Communication](#)
- [Analytics and Modeling](#)
- [Post-acute Follow up](#)
- [Health Information Exchange \(HIE\)](#)
- [Social Media](#)
- [Cloud Technology and Mobility](#)
- [Robotics](#)
- [Innovation](#)

First, we briefly examine the background and policies that are driving recent policies on readmissions. We will then present each of these strategies at a high level, and show how information technology can be used in many ways, across domains, to help reduce readmissions. Some of these strategies may already be familiar, while others are yet to be fully developed. Research for this overview was conducted by the HIMSS Hospital Readmission Workgroup of the Management Engineering – Process Improvement Committee, and members of its Community of Profession. We hope that you find value in the options presented.

THE READMISSIONS-REIMBURSEMENT LINK

The ATA Wiki succinctly defines the connection: “Currently, Medicare pays for inpatient care provided by acute care hospitals using a prospective payment system where each patient is assigned to a diagnostically-related group (DRG) and paid based on an estimate of the average resources needed to care for a patient with specific diagnoses. Certain atypical cases may qualify for additional outlier payments.”⁽¹⁾ A major contributor to costs is hospital readmissions. The economic burden is staggering. A study of re-hospitalizations among patients in the Medicare fee-for-service program, published in the *New England Journal of Medicine*, along with a review of post-hospital transitions published in the *Journal of Hospital Medicine*, found that:

1. Twenty percent of patients were readmitted within 30 days, and 50.2% of those readmitted patients never had a follow-up visit with a primary care physician⁽²⁾;
2. Patients lacking timely primary care physician (PCP) follow up were 10 times more likely to be readmitted, equating to readmission rates of 21% for patients lacking timely PCP follow up versus 3% for patients with timely PCP follow-up⁽³⁾; and
3. Seventy percent of patients were readmitted within 30 days after a surgery for a medical condition such as pneumonia or a urinary tract infection.⁽²⁾

In addition, a report by The Commonwealth Fund⁽⁴⁾ cites a survey indicating that test results and medical records were missing at 23% of follow-up patient appointments, and also found that about 60% of medication errors occur during transitions of care, at an annual cost of \$3.5 billion.

The Medicare Payment Advisory Commission (MedPAC) has studied the avoidable hospital readmission issue.⁽⁵⁾ In a report to Congress entitled “Promoting Greater Efficiency in Medicare,” researchers found that “...the failure to adequately attend to the care transition at discharge from the hospital results in additional Medicare spending; 17.6 percent of admissions result in readmissions within 30 days of discharge, accounting for \$15 billion in spending. Not all of these readmissions are avoidable, but some are.” It is believed that about 75% of 30-day Medicare readmissions are potentially preventable, with potential savings of \$12 billion to Medicare. Variation in readmission rates by hospital and geographic region suggests that some hospitals and geographic areas are better than others at containing readmission rates.⁽⁶⁾ It is estimated that Medicare can save about \$100 billion over 10 years if high-cost areas are brought to the national average.⁽⁷⁾

The Patient Protection and Affordable Care Act

One provision of the Patient Protection and Affordable Care Act (PPACA) is the Hospital Readmissions Reduction (HRR) Program. “Starting in fiscal year 2012, inpatient prospective payments to a hospital will be reduced based on the dollar value of the hospital’s percentage of preventable Medicare readmissions”⁽⁸⁾ for three conditions: Acute Myocardial Infarction, Heart Failure and Pneumonia. All DRG payments will be reduced up to 1% in 2013, 2% in 2014, and 3% in 2015 and beyond.⁽⁹⁾

Key features of the program include:

- Performance measurement will be based on readmission measures for three conditions that involve high-volume or high-expenditure readmissions: (i) acute myocardial infarction; (ii) pneumonia; and (iii) heart failure. The Department of Health & Human Services (HHS) is authorized to increase the number of applicable conditions in federal fiscal year (FFY) 2015.
- An excess readmission would include an admission that occurs within 30 days following the date of discharge from the hospital, but would not include an admission that is unrelated to the prior discharge.
- The base inpatient payment for hospitals with *actual* readmission rates higher than their Medicare-determined *expected* readmission rates will be reduced by an adjustment factor derived through the application of a complex formula. The calculated reduction will apply to *all* Medicare discharges.
- Information compiled under this program will be made available through Medicare’s Hospital Compare website.
- HHS will develop a program by 2012 for high-readmission rate hospitals to improve their readmission rates through the use of patient safety organizations.⁽¹⁰⁾

On August 18, 2011, the Centers for Medicare & Medicaid (CMS) published final rules in the *Federal Register*⁽¹¹⁾ which include a number of provisions to implement various sections of the PPACA. Among these are the requirements for a Hospital Readmissions Reduction Program and related quality data reporting measures.⁽⁸⁾ The Hospital Readmissions Reduction Program will begin October 1, 2012 (FFY

2013). Medicare payment reductions under this program will be capped at 1.0% in FFY 2013. CMS will use 3 years of data (discharges from July 1, 2008 through June 30, 2011 for FFY 2013) to calculate readmission rates. If the ratio of a hospital's risk-adjusted readmission rate to the unadjusted raw U.S. average rate is greater than 1.0, the hospital will be subject to a payment penalty.⁽¹²⁾

“PPACA Section 3026 provides funding for a five-year program beginning January 1, 2011, to eligible entities that furnish improved care transition services to high-risk Medicare beneficiaries. Eligible entities include hospitals and qualifying community-based organizations that provide care transition services. The program is intended to improve the care of Medicare beneficiaries at high risk for readmission.”⁽¹³⁾ The Community Based Care Transitions Program (CCTP) mandated by Section 3026 of the Affordable Care Act is specifically designed to encourage the development of strong partnerships between hospitals with high readmission rates and community-based organizations (CBOs). These partners are encouraged to implement evidence-based interventions targeting high-risk beneficiaries from their communities who would most benefit from the proposed interventions.⁽¹⁴⁾

According to its press release, HHS says it will invest up to \$1 billion in federal funding: “\$500 million of that funding was made available through the Community-based Care Transitions Program. Up to \$500 million more will be dedicated from the Centers for Medicare & Medicaid Services (CMS) Innovation Center to support new demonstrations related to reducing hospital-acquired conditions. The funding will be invested in reforms that help achieve two shared goals:

- ***Keep hospital patients from getting injured or sicker.*** By the end of 2013, preventable hospital-acquired conditions would decrease by 40-percent compared to 2010. Achieving this goal would mean approximately 1.8 million fewer injuries to patients, with more than 60,000 lives saved over the next three years.
- ***Help patients heal without complication.*** By the end of 2013, preventable complications during a transition from one care setting to another would be decreased so that all hospital readmissions would be reduced by 20 percent compared to 2010. Achieving this goal would mean more than 1.6 million patients will recover from illness without suffering a preventable complication requiring re-hospitalization within 30 days of discharge.”⁽¹⁵⁾

Given the significant pressure on the provider community to reduce readmissions, it is worth examining the role information technology might play in achieving some of these goals. The topics below are not an exhaustive exploration of options, nor is every combination and permutation of the options explored. Our intent is to provide insight, options, and spur creative thought, and assist the provider community in reaching its goals.

CASE MANAGEMENT

One proven application of information technology to the readmissions problem is case management. Patients are at increased risk for adverse events, including hospital readmission, during transitions of care, such as discharge from the hospital to home or to another level of care. Once discharged from the hospital, community caregivers including the patient and their family assume responsibility for the patient's daily activities, diet, medication, etc. They must have the necessary information in order to seek

appropriate post-acute care, recognize early signs of a worsening condition, institute early interventions, and avoid unnecessary readmission. Written, fully understandable discharge instructions will ensure that the patient receives the information necessary to stay healthy.⁽¹⁶⁾

A study prepared by Health Management Associates for The Commonwealth Fund offered findings from four case studies of hospitals with exceptionally low readmission rates.⁽¹⁷⁾ In terms of care coordination, these hospitals paid attention to discharge planning from the first day of the patient's stay. An assessment was performed as soon as possible after admission, typically within eight hours. Health information technology was leveraged to facilitate the patient assessment and discharge planning process. Once a patient was hospitalized, the EMR was used to promote integrated care, communication, and quality improvement. Case managers used risk assessment software to assist with establishing readiness for discharge, as well as appropriate level of care after discharge. Nursing assessment tools were used to generate automatic case management, social work, or other indicated referrals. For example, case managers at Memorial Hermann Memorial City Medical Center use risk stratification software to assess readiness for discharge and ensure appropriate post-discharge levels of care.

“Memorial City maintains a ratio of one case manager for every 25 patients, but they expect to move to a 1:20 ratio in the future. The process begins with a nursing assessment, which is conducted within eight hours of a patient's admission. The assessment is 80 percent electronic and uses branching logic (meaning that certain responses trigger automatic referrals for case management and/or social work consults). Any nursing assessments associated with a prior admission are available in the record for the case managers and social workers' review. All case managers are assigned to a specific hospital unit, which enables them to become familiar with the physicians on that unit, the patients' specific needs, and the most appropriate resources in the community. The hospital has performed well above national averages for the last three years on measures of AMI and pneumonia care, and is currently in the top 10% for these conditions.”⁽¹⁸⁾

COMMUNICATION

Patient communication can serve as a key strategy to manage and control patient readmissions. Hospitals will continue to use traditional forms of communication, but will also explore and plan for the use of technology that will be able to supplement and/or enhance traditional forms of communication. Traditionally, the means to avoid hospital readmissions centered on functions such as inpatient case management (as above), appropriate patient and home care-giver teaching, written discharge instructions, phone-based follow-up, and ongoing community-based education.

These traditional methods can be further enhanced by the use of information technology. Again, according to the Commonwealth Fund, health information technology (e.g., electronic health records, patient registries, and risk stratification software) can reduce avoidable readmissions and improve quality.⁽¹⁷⁾ Health IT products can “engage and support patients in health-related decision making and management of their own personal health information.”⁽¹⁹⁾ Automated communication systems can encourage patient engagement and at the same time assist healthcare providers in meeting their targeted quality and cost goals. Examples of these systems include personal health records (PHRs), telemonitoring, and online, Web-based educational material.

From a provider perspective, what technologies are likely to reduce avoidable hospital readmissions? According to a recent study conducted by the Institute of Medicine of the National Academies, restrictions on the “free exchange of information” are the “most critical barrier to patient safety and transparency.”⁽²⁰⁾ To increase the exchange of information between patients and doctors, “Some studies demonstrate that patient engagement tools reduce hospitalization rates in children, increase patient knowledge of treatment and illnesses and increase clinical knowledge.”⁽²¹⁾ For example, an electronic health record (EHR) is one engagement tool that has proven effective in increasing patient and doctor communication, increasing patient safety, and coordinating patient care. “The Department of Veterans Affairs was able to demonstrate that an EHR could help coordinate care by providing a continuous flow of information among multiple clinicians.”⁽²¹⁾ What follows is an overview of engagement tools that providers may consider to increase communication with their patients.

- ***iTV Patient Engagement System*** – iTV is an interactive digital television tool, which can be used in the hospital or in the home to educate and prompt patients to carry out the functions associated with their agreed upon plan of care.
- ***Risk Assessment Software*** – Risk assessment software can assist case managers in assessing and tracking patients during their hospital stay, establishing an appropriate level of care, and assessing readiness for discharge.
- ***Interactive Voice Response (IVR) System*** – An IVR provides a mechanism for the hospital to monitor cardiac patients after discharge.
- ***Disease Management System*** – A disease management system allows for the ongoing case management of chronic conditions such as diabetes or COPD by a provider organization. It is generally used by a nurse who stays in touch with a patient to provide ongoing education, support, and assistance in managing their chronic condition.
- ***Patient Registry*** – A patient registry is an automated registry which can be used to notify community physicians about their patient’s condition and recent hospitalization.

- **Patient Portal** – A patient portal is a module within a hospital’s EMR and is used to push relevant information to the patient opting to use the portal. The type of information shared includes medications, allergies, diagnostic results, and documented summaries of hospital stays.

All of this technology can aid communication both for the patient and the provider. In order to successfully implement these tools, it is imperative that provider organizations focus on a patient-centered approach when implementing these technologies and on establishing a goal of improving quality care.

ANALYTICS & MODELING

Business intelligence tools, which have been widely used in many vertical domains such as banking, manufacturing and insurance, are gaining momentum in healthcare. Recently, KLAS reported three key requirements for Accountable Care: “analytics, health information exchange (HIE), and data warehouses.”⁽²²⁾ Dashboards and analytic reports are critical in helping healthcare organizations focus on house-wide readmission rates. At a glance, management and department heads can view the organization’s readmission rates on a dashboard, while analytic reports can examine critical drivers of performance that affect readmission rates.

Dashboards offer critical functionality in tracking and graphically displaying key performance indicators for important healthcare outcomes or organizational strategic objectives. Often these key performance indicators support the capacity to drill down to lower levels. High performing healthcare organizations depend on clinicians and managers to have information readily available on a near-real-time basis to aid in informed decision-making. Care providers are looking for information that helps them understand what processes are working well and which processes are broken. Dashboards are one tool that aid in the understanding of clinical and financial process measures as well as outcomes. Performance and adherence to best practice guidelines across key product lines, patient registries and disease cohorts, can effectively be aided by the use of dashboards and analytics.

Any dashboard is only as good as the analytical model which assimilates large volumes of data to arrive at meaningful analysis and key indicators. The value of any analytical or modeling system is dependent upon the quality and completeness of the data set. Vast data warehouses with millions of patient records provide a robust foundation for the development of analytical models. The ability of data aggregators to pull in data feeds from disparate clinical systems is significant in providing a comprehensive and longitudinal view of each patient that includes care that they have received in acute and non-acute settings. This wide swath of robust data is critical for prediction of readmission.

Currently, analytic models for estimating risk of readmission can be broadly categorized into three categories:

1. Retrospective administrative data,
2. Real-time administrative data, and
3. Primary data collection.

Retrospective administrative data models in the U.S. include CMS models for congestive heart failure, acute myocardial infarction and pneumonia admissions. These models are popularly used in acute care settings, as they rely on data elements easily collected such as known co-morbidities and prior admissions. However, a Department of Veteran Affairs (VA) study concluded that these models did not

significantly show an ability to predict 30-day all-cause readmissions. Similarly, models using real-time administrative data often use variables from the EMR to supplement the retrospective data. Social factors, such as socioeconomic status, drug use, and marital status, are the most common elements in real-time administrative models. Finally, primary data collection models contain data elements collected from patient surveys and more extensive chart review. These models are mostly designed to be able to assist clinicians in making care decisions prior to discharge. Although potentially helpful, this data is sometimes not available in a manner timely enough to create actionable interventions that reduce the likelihood of readmission.

For healthcare organizations to better manage who is at risk for readmission, the predictive models must have better discrimination in identifying who is at risk. In general, almost all the retrospective risk prediction models studied do not have high accuracy in identifying patients likely to be readmitted. Some studies found an improvement when social factors such as socioeconomic status, access to care, substance abuse, housing discontinuities, and functional factors such as ADL dependence, mobility, cognitive and visual impairment were added. However, other studies did not find any significant difference when using these variables. Many commercial software and informatics vendors are currently expanding on these early efforts and developing advanced predictive models which are capable of not only utilizing retrospective data, but pulling in real-time clinical data for patients while they are in an acute care setting. Early analyses show promise in the predictive ability of real-time patient data found in hospital pharmacy and laboratory systems.

For healthcare organizations to be successful in reducing readmissions, business intelligence tools are necessary. Large data warehouses populated with data from across the healthcare system including inpatient, ambulatory, and home-care related data are important sources that will feed the data model to predict those at risk for readmission. Artificial intelligence and advanced predictive models are being developed based on their ability to map patterns between relevant data points. As more work is done in this area, healthcare organizations will be able to target their resources in working with those patients most likely to be readmitted. Finally, high performance management requires measurement in this 21st century healthcare environment.

POST-ACUTE FOLLOW UP

To assist in the avoidance of readmissions, it is imperative that post-acute follow up occur in a timely manner so that management of the patient after discharge will ensure a successful post-hospital outcome. Silow-Carroll et al state in *Reducing Hospital Readmissions: Lessons from Top-Performing Hospitals* that healthcare providers should “align hospitals’ efforts with those of community providers to provide a continuum of care. While this may be best achieved in integrated systems, such cooperation can be facilitated through collaborative relationships among hospital and community providers.”⁽¹⁷⁾ The community providers need to cross the spectrum to include primary care physicians, specialists, rehabilitation, home care, hospice, long term care, and other forms of post-hospital care. This article also notes that providers of care need to “understand and honor patients’ preferences for end-of-life care.....to reduce unwarranted and unwanted readmissions.”⁽¹⁷⁾ It has been well-documented in the literature that often the most expensive care provided to a patient is end-of-life care and this care may be contrary to what a patient wishes because information contained in an advance directive is unavailable at the point of care.

From a technology perspective, appropriate health information exchange between the hospital and the follow-up provider can serve as a lifeline between these two entities. Health information exchange is discussed below. The follow-up provider can be made aware of the hospital's discharge plan and the condition of the patient at discharge. The follow-up provider can receive a more comprehensive history on the patient as well as a better understanding of the patient's hospital course and prognosis.

Another technology that is supportive of post-hospital care is social media, expanded upon elsewhere in this paper. There are several sites that provide patients with an opportunity to interact with others who are suffering from the same chronic or catastrophic illness. Although this interaction provides no direct medical benefit, it does cater to the psychosocial needs of the patient and can be instrumental in assisting some patients to cope with their disease.

Lastly, telemedicine can also assist in managing a patient following discharge from a hospital. Key patient vital signs can be monitored and electronically conveyed back to the hospital or to a provider who is following the patient after discharge. The patient's primary care physician, or specialist following the patient, can be alerted when an abnormal result is identified and the provider can rapidly intervene to manage the patient's condition.

HEALTH INFORMATION EXCHANGE

For communication to occur, an infrastructure must first be in place. The American Recovery and Reinvestment Act (ARRA) provides incentives for "meaningful use" of EHRs through the Health Information Technology for Economic and Clinical Health (HITECH) Act⁽²³⁾. One of the three main components of meaningful use is the electronic exchange of health information. Among the provisions of the HITECH act is support for states to establish health information exchanges and the establishment of regional extension centers (RECs). The ongoing development of a robust information exchange infrastructure will play a vital role in reducing the incidence of preventable hospital readmissions by enhancing communication throughout the healthcare continuum. A recent article in the *New England Journal of Medicine* provides an excellent overview describing the unmet potential of health information technology (HIT).⁽²⁴⁾ Clinical processes and HIT's capabilities must evolve in order to improve and coordinate care. EHRs must present data in standard ways in order to communicate effectively with the emerging regional HIEs and ultimately, the Nationwide Health Information Network (NwHIN).

The HIMSS HIE Wiki⁽²⁵⁾ and HIMSS HIE Toolkit⁽²⁶⁾ provide a wealth of background information, and readers of this paper are encouraged to refer to them liberally. There is tremendous potential for HIT, specifically including HIE, to reduce hospital admissions and readmissions, and enhance quality of care.

Even though an increasing number of healthcare providers and organizations are using an EHR, the healthcare paradigm is in a state of flux. In addition, patients are increasingly mobile. There is an increasing disconnect between outpatient and inpatient care, as fewer PCPs provide care in the hospital setting. This care is now provided by dedicated hospitalists. A significant number of patients do not have a primary care physician, or that physician may be located in a different community. Furthermore, although they may be local, many physicians do not belong to an integrated health system. Even if a physician has an EHR in place, it may not be interoperable with the system used in the nearby hospital. It is apparent that these factors can lead to tremendous communication issues and the potential for significant medical errors, with unnecessary admission and readmission to the hospital.

In fact, studies have shown that on admission to the hospital, 54% of patients had at least one medication discrepancy, with almost half of them considered a potential threat to the patient.⁽²⁷⁾ At the time of presentation to the emergency department or hospital inpatient unit, the emergency physician or hospitalist often does not have ready access to a patient's ambulatory records and information has to be gleaned from an often unreliable patient history or by piecing together whatever existing records are available. Conversely, upon discharge from the hospital, the discharge summary is the most common means of communication between the hospitalist or specialist and the PCP. Studies have shown that these summaries are often incomplete, and furthermore, they often arrive late or not at all. It has been found that approximately 75% of the time, discharge summaries were not received by the PCP at the time of the hospital follow-up visit.⁽²⁷⁾ Furthermore, medication reconciliation during the discharge process must be done completely and accurately. One study found that there were unexplained discrepancies between the preadmission medication list and discharge medication orders in 49% of hospital discharges.⁽²⁷⁾ If the post-discharge medication regimen is poorly documented or inaccurate, adverse drug events and errors, possibly leading to readmission, can occur.

HIE is "...the exchange of health information for patient care across traditional business boundaries in health care. Many health care organizations that have exemplary HIT systems have difficulty providing their patient information to other entities where the patient may receive care. An increasingly mobile population also needs to have 'data following the patient.'"⁽²⁸⁾ Reduced preventable hospital readmissions are an expected outcome of improved care coordination. Increased use of HIT and, in particular, participation in an HIE are touted as ways to improve coordination of care.⁽²⁹⁾

An illustrative and rather dramatic example is provided by the recent use of an HIE in the provision of care to patients in evacuation centers during a disaster scenario. Southern Tier HealthLink, located in Binghamton, NY, was established in 2005 as a partnership between two local healthcare systems and physicians in the community. It began with funding from New York State to build the foundation for a HIE in the region, with approximately 470,000 residents, 5 hospitals, and over 800 physicians. Currently over 100,000 patients have provided affirmative consent, almost 1,900 providers and clinicians are connected, and there are 13,519 users of the patient portal.⁽³⁰⁾

In early September, 2011, Tropical Storm Lee caused flooding that displaced 23,000 residents of the area. Many patients arrived at two large evacuation centers without any medications or records. Some were transported from their homes; others were discharged from local hospitals and emergency departments directly to the evacuation centers. A significant number of these patients had complex medical problems requiring immediate attention. Many of these patients did not know their medications or dosages. Wireless connectivity at each site provided access to the HIE via the Web portal. Ultimately, 46 patient records were accessed from the HIE during the flood. A number of other patient records were accessed directly from the NextGen EHR, which is used by the UHS Healthcare System. Records could be viewed by the healthcare providers and then printed out if necessary. Of particular importance was the availability of medication and allergy information that otherwise would not have been known. In many cases, this allowed care to take place at the evacuation centers, rather than having to transport patients to the hospital to be admitted or readmitted.⁽³¹⁾

SOCIAL MEDIA

The adoption of social media continues to grow within the healthcare arena as a platform for patients to find physicians, to interact with and find medical information, and to conduct dialogues regarding their individual medical care. According to Friedman and Gyr, the “digital life” of a patient has the potential to become a useful adjunct to their in-person visits with medical staff in a healthcare facility.⁽³²⁾ As providers continue their exploration and implementation of information technology-related tools and systems which supplement best practice case management protocols, they typically begin by delving into the root causes of why preventable hospital readmissions occur. According to Dr. Benjamin Miller, Professor of Family Medicine at the University of Colorado's presentation on Social Media and Healthcare, the four leading causes of hospital readmissions include poor patient information on possible prescription drug interactions and dosages; a lack of information of warning signs regarding when to call their physician; lack of timely post-discharge office visits; and poor transfer of information to ambulatory caregivers.⁽³³⁾ The utilization of social media/networking offers viable opportunities to address each of these post-discharge information gaps, and is proving to be an effective tool in the fight against hospital readmissions. Consequently, the increased adoption and utilization of social media tools within the healthcare arena, along with the potential of these tools to mitigate hospital readmissions, warrants further exploration by provider organizations and other healthcare entities.

Social media/networking tools such as Twitter, Facebook, YouTube, and text messaging each provide unique vehicles to distribute information to patients, and more importantly these tools create a two-way feedback loop. Facebook, with over 800 million users and with the ability to send private messages, may be a viable avenue for post-release patients to interact with their primary care physician (<http://www.facebook.com/press/info.php?statistics>). YouTube can be used as an extended training source for released patients. YouTube vignettes can be customized based upon condition for education on warning signs as well as medication information. For example, ChannelCare Digital Signage Program for Improved Performance does just this in their video available on YouTube (http://www.youtube.com/watch?v=I_Xn1NGhUuQ). Short message service (SMS), also known as text messaging, is another useful tool.

Short Message Service (SMS) – Text messaging is a highly relevant medium of communication. The mobile phone platform has a wide adoption rate. Eighty-five percent of Americans own mobile phones according to the PEW Research Center's Internet and American Life Project. Health-related text messaging can link patients to online-content related to post-release guidelines. SMS messages can be sent to recently released patients reminding them of appointments, post-release care protocols, medication regimens and times, and referring them to informational sites or educational events on media such as Second Life. Text messages can also be sent to providers informing them of a patient's response or lack thereof. According to Jack Hershey, Microsoft's general manager for U.S. Public Section Health and Human Services, solutions such as Denver Health's Chronic Condition Management Platform can have an immediate impact on re-admission rates and are replicated and implemented as part of any hospital or clinic's at-home chronic condition management program.⁽³⁴⁾ The University of Miami School of Medicine and the Cleveland Clinic are using similar CCM platforms. Miami is using SharePoint as a Web portal and Microsoft Office Communications Server as an instant-messaging tool.⁽³⁴⁾ Telephone-based systems are another tool increasingly being utilized to reduce hospital readmissions.

Telephone – Phytel is an application which auto dials recently released patients to remind them of follow-up activities, or to take their medications. The messages are tailored based upon the patient's condition.

Phytel sends patient satisfaction surveys to patients within three days of discharge to ensure that they understand their care instructions. Non-responses are programmed to trigger a call from the hospital. According to C. Edward Brown, CEO of the Iowa Clinic, “by using Phytel to maintain contact automatically with patients between visits, our providers have greater assurance of meeting clinical standards of care.”⁽³⁴⁾ Twitter is another popular tool with the potential to gain widespread utilization within the industry.

Twitter and Facebook – Future reference guides can be made available by access to Twitter. For example, hospital post-release accounts can be set up with informational messaging and reminders for patients who are being released from the hospital. Johns Hopkins Hospital offers a comprehensive and interactive approach using social media to provide health information and to refer patients to needed online or offline resources. Johns Hopkins Hospital uses Twitter to refer patients to the organization’s Facebook page. Additionally, patient Twitter accounts can be used to distribute information that link patients to information regarding their diagnosis and post-discharge protocols. These accounts can also be used to provide links to community-based transportation and support groups. Alternatively, physician and caregiver Twitter and Facebook accounts can also be used to keep providers informed of the progress of their patient’s discharge.⁽³⁴⁾ SecondLife (SL) is another potential social media tool.

SecondLife – SecondLife (SL) is a 3D alternate reality universe with a member (resident avatar) that provides outreach to a professional, educated, and aging population. Eighty-five percent of its participants are adults 25 – 45+ years in age.⁽³⁵⁾ SL already houses destinations for leading healthcare organizations such as the Mayo Clinic, which provides events, seminars, and books on health. Events can be organized on a routine basis around hospital post-release best practices. A dedicated SL destination can also be organized. SL is capable of having question and answer interactions between the sponsor and the resident avatar using local instant messaging or direct instant messaging, or through voice capability.

CLOUD TECHNOLOGY AND MOBILITY – APPLICATIONS AND ISSUES

As budgets tighten, both the government and the private sector are looking for ways to decrease overall healthcare expenses. Avoidable hospital readmissions cost Medicare ~\$12 billion per year⁽³⁶⁾ and drive down patient satisfaction. A recent Agency for Healthcare Research and Quality (AHRQ) study found that 75% of hospital readmissions are preventable.⁽³⁶⁾ The AHRQ study found the factors leading to avoidable hospital readmission rates include, but are not limited to, the following:

- The quality of post-discharge nursing home, home health, and primary care;
- The level of patient understanding and adherence to discharge instructions;
- Adverse drug events/interactions; and
- Lack of a timely post-discharge physician visit.

To reduce avoidable hospital readmissions, healthcare providers may want to consider the use of cloud computing and mobile technologies. With the rise and improved performance of mobile devices and connectivity options for physicians, other care givers, and patients, the technology of the cloud is evolving to play a larger role in post-acute care and prevention of readmissions of patients with acute and chronic illness.

Few would argue that the ability to closely follow, and ensure compliancy to prescribed protocols leads to better outcomes and lower readmission rates. The demands on multidisciplinary care teams today, led by physicians, create a unique set of challenges that the elements in the cloud can help to mitigate.

Mobility – Mobility is a critical benefit of cloud technology. Improvements in smart device connectivity and the ubiquitous accessibility of the Web (hospital, Starbucks, and your own mobile hotspot on the road) mean that physicians have access to resources traditionally available to them only when tethered to a PC. Additionally, mobility offers the option of a more flexible work day given the ability to be less dependent on the “desktop” PC. A sample of mobile technologies to consider includes:

- **Telemedicine** – Electronic communication for consultative, diagnostic, and treatment services;
- **Mobile Health (mHealth)** – Use of integrated mobile telecommunication and multimedia technologies within mobile and wireless healthcare delivery systems; and
- **Remote Monitoring Devices** – Routine testing performed on a patient post-discharge with results conveyed to a healthcare worker in real time.

Online Tools and Reference Materials – Mobility and connectivity provide for finger-tip access to tools for discharge planning, medication efficacy and interaction checking, diagnostic information (test results, labs, etc.) and much more.

“Traditional” Technology Accessibility – Cloud technology further offers more options for providers wishing to adopt an EMR system. The cloud has enabled Software as a Service (SaaS) and Application Service Provider (ASP) models for EMR software solutions. These solutions reduce the cost of implementation and ownership of an EMR with a greater degree of penetration in the provider community. Coupling ambulatory EMR access to HIE data and virtual private network (VPN) access to hospital-based EHRs, offers providers multiple options to access patient data and guide follow-on care. From a patient perspective, the convenience of daily monitoring and automated data reporting provided by TeleCare solutions can mean fewer trips to their PCP or the hospital.

Personal Health Records and Health Information Exchange – Both PHRs and HIE provide for an enhanced culture that supports continuity of care with patients being tracked and managed by multiple providers. Comorbidities are better managed across the patient’s various specialty encounters when all providers have access to the patient’s information.

Hospitals have realized the potential benefits of mobile applications across the care continuum and are implementing enterprise-level mobile solutions to improve productivity and reduce medical errors. CompTIA data indicates that almost one-third of providers currently use their smart phones or tablets to access electronic medical record (EMR) or EHR systems, with 20% expecting to start engaging in this mobile usage within the next year.⁽³⁷⁾ The providers can now be quickly alerted to emergency situations.

Further, the Motorola Enterprise Mobility Healthcare Barometer found that respondents’ usage of key mobility applications attributed to a 31% reduction in manual errors. Medication mistakes are among the most common medical errors in the U.S. It is estimated that medication mistakes harm at least 1.5 million people and cost \$3.5 billion every year. This study also revealed that mobile workers within a healthcare environment utilizing several key mobile applications were able to recover approximately 39 minutes per day, which can lead to greater patient care and/or reduced payroll costs.⁽³⁸⁾

Reductions in medical errors, increases in productivity, and mobile access to patient records can all help reduce hospital readmissions and are benefits of both the cloud and mHealth. However, there are also risks and impediments to adoption and broader utilization to consider before adopting these technologies. These include, but are not limited to:

- Connectivity isn’t always ubiquitous. And, even with connectivity, a specific ASP or SaaS EMR may be down due to local service issues.

- The privacy of patient information and data security both in storage and transmission are at physical and electronic risk. Unless the data is protected through encryption software or the device is protected through an authentication feature, such as a password or biometrics, the data may not be secure. Mobile devices retain a record of the data on the device and, therefore, expose this data to unauthorized disclosure.
- The importance of using a common clinical language, such as ICD or SNOMED is critical as the meaning of data can vary from system to system.

The use of “remote patient monitoring technologies (RPM) [can]...reduce avoidable readmissions rates by improving coordination across the continuum of care and promoting seamless transitions from the hospital to home, skilled nursing care, or home health care.”⁽³⁹⁾ However, the use of mobility in health-care (mHealth) also raises the risk of protected health information (PHI) being compromised. This leads to issues regarding violation of patient privacy rights.

The trend toward greater utilization of mobile devices to exchange PHI is of concern because the Health Insurance Portability and Accountability Act of 1996 (HIPAA) specifies covered entities are accountable for the actions of their workforce.⁽⁴⁰⁾ HIPAA outlines national standards designed to protect individuals’ electronic PHI that is created, received, used, or maintained by a covered entity.⁽⁴⁰⁾ Covered entities may include mobile devices used to track, monitor, store and/or exchange PHI. Therefore, covered entities must identify and establish administrative, physical and technical safeguards to protect PHI.

The use of mHealth products as well as services by clinicians and health systems further raises possible medical malpractice issues. Medical malpractice is defined as “negligence committed by a professional healthcare provider—a doctor, a nurse, a dentist, a technician, a hospital, or a nursing facility”—whose duty of care “departs from a standard of practice of those with similar training and experience, resulting in harm to a patient.”⁽⁴¹⁾ Healthcare providers may face claims, for example, that mHealth devices were negligently deployed, resulting in an avoidable harm to the patient. Patients, in turn, may bring a claim against the healthcare practitioner using the device. The risks associated with improper use of mHealth devices and/or services are real and need to be addressed by hospitals and clinicians alike to avoid medical malpractice claims.

The current demographics of those likely to benefit most from the use of mHealth are least at ease with the cloud. Aging baby boomers may be less techno-phobic as they begin to seek ongoing healthcare services for chronic conditions. Time is required for this and for all users to develop comfort and confidence with the reliability, dependability and security of the technology.

In summary, the application of mobile technology to reduce hospital readmissions has tremendous potential. Risks to patient privacy and data security are issues that must be addressed through proper safeguards, such as policies, procedures, and technologies. With the right mix of innovation, use, and oversight, mobile technology and the cloud can have a beneficial impact on providers, payers, and, most importantly, patients.

ROBOTICS

The use of robotics in healthcare is an emerging technological field which promises significant gains in quality of life at lower costs based on improved efficiency, precision and ability to perform repetitive tasks accurately. Several innovators have developed prototypes which have been shown to be safe and effective in early trials. This area of healthcare is set for rapid growth in the next decade as the public recognition for improved quality of life becomes more apparent along with the expected growth of the aging population and the projected shortages of qualified workers in the healthcare field.⁽⁴²⁾

As the costs of care continue to escalate, the usefulness of semiautonomous or even autonomous robots will be recognized as beneficial alternatives to the traditional forms of healthcare. Although robotics is still in its infancy, several innovative products have been developed and are in current use throughout the world. As this technology continues to improve, its effect on care transitions will be seen as a positive step forward in the care of the chronically ill.

Benefits of Robotics – Robot-assisted surgical procedures have been in use since the mid 1980s. In the U.S., the first FDA-approved surgical robotic system was in 1994. It was developed by Computer Motion under a NASA funded research grant. Known as the ZEUS Robotic Surgical System, it was first used in the U.S. for reanastomosis of a fallopian tube in 1998. This company merged with Intuitive Surgical, the maker of the da Vinci Surgical Robotic System in 2003. It is estimated that more than 48,000 robot-assisted surgeries have been performed.⁽⁴³⁾ The benefits have included more precise incisions with improved optics, less pain and scarring, and a shorter hospital stay.

Independent Robotic Assistance – Use of prototype robotics has been demonstrated at nursing care facilities. With minimal patient instructions taking approximately 5 minutes, a robot assistant has been able to complete a task of providing a timed reminder for a scheduled appointment (e.g., physical therapy appointment) with the patient, assisting the patient with walking down the hall to the appointment and providing information after the successful delivery of the patient to the physical therapy room.⁽⁴⁴⁾

Sustained Robotic Activities – Rehabilitation following a stroke or other central nervous system injury usually requires extensive repetitive activities under the supervision of a therapist. Researchers in Switzerland have developed the Lokomat which uses a robot to automate the patient's training while doing treadmill exercises. This system employs sensory feedback to adapt to the patient's behavior, which improves the natural body movements of hip, pelvis and lower extremities.⁽⁴⁵⁾

Economic Benefits – Initially, the costs of new technology, including robotics, are difficult to justify for patient care. As technology matures and costs fall, the economic driver of labor reduction will be a prime factor for robotic usage. It is expected that the increasing growth of the aging population and the reduction in numbers of the younger population, who make up the healthcare workforce, will require more alternatives to satisfy quality of life issues. The robotics industry is poised to take advantage of these economic patterns.⁽⁴⁶⁾

Robotics for Inpatient Care

Interactive Bedside Monitoring – Developments in nursing robotics are expected to improve the efficiency of patient monitoring during the patient's hospital stay, alerting the nurse to various changes in vital signs and patient movements. Also, robots with telepresence features will allow an interactive virtual consultation with the patient's doctor.⁽⁴⁷⁾

Assistance with Physical Tasks – Several types of robots are in development to assist the bedside nurse with physical tasks such as lifting the patient, changing beds and assisting with patient bathing.

Robotics for Rehabilitative Care

Aids for Rehabilitation of Stroke Patients – Demographic data indicates that increasing numbers of the aged population are surviving strokes and require extensive rehabilitation to regain a useful quality of life. To address the needs of these patients, it is anticipated that rehabilitative robots will be able to augment the activities of a physical therapist, improve quantitative data through sensing technologies to support rehabilitative support and improve the speed of recovery.⁽⁴⁸⁾

Robotized Motor Prosthesis – The research on limb prosthesis continues to progress. Intelligent prostheses such as those for replacing the function of the hand are under development with improved

degrees of freedom, allowing for a more natural grasping function. Built in detection systems provide force feedback to prevent damage to items being handled.⁽⁴²⁾

Robotics in the Smart Home

Robot Assistants for Activities of Daily Living – Prototype robots designed for assisting the elderly with activities of daily living are being developed at the University of Pittsburgh, the University of Michigan, and Carnegie Mellon University. Robots fitted with video and audio constitute telepresence capabilities that allow interactions with healthcare workers at a remote facility. It is anticipated that these robots will be able to reduce the need for expensive trips to a provider's office.⁽⁴⁵⁾

Robotics for Memory Impairment – Memory impairment is correlated with advancing age, which is expected to significantly increase over the next few decades. Robots may prove invaluable to this population as the desire to remain at home and retain a maximal amount of independence becomes more acceptable. Personal robotic assistants are being designed to model the client's daily plans by tracking the client's observable behavior and making "decisions about whether and when it is most appropriate to issue reminders."⁽⁴⁹⁾

Robotics for Social Interaction – This area of robotics is still in its infancy. Research for robotics to assist in cognitive and social therapy stands to provide better monitoring systems that have the ability to learn from observed behaviors so that interactions can be more meaningful. Robots that are designed as replacements for pets or provide gaming interactivity will prove to be useful with Alzheimer's patients suffering from early dementia.⁽⁵⁰⁾

Robotics of the Future

Transition to Cybernetics – Some researchers have postulated that future robotics will merge with human biosciences to create a cybernetic human known as a cyborg. The initial desire for this capability will be to enhance the quality of life for those with severe disabilities. Others have voiced the ethical concerns over extension of life with this technology.⁽⁵¹⁾

Nanobots of the Future – If forecasts prove accurate, nanotechnology stands to revolutionize the field of medicine. This technology, linked to micro-engineering of organic bots, will serve to enhance delivery of medications to target organs, provide early diagnostics at the cellular level and assist with molecular tissue repair.⁽⁴²⁾

In summary, the field of robotics has grown tremendously over the past decade and is making great strides to assist in the care of chronically ill and debilitated patients. As the age of the population increases, it will become increasingly important for those involved in healthcare policy to consider assistive robots as adjuncts to therapy for these patients.

INNOVATION TO ADDRESS AVOIDABLE READMISSIONS

The pace of technology innovation in healthcare is significant—alternatives in technology, process, and applications are substantial and ever increasing. The role of innovation in driving toward lower readmissions is multi-part and the "consumer" faces a number of challenges.

Certainly, innovation in mobile computing devices and ubiquitous connectivity are driving use of cloud-based solutions as discussed elsewhere in this paper. The future success of innovation in addressing readmissions is best defined as the ability of individuals and organizations to aggregate the options currently available, or in development, into a dynamic and practical solution that will address their organization's unique challenges. The array of ever-changing options for software, hardware, mobility, connectivity, and information growth requires users to focus on solutions to their challenges, while at the

same time resisting an urge to adopt innovative solutions just for the sake of innovation. Piecing together the right form—whether phone, tablet, laptop, desktop—with the right software, and the right connectivity solutions will assist in determining the most desirable solution to prevent or reduce hospital readmissions.

The issue at hand is to define the right combination. Configurations stand to vary based on whether you are an employed hospital clinician, a provider of care working in multiple locations, or the patient. The resources needed by a provider are different from those needed by the patient or a hospital clinician. Access, scope of information, speed to information, all differ. Innovations in technology stand to outpace the ability of organizations to determine optimal use. A classic example is Microsoft Office. Of all the features and functions available for use within this software package, how much is routinely used? Users can hide behind by the 80/20 rule, but in reality, most users probably only use about 5% of the functionality available within this software package.

Cost Factors – There are costs associated with innovation and there is always a choice in adoption of innovations. Individuals or organizations that choose to be on the leading edge of change often pay a premium for this privilege. The benefits to early adoption are not always clear. Early adopters generally pay a higher cost to acquire the technology, assume higher risk in finding defects with the product, and experience less organized support from the developer. In many instances, the support provided is “just in time” as the organization will be working with the developer to refine the product. The decision to adopt an innovation early on in its life cycle is one that must be weighed carefully against meeting the needs of the organization in ways that cannot be met with existing, perhaps “proven,” technology.

Management and Leadership – Setting a Vision, Pace, Benefit, and Risk – Organizations traditionally struggle in managing the challenges of innovation. Allowing individual groups of users, or consumers, to define the needs and expectations of an innovation can be difficult to manage. Careful attention to multi-use technologies as opposed to one-off selections will keep total costs related to acquisition, implementation, education and support lower, and ultimately provide a better solution for the healthcare facility.

Pilot programs and cooperative development allows an organization to explore the benefits of different solutions, while managing cost and exposure. For some individuals the decision to adopt innovation is personal. These individuals believe that the organization must have the newest gadget available. For others, they see the tried and true as less risky and would prefer to live within the confines of a slightly older solution. Both of these approaches pose a tradeoff and a risk. Aggregation of multiple technology innovations into a solution where a plurality will find comfort is what should drive the decision-making as it relates to innovation.

Obsolescence – The pace of technology innovation can be phenomenal. Technology users risk the obsolescence of their solutions due to natural upgrade opportunities. To stay current, an organization must remain on the upgrade pathway.

Moore’s Law states that more likely than not, central processing unit (CPU) power will double every 18 months. This shows how rapid CPU advancement has come and gone in just the last decade. Aside from CPU power, mass storage capability, communications speed, and miniaturization efforts have all contributed to a technology infrastructure that has enabled a self-perpetuating, world-wide consumer market for innovation. As innovation becomes affordable, it changes the way organizations do business to meet their stated mission. This phenomenon is seen in every industry, including healthcare.

Innovative Leadership within the Organization – The innovative leader is one with a vision for the future and a passion for motivating others to achieve this goal without reservation. An innovative leader

sees the capability of up and coming technology and drives the vision for use into the fabric of the organization.

Steve Jobs demonstrated an exceptional ability as a transformational leader. Transformational leadership is the theoretical model grounded in moral foundations.⁽⁵²⁾ Not everyone has the ability to become an effective transformational leader. One of the characteristics of a leader is to inspire or engage employees to adopt a vision and goals. Landale⁽⁵³⁾ expresses that an effective leader focuses on how to make people successful by having the ability to listen, encourage and enthuse. An effective transformational leader can therefore include workers, managers, technical librarians and others who perform in collaboration across boundaries within changing and innovative organizations. Welch⁽⁵⁴⁾ suggests that organizations select workers who exhibit: (1) positive energy, (2) an ability to energize others, (3) the ability to make tough decisions, and (4) passion about their work. Such people are effective transformational leaders. Each of the leadership dimensions mentioned above translates directly to the effectiveness of a transformational leader.

In summary, innovation:

- Is constant in the technologies, processes and techniques supporting healthcare delivery.
- Must be combined into systems that work together to address specific issues such as reducing avoidable readmissions.
- Requires leadership (vision and transformational) to effectively leverage innovation and manage its incorporation into organizations.
- Is recognizing that adoption of innovation comes with choices and costs that must be balanced along with risks and rewards.
- Presents different perspectives based on who will be the consumer of the technology.

The role of innovation in reducing avoidable hospital readmissions focuses on managing these elements and reaching a state where the maximum benefit can be realized for the providers, caregivers, and patients. Given the financial pressures on the healthcare community, new technology, and new perspectives on old technology, will drive innovation that will assist in negating avoidable readmissions.

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