

Old Age, New Technology, and Future Innovations in Disease Management and Home Health Care

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The nation's nearly 80 million baby boomers are about to enter their peak years of chronic disease and are set to become an unprecedented driver of health care costs. New technology, however, promises to enable a transformation in the delivery of care, putting patients at the center of care systems that engage and empower them and their families, directly connecting patients to caregivers, and personalizing services in response to patients' unique needs, preferences, and values. Such care systems also offer the promise of strengthening an understaffed, underresourced home health care industry. Leveraging technology, disease management (DM), and home health have the opportunity to work together to more efficiently and effectively meet the needs of a rapidly aging society through better coordinated care that reduces avoidable hospital readmissions and other adverse events. This is achieved by positively affecting such things as home safety (e.g., falls), medication adherence, nutrition, and heart failure.

ALTERNATIVE FUTURES FOR HOME HEALTH CARE AND DISEASE MANAGEMENT (DM)

Although aging and disease have always been a part of society, future demographic trends, economics, and a new set of expectations of today's and tomorrow's older adults demand a rethinking of how home health care and DM might be delivered. These socioeconomic

factors and others have been translated into dire forecasts that predict astronomical health care costs, diminished quality of life, and a health care system that teeters on the breaking point. However, the potential of an impending crisis to capture and focus the attention of the public, policy makers, and health care professionals, combined with the ready availability of new technologies, may actually create an opportunity—an opportunity to envision and implement new ways of delivering home health care and DM services that will not only respond to the “disruptive demographics of an aging society” but also improve health care for all (Coughlin, 1999).

Consider the following alternative scenario: An elderly person who has diabetes and chronic obstructive pulmonary disease (COPD) is beginning to show early signs of Alzheimer's. On doctor's orders, a home health care nurse visits the patient periodically. The nurse takes the patient's vitals, tests blood glucose, and conducts spirometry and pulse oximetry to check pulmonary function blood oxygenation. The nurse verifies that the patient is doing well. Between visits, home health care cannot monitor the patient's condition. A week or so later the patient has forgotten to take his medications, experiences a pronounced desaturation of oxygen, and is hospitalized. The patient is now at high risk, increasing his family's stress, and further stressing limited health resources.

Key Words: chronic disease; disease management (DM); risk stratification; telehealth/telemedicine; aging; technology

Now imagine that same patient in an advanced DM program like those available, but not yet pervasive, today in traditional home care programs. As a participant in a DM program, the patient has a home health telecare unit in his home that features diagnostic peripherals (a blood pressure monitor, glucose meter, and combination spirometer and/or pulse oximeter). Clinical data from the unit is automatically streamed and transmitted to a centralized DM workstation, and the nurse assigned to the patient reviews the data, which is automatically formatted in a report that trends the patient's information. If the data are not transmitted at the scheduled time each day, the telecare unit beeps an audible warning, and a digital voice reminds the patient to do his testing. In addition, an alert pops up on the DM nurse's workstation. Thus, intelligent integration and use of technology keeps the patient connected for ongoing monitoring to prevent complications, improves the quality of life of the patient and his family, optimizes the use of home health service resources, and ultimately appropriately manages the costs to public and private insurers.

Such technology is coming into use today, and innovation is dynamic. Technology is rapidly advancing, is more widely available, and is becoming more affordable. The availability of small and passive sensors that can seamlessly detect and report vitals, care management systems that can improve adherence to diet and medication guidance, communications that improve collaborative decision making between patients, families, and caregivers all promise to enable the transformation of care delivery. DM programs in many instances are already serving as a coordinator of patient information and care, leveraging technology to allow experienced and advanced practice nurses the ability to reach and educate thousands more patients than would be possible in a traditional care setting. As technology advances and society ages, DM services offer even greater promise as aggregators of data across the health care continuum—including home health—providing DM nurses an even greater opportunity to act on the information before them. The ability of DM to increase the capacity of nurses to meet increasing demand for complex care management is important given the predicted nursing shortage. To understand this transformation and the promise of technology to make real innovation possible, it is useful to understand how DM has evolved to date.

THE HEALTH AND BUSINESS CASE FOR DM

As corporate America's concern about escalating health care costs intensified in the 1980s, Blue Cross Blue Shield plans and other insurers, often pressed to take action in response to direct demands from their major business customers, began to organize and analyze health data. In many instances, employers and insurers were assisted by specialized firms (such as Medstat, the Health Data Institute, and Corporate Health Strategies), founded by entrepreneurs from various academic medical centers. These firms pioneered the development of analytic databases from medical claims and insurance eligibility data by creating algorithms to link and consolidate individual claims into complete episodes of care. For the first time, many of the nation's largest employers began to get a detailed look at the patterns of diagnoses and service utilization driving their health care costs (Aquilina, 1990; Aquilina & Louiselle, 1992; Gotowka, Jackson, & Aquilina, 1993).

Case Management

A basic picture came to light. Data analysis revealed the essential shape of the population-cost curve that most health care and medical management professionals today readily understand. About 5% of the individuals in a commercially insured population typically account for 50% or more of the group's total health care expenditures (Royer & Shaw, 2003). As this picture came into focus, more in-depth analysis uncovered a large number of catastrophic cases among the small number of high-cost claimants. "This emerging understanding propelled case management forward into the mainstream of medical management and health plan operations" (Keim, 2003, p. 24). Insurers and health maintenance organizations (HMOs) started to develop case management departments, and case management consultants and companies entered the health care marketplace. Experienced nurses were recruited and hired as case managers. Their basic resource was their clinical experience. Their primary technology was the telephone.

Initially, case management took primary aim at catastrophic cases: low-volume, high-cost events, including brain tumors and spinal cord injuries. Cases were identified from current claims. Thus, when nurse case managers got involved, substantial costs had usually

already been incurred. The nurses worked to facilitate communication among patients and their families, their primary care physicians, specialists, hospitals, and patients' health plans. Their goal was to ensure that a specific plan of care was formulated, implemented, and coordinated. Case managers frequently negotiated with insurers' benefits departments to secure exemptions to benefit coverage exclusions or restrictions (e.g., to cover extended home health care) to move patients to more appropriate and lower cost care settings.

DM Emerges

Case managers also encountered cases involving patients with chronic diseases whose conditions were not well controlled, leading to complications and precipitating high-cost medical crises. This was the well-documented gap in care for patients with chronic diseases that drove the emergence of DM. Disease management today is defined by the Disease Management Association of America as

a system of coordinated health-care interventions and communications for populations with conditions in which patient self-care efforts are significant. Disease management

- supports the physician- or practitioner-patient relationship and plan of care
- emphasizes prevention of exacerbations and complications utilizing evidence-based practice guidelines and patient empowerment strategies
- evaluates clinical, humanistic, and economic outcomes on an ongoing basis with the goal of improving overall health.

[DM] components include

- population identification processes
- evidence-based practice guidelines
- collaborative practice models to include physician and support-service providers
- patient self-management education (may include primary prevention, behavior modification programs, and compliance and/or surveillance)
- process and outcomes measurement, evaluation, and management
- routine reporting and/or feedback loop (may include communication with patient, physician, health plan and ancillary providers, and practice profiling).

Full-service [DM] programs must include all six components. Programs consisting of fewer components are [DM] Support Services. (Disease Management Association of America, n.d.)

INNOVATION IN DM: RISK IDENTIFICATION AND STRATIFICATION

In the 1990s, DM confronted a basic fact: Not all patients with the same chronic disease have the same overall medical needs. Consider an individual with diabetes whose condition is well controlled. Contrast that individual with another person with diabetes with a low-density lipoprotein (LDL) cholesterol level exceeding 130 mg/dL, a hemoglobin A1c (HbA1c) greater than 10%, systolic blood pressure pushing well above 130 mm, and who smokes a pack of cigarettes a day. Both have diabetes. However, they have vastly different levels of health risk. The DM interventions appropriate for one may not be relevant for the other. Without a more accurate way to identify risk and deliver appropriate services, patient health status could potentially deteriorate, and precious resources would be wasted when leveraged inappropriately or avoidable emergent care occurred.

Advanced Care Management: High-Risk, Complex Populations

The realization that high-risk, complex populations needed further stratification for risk and matched intervention protocols led health plans and DM organizations to develop predictive modeling programs. These programs stratify individuals identified with specific chronic conditions into different levels based on the predicted risk of future high costs. For any of the chronic conditions commonly addressed in DM (see Table 1), populations can be segmented into low-risk and high-risk groups. The intensity and content of resources and tactics can then be matched to levels of health risk. For those at low risk, health promotion and evidence-based standards of care self-management initiatives are appropriate. More intensive 1:1 telephonic nurse interventions can be directed to those at higher risk, who can represent 10% to 30% of commercially insured populations. Unlike case management, which focuses on in-patient care when higher cost utilization is already occurring, care management, which aggressively and proactively addresses care across the continuum (all practice settings), emerged.

As DM organizations, employers, insurers, and health plans implemented and refined DM programs in the 1990s, they encountered another issue. Programs that were designed to address the needs of those at varying levels of health risk within specific disease cat-

TABLE 1
Conditions Commonly Addressed in Disease Management

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- diabetes
 - coronary artery disease
 - congestive heart failure
 - chronic obstructive pulmonary disease (COPD)
 - asthma
 - chronic kidney disease
 - end-stage renal disease
 - cancer
 - depression
 - tobacco addiction
 - osteoarthritis
 - acid related stomach disorders
 - chronic back pain
 - hepatitis C
 - osteoporosis
 - irritable bowel syndrome
 - decubitus ulcers
 - atrial fibrillation
 - urinary incontinence
 - inflammatory bowel disease
 - fibromyalgia
-

SOURCE: American Healthways. Used with permission.

egories did not always effectively serve those at highest risk, because they often have multiple medical conditions and complicated psychosocial problems. Thus, DM organizations that had significantly advanced their methodologies to identify, segment, and assist patients with particular chronic conditions expanded their approach to address the more complex needs of patients with multiple chronic conditions.

Low-Prevalence, High-Impact Subpopulations

In addition, within the 5% of the typical population who account for 50% of total health-care expenditures, those at the highest level of risk represent 1% or less of the population, yet account for 20% to 30% of total costs. They are highly complex patients, from clinical and psychosocial standpoints. Patients of all ages, but particularly the elderly, tend to have multiple conditions, which cut across many individual diagnostic categories. Up to 45% of the highest risk segment has five or more distinct diagnoses, each of which can be the focus of condition-specific DM. In contrast with individuals with diabetes, whose levels of health risk may accelerate and moderate over time, the highest risk segment is always in flux, with up to 15% monthly turn-

over (Forman & Kelliher, 1999). Advanced data mining capabilities of mature providers brought these performance improvement opportunities to light.

The health problems of those at greatest risk often isolate them from family, friends, and coworkers. The aging population, many of whom are aging alone, are often at the greatest risk of isolation. Cycles of isolation, subclinical depression, and deterioration of health status can send them on a downward spiral. And many people at highest risk tend to be disconnected from care systems and/or are receiving disjointed care. Health plans and some DM organizations have begun to make that connection by expanding their intervention set along the medical management continuum, integrating case management, DM, high-risk care management, and behavioral health services to better address the total health care needs of the most costly populations. Care management systems aggressively provide personalized, evidence-based care on an individual and population level.

Advanced Predictive Risk Algorithms

Some DM organizations refined their risk identification and stratification methodologies to identify highest risk individuals with predictive algorithms based on emerging clinical complexity and impending high costs (Forman & Kelliher, 1999; Glynn & Patel, 2004). These methodologies account for changes over time in the highest risk population segment as individuals' levels of imminent risk fluctuate. As a result of these advances, many health plans have complemented their DM programs with specialized, health management services focused on their highest risk population segments. By directing intensive management services to those at highest levels of predicted risk, they have improved the health status of those members while reducing avoidable, excessive utilization and cost rates, achieving 25% to 30% decreases in per member per month (PMPM) costs for those at highest health risk (Isham & Kraemer, 2003; Keim, 2003; Royer & Shaw, 2003). The excessive utilization targeted is reduction of avoidable emergent and/or acute care by proactive leveraging of care management resources. This reduction not only reflects improved health status but also reflects improved patient safety (patients have less exposure to potential risks, hospitalization, or emergency room [ER] care). The PMPM cost-reduction strategy is similar to the home care strategy to reduce cost per "episode of care" for patients with Medicare as

the payer in the current Prospective Payment System (PPS).

DM Outcomes

Disease management programs focused on individuals with one or more core chronic conditions—such as diabetes, congestive heart failure, COPD, and asthma—have reduced annual per-member costs by as much as U.S. \$500, reduced ER visits 18%, reduced hospital admissions 14%, and reduced total health care cost trends 200 to 300 basis points (Gold & Kongstvedt, 2003). Results within the first 30 months of a DM program for members with diabetes in a Medicare Cost Plus plan (Mayes, 2003) showed

- a 16% reduction in hospital admissions per 1,000 members with diabetes compared to a 7% increase for members without diabetes;
- a 2% increase in ER visits per 1,000 members with diabetes compared to a nearly 20% increase of members without diabetes; and
- total gross savings of \$14.7 million and a 3% cumulative decrease in PMPM costs for members with diabetes compared to a 20% increase for members without diabetes.

Results within the first year of a DM program for members with congestive heart failure or coronary artery disease in a Medicare Cost Plus plan (Mayes, 2003) showed

- an 8% reduction in patient admissions per 1,000 cardiac members compared to a more than 28% increase for noncardiac members;
- a 6% increase in ER visits per 1,000 cardiac members compared to a 20% increase for noncardiac members; and
- total gross savings of \$4.9 million, and an increase in PMPM costs of less than 3% compared to a 17% increase for noncardiac members.

In addition, first-year results of a CIGNA HealthCare diabetes DM program for more than 43,000 members enrolled in the program in 10 major U.S. urban areas across 12 states showed average cost declines of 5% to 8%, with the most significant source of savings from a decrease in hospitalizations. As expected, pharmacy costs for the group rose as members were encouraged to comply with medication regimens. Improvements were demonstrated in six key indicators of quality in diabetes care: dilated retinal exam, lipid testing, HbA1c

testing, micro albumin testing, prescribed angiotensin converting enzyme (ACE) inhibitors or angiotensin receptor blockers (ARBs), and tobacco use (Villagra & Ahmed, 2004).

Mature DM Providers

With mounting evidence of clinical and financial outcomes improvement and increasing adoption of DM programs by health plans, employers, and government, advanced DM organizations have evolved into providers of integrated population health management, which features (a) intensive care management for individuals at the highest level of risk for deteriorating health status and highest costs; (b) chronic DM, tailored to calibrated levels of health risk, for those with specific chronic conditions; and (c) personal health management focused on prevention and self-management for those at lower levels of predicted health risk. As this evolution continues, many in the DM industry continue to customize services, leveraging learning and new technologies to increasingly adapt to each unique individual, offering tools and management techniques tailored to maximize appropriateness, responsiveness, convenience and impact. To this end, patient quality of life and satisfaction is addressed with individualized patient-centered care.

USING TECHNOLOGY TO DEVELOP NEW CONNECTIONS WITH OLDER PATIENTS

Whereas home health care services have traditionally delivered by touch, DM services predominantly connect with patients by telephone, Internet, and mail. Some increase in onsite nurse interactions will occur as DM services are introduced into the Medicare fee-for-service population because approximately 5% to 8% of beneficiaries reside in an institutional care setting. Together, home health and DM services offer an opportunity to provide a blanket of care that further improves health, wellness, and outcomes. During care calls, DM nurses discuss the at-risk member's current condition and symptoms, current medication regimen and adherence, the physician's care plan, self-care and behavior change goals, readiness to change, and self-care skills. DM nurses strive to build trust based on patient-centered, culturally and/or linguistically appropriate education in self-care, consistent therapeutic communication of positive intent, and encouragement and support for at-risk individuals to define and take specific

steps to improve their health status. Frequencies of contacts, and the focus of care plans, are calibrated based on risk stratification levels, and data is collected and reported regarding care management goals progress and specific targeted outcomes.

Nurses in DM today use specialized software applications to organize and manage their work, track the latest in standards of care and evidence-based medicine, and coordinate claims, pharmacy, lab, home monitoring, and patient-provided information. Such systems summarize patient data, present the appropriate chart to the disease manager before each call, and provide disease-specific tools (e.g., assessment tools tailored specifically to each of the primary diseases managed and disease-specific health education and self-care resources). Disease management applications also include tools for managing the process. Nurses use the software to schedule future calls and tasks and track care plans.

Traditional home care programs have implemented some specialized software programs; however, they are usually focused on the Medicare population either off the shelf (purchased from a vendor) or developed specific to their population (based on retrospective data mining of their historical Medicare population data). For example, targeted OASIS, medication, equipment and/or supply, and cost data are viewed together in Web-enabled, disease-specific applications. These systems provide efficient viewing of focused individual patient data for care management (e.g., planning visit interventions and needed plan of care changes) and advanced practice remote consultation with front-line nurses (Dailey, 2005). Some home health agencies have integrated case management software programs that cue care management automatically within their electronic documentation systems as well. However, DM programs have built and/or bought and/or integrated sophisticated systems to assess risk and then precision cue and support care management for complex populations across payers focused mainly on telephonic intervention.

Conventional DM by telephone is evolving with the introduction and adoption of telehealth technologies. According to the American Telemedicine Association, telehealth uses a wide range of information and communications technologies (e.g., telephone, videoconferencing, Internet-based devices, etc.) to provide specialist referral services, patient consultations, remote patient monitoring, medical education, and consumer medical and health information all through networked

programs; private connections linking hospitals, clinics, and specialty services; primary and specialty care to the home; and the growing range of Web-based e-patient services (American Telemedicine Association, www.atmeda.org). Many of these systems apply standard telephone or Internet technology to simultaneously transmit voice and video along with streams of clinical data from remote peripherals, such as digital blood-pressure monitors and blood glucose readers (Moore, 2005). Telehealth technologies enable voice, video, and data to be transmitted from and to patients' homes, so that physicians and nurses can "visit" patients at home without leaving their offices.

The aging of the population, its health care needs, and the availability of a wide range of novel technologies are creating a wide range of possibilities to drive innovation in and collaboration of DM and home health care. However, technological invention alone is not innovation. Understanding what needs to be done and what could be done, but is not today, puts the panoply of devices and gadgets into practical use—changing what we do, not simply doing what we do better.

Information and communications technologies provide home health care services and DM providers with the opportunity to rethink how we define and deliver care and new ways to integrate and monitor patients at risk, manage patient populations and caregiver resources, and motivate patients and their families to actively engage in their own health and wellness (e.g., through biofeedback). Instead of limited, single-purpose interventions that optimize monitoring, or those systems that enhance efficiency in the delivery of care, home health care and DM are now set to leverage technology to create an alternative vision to caring for the and elderly, and all patients who are chronically ill—an integration of high touch and high tech, resulting in a blurring of systems and services to provide quality care for existing conditions, preventative interventions to slow or stop the onset of other conditions and management strategies to reduce costs. Table 2 summarizes how technology might assist home health care and DM providers to better monitor, manage and motivate patients.

MONITORING

A wide range of communications technologies are now available and are increasingly being put into use to monitor the vitals of home-based patients. Although

TABLE 2
An Integrated Approach to Technology Use in Home Health Care and Disease-Management Services

	<i>Function</i>	<i>Technologies</i>	<i>Innovation and Outcomes</i>
Monitor	24/7 monitoring of health and activities	Intelligent devices and appliances, Internet-enabled services, predictive behavior models, and so on	Reduction of emergency events, rapid intervention to health changes and/or decline
Manage	Identify and prioritize patients requiring remote or home-based intervention	Information technology and software with embedded risk models to triage, review, and assess patient progress	Efficient use of home health care human and financial resources
Motivate	Engage, educate and empower patient and/or family in their own health	Glanceable display technologies, two-way communications, integration of fun and familiar entertainment systems to coach and connect patients, caregivers, families	Management of existing conditions and prevention of disease

SOURCE: MIT AgeLab.

many of these systems are familiar, for example, Internet-enabled weight scales or electrocardiograms (EKGs), these systems are increasingly easy to use and provide 365/24/7 coverage and data collection. Specific technology applications are going beyond the home health aide in delivery of service but helping family caregivers as well (Sheridan, Coughlin, Kim, & Thompson, 2001). For example, the use of radio frequency identification technology and even satellite communications (GPS) placed in the home or on the person are facilitating systems to track and monitor Alzheimer's patients with a high risk of wandering behavior. Similar systems are now becoming commercially available to monitor the movement of older adults who are chronically ill and live alone. These "intelligent" systems learn the regular habits and routines of the patient, for example, how they walk, what time they typically wake up, visit the kitchen, or even leave the house. These patterns might be used to identify and predict a potential problem, for example, fatigue from a new medication or a change in gait that might be a precursor to a fall. Deviation from established patterns are detected by the sensors that are installed throughout the home and reported to a call center, home health service provider, adult child, or, if more urgent, emergency services. Other systems include "smart toilets" that are able to passively monitor, measure, and communicate to caregivers changes in blood glucose, weight, body mass index, and a variety of other vitals via the Internet in a way that requires little or no technological knowledge by the patient.

MANAGEMENT

Although many technology systems exist today to improve the administrative efficiency of traditional home health care and DM, broader and more coordinated use of these technologies promises to extend the reach and touch of home health and DM providers. Heart failure offers a good example. Some five million people in the United States are living with heart failure, and more than half a million new cases are reported annually. Most patients are elderly, and one half of all heart failure patients have three or more other medical conditions. Managing heart failure is a challenge because patients and caregivers must monitor a range of factors, such as diet and weight, blood pressure, and medications. Heart failure patients should weigh themselves daily as a means to detect fluid accumulation as an early warning sign. Home monitors that prompt patients to weigh themselves, and then automatically transmit the data to a coordinating, centralized DM or home health care service, alert medical professionals if patients may be beginning to decompensate. Use of such telehealth for remote monitoring by nurses can be more effective than standard outpatient care following hospitalization for heart failure, with documented 32% lower readmission rates and 25% lower costs (New England Healthcare Institute [NEHI], 2004). And the technology can support more precise identification of the patients who would benefit the most from an actual home health care visit. Appropriately used, technology can be a great resource to home health care providers when visiting the home as well. For example, cell phones

enabled with cameras are being used to collect data on wound care and dermatological issues in a project being conducted by Partner Telemedicine at Massachusetts General Hospital. Other uses include photographing a medicine cabinet to develop a visual database of prescription and over-the-counter medications available to the patient. Home care has piloted and implemented several of the above technologies in real time and store-and-forward telehealth technology and is working to reduce the need for in-home visits to improve profitability in PPS.

Creatively exploited technology is a care force multiplier. For example, home health care nurses who might be able to manage 10 patients a day can manage 20 or 30 with telehealth technology. Patients whose conditions have already been diagnosed can be monitored as frequently as necessary, and their therapies can be adjusted without home health care or office visits. Telecare and in-home monitoring, collected and coordinated by DM organizations already skilled at providing such services, can enable more sophisticated home care as well, providing health deterioration detection and alerts prior to symptom development (Khasanshina & Stachura, 2005). As a result, telehealth boosts efficiency and increases access to medical care and DM services. The home health industry is grappling with aligning financial incentives for nurses and other interdisciplinary providers changing payment systems where payment by visit had been the predominant nurse payment system prior to PPS. A system is needed in home health so a nurse is paid to provide care management whether it is on the phone, monitoring telehealth data and so on. This conversion from a visit based to "intervention" based system is evolving in home health, setting the stage for seamless and efficient integration between home care and DM providers.

MOTIVATION

Perhaps the greatest frontier between home health care and DM is providing the motivation to pursue behavior patterns that manage disease, improve outcomes, and reduce costs. Systems that integrate technology with social networks of family, friends, and even DM partners are being developed to motivate patients to take their medication, adhere to their prescribed diets, exercise, or stop poor health behaviors, for example, smoking.

The MIT AgeLab is developing a menagerie of "Pharm Animals" that will use emotion and play (and

at times, guilt) to remind people to take their medication on time and in the prescribed dosage. One of the Pharm Animal applications is the "Pill Pet." The Pill Pet is a handheld furry toy with a small display on the front that may simply have a smiley face or a changing picture of a grandchild. The Pill Pet reminds an older adult to take their medication with an audio alarm and a worried or saddened face on the display. If the Pet does not detect compliance, it becomes sad, ill, and, over a prescribed time, dies, requiring a trip to the pharmacy or doctor to bring it back to life. Other systems include "glanceable displays" that may include picture frames, cubes, and orbs or objects that may appear to be a piece of art that change color from green to yellow to red, showing changing states of health from good to fair to poor (Coughlin, 2005).

Another example now entering the U.S. market leverages the nearly ubiquitous cell phone. One company in partnership with a major telecommunications provider is using the camera on the cell phone to provide motivation and guidance to those who are well while introducing an innovation for those who are chronically ill. The service instructs users to take regular photographs of their meals. The photos are then sent to a central database where a nutritionist and diet coach provides counsel, guidance—maybe even a well-meaning admonishment—to guide good diet.

Even the universally familiar television is becoming a platform to collect information from the patient to improve home health care. Perhaps more important, it is also being used to engage and motivate patients in their own health. One system links a variety of weight, blood pressure, even EKG-related devices to the television's cable box, enabling the patient to send her or his data to a call center. Unlike most systems today that "take and collect" information from patients, this system enables patients to tune into their private "health channel," allowing them to see their own data over time, videoconference, and view health information gathered just for them—making patients not just the center of care but an active participant in the delivery of care.

DM AND HOME HEALTH CARE SYNERGIES

Three factors now shape the potential synergies between DM and home health care: (a) the aging of the population, (b) the growing burden of chronic disease (elderly with chronic disease and chronically ill popula-

tions now living longer with newer medical advances), and (c) the continuing nursing shortage.

In North America, the percentage of the population age 60 years and above is projected to increase from 16% to 25% over the next 20 years. Health care utilization and costs increase with age. The baby boomers are beginning to enter their peak years of utilization. The baby boom generation has more education, more income, and greater exposure to and experience with technology than any previous generation. As a social group, boomers expect personalized, real-time service. As their health-care needs increase, boomers will demand to be in control of their own care. They want the health care system to be more responsive to their needs, values, and preferences. In turn, this translates into growing demands for the application of technology that enables patients to remain independent and to see and control their own health information and medical care. It also will require the use of technology to make the care process more patient centered and convenient.

The second critical factor is the burden of chronic disease. "For several decades, the health care needs of the American people have been shifting from predominately acute care to chronic care. Today, chronic conditions are the leading cause of illness, disability and death in the United States" (Institute of Medicine [IOM], 2003, p. 17). In 20 years, from 2000 to 2020, the number of Americans with chronic conditions is likely to grow by 25%. The need for DM and home health care is going to continue to increase. Disease management and home health care must adapt, look for ways to complement each other, and contribute to the redesign of care systems and the adoption of technology to shift from today's focus on acute and emergency care toward providing planned, proactive care that helps manage chronic disease.

Consider also that health care organizations across the United States are coping with a nursing shortage. Some 70% of all hospital chief executives reported in October 2004 that their facilities were experiencing shortages (American Association of Colleges of Nursing, 2005). In long-term care, approximately 100,000 health care professionals are needed to fill key nursing jobs across the United States today (National Center for Assisted Living, 2005). Given the shortage, the daily demands on overburdened caregivers cause stress, injuries, and absenteeism and contribute to medical errors that compromise patient safety.

The nation's health care system, including DM and home health care, now faces a "perfect storm." We have an aging population with ever-increasing health care problems and service needs, demands for more patient-centered and responsive care delivery, and a growing burden of chronic disease, but a shortage of caregivers, most of whom still work in care systems designed primarily to focus on acute and urgent care. To successfully navigate the storm, our nation's health care system should look to innovative approaches that are able to effectively and intelligently leverage new technologies, work seamlessly across the health care continuum to coordinate care, and create broad-based efficiencies in the use of human and capital resources. There simply will not be enough nurses or other caregivers to do otherwise.

Consider the impact of integrated, collaborative systems that could help people measure their body's metrics on a regular basis. Today, although we are able to instantly track merchandise being shipped across continents or recall in a few keystrokes what the weather was 2 years ago in Any Town, USA, we have no comparable systems in place when it comes to individual health status. Most patients only get their blood pressure or pulse checked at their doctor's office. Even people who suffer from complex and severe illness may only weigh themselves or check their blood pressure once a day. How can you manage what you do not measure? Generally, patients do not have easy-to-use tools or techniques for consistent monitoring, journaling, and managing their health information, let alone the ability to share it or communicate it with the relevant context often needed by their health care providers or other caregivers. Our bodies need gauges just like a car needs a speedometer and a fuel gauge to even be considered operable. Just like in a car, technology can provide those gauges and systems are in place to protect patient confidentiality.

DM AND HOME HEALTH CARE INTEGRATION

Home health care needs the care force multiplier provided by effective DM methodologies, tactics, and technologies. In turn, DM needs the feet-on-the-street advantages of traditional home health care services to drive even greater improvements in health outcomes across the health care continuum. Three areas where DM and home health care, working together through advanced technologies, could greatly improve outcomes among the elderly are home safety (e.g., falls

prevention), hospital readmissions for heart failure, and proper nutrition and/or hydration.

Among older adults, falls are a serious public health problem. In the United States, one of every three persons older than age 65 years falls each year (Tinetti, Speechley, & Ginter, 1988) and two thirds of those who fall do so again within 6 months (Hornbrook et al., 1994). Among people age 65 years and older, falls are the leading cause of injury deaths and serious injuries, and about 9,600 older adults died in 1998 from fall-related injuries (Murphy, 1998). One half of all older adults hospitalized for hip fracture cannot return home or live independently after their injuries (Melton & Riggs, 1983; Scott, 1990). In addition to the physical injuries caused by falls among the elderly, falls also can have serious psychological consequences. Many older adults avoid activities because they fear falling, but limiting what they do actually increases their risk of falling (Kraus, Black, Hessol, et al., 1984).

The causes of falls can be divided into two categories: personal factors and environmental factors. Personal factors include muscle weakness, balance problems, limited vision, and taking certain medications such as tranquilizers or antidepressants (Ray & Griffin, 1990; Scott, 1990; Sorock, 1988). Environmental factors include home hazards such as clutter, loose rugs, or other tripping hazards; poor lighting, especially on stairs; and not having stair railings or grab bars in the bathroom (Tinetti & Speechley, 1989).

Fall prevention programs that are most effective include education on fall prevention, home assessments and/or safety checklists, and connection to home repairs and/or safety improvements. Monitoring and educational capacities already in place among DM programs coupled with the latest technologies and in-home visits by home health caregivers could more effectively and efficiently address this driver of clinical and financial catastrophes. In addition, a variety of home-based systems are now available to assist caregivers and families in monitoring patient gait, activity patterns, and other markers that may predict a fall. These prevention-based technologies, integrated with the increasing use of personal emergency response systems, may provide 24/7 safety in between visits and identify areas where intervention may be necessary to prevent a fall. This is particularly important for stratified populations on anticoagulant therapy. Fine tuning of fall-risk tools (and other risk tools such as the Braden pressure ulcer risk tool) to the home environment will further the science of managing those who are frail and elderly and

those who are chronically ill in the community (testing reliability, validity, specificity, and sensitivity of instruments developed and well tested for in-patient settings but needing further testing for the home environment). The blending of home care and DM data and expertise in furthering the predictive accuracy of these tools to reduce falls and other adverse events and cost (e.g., care related to injury from falls and premature and/or avoidable placement is costly in human and dollar terms).

Congestive heart failure (CHF) is the most common discharge diagnosis for Medicare beneficiaries. Re-admission after hospitalization for CHF is common, with almost 50% of beneficiaries being readmitted within six months (Krumholz, Parent, Vaccarino, et al., 1997). Studies have concluded that readmissions could be prevented in 40% of cases (Vinson, Rich, Sperry, Shah, & McNamara, 1990). And while DM is already using home monitoring devices and other techniques and tools to greatly reduce hospital readmissions for a relatively small number of patients with CHF, expansion of DM's role within this population that is more difficult and frail and integration with home health care providers could provide affordable, targeted, real-time checks and balances on patient status, driving dramatically reduced readmission rates for seniors with CHF and other chronic conditions.

Malnutrition and dehydration among the elderly can lead to increased risk for new or worsening existing costly pressure ulcers, decreased wound healing rates, and development of costly nonhealing chronic wounds, increased fall prevalence, increased dementia, increased hospitalizations, decreased level of functioning, reduced immune function and/or increased risk of infection (particularly urinary tract infections, a common cause for rehospitalizations), reduced mobility, comorbidities such as diabetes, reduced quality of life, and longer length of stay at hospitals. In an integrated approach, home health provides the invaluable onsite assessment, self-care and caregiver education, and skill training and direct care (e.g., wound care) for this population who is fragile, beaming relevant and timely information back to DM nurses, who could provide ongoing education, encouragement, and monitoring between doctor, home health, and caregiver visits.

CONCLUSION

While the "perfect storm" of an aging population, a growing burden of chronic disease and a fragmented

delivery system primarily designed for acute and urgent care should be cause for alarm, it should more appropriately be looked at as a call to action. This perfect storm presents us with an opportunity to capture the attention of decision makers and individuals to address the public and private health care needs of an aging population today and of the boomers tomorrow. Our federal and state governments are already looking for ways to address the rising health care costs for at-risk populations without compromising health care quality. Medicare is testing innovative systems and technologies, including chronic DM, to determine national quality, care, and cost solutions. The collective conversation should not be whether to provide DM services versus home health care versus anything else. Instead, the conversation should be about ways technology can enable a change in our systems that provides patients with the appropriate interventions from the appropriate providers at the appropriate times.

Along the way, it is critical to remember that technology does not replace touch or the human connection; it can only enhance it and make it more efficient. Home health professionals would be well served by incorporating technology and DM into their standard education curriculum and practice.

However, innovations that require changes in practice and process need support from the health professions, technologists, and government. To realize the range of benefits that home health care, DM, and the appropriate use of technology may deliver to an aging population, several activities should be pursued.

Public policy should continue to provide incentives to developers of technology while guaranteeing that resulting innovations are available, affordable, and acceptable to older patients and boomer families who are low income, poorly educated, and less tech savvy.

The creative exploitation of technology is a great opportunity but will also present considerable change management problems in how we operate, define, deliver, and manage care at home and throughout the health care system. The home health care profession should aggressively integrate the use of home technologies into its education and/or degree programs and continuing education curricula.

An abundance of novel devices and technologies exist today and promise to improve the quality and efficiency of home health care and DM. However, many of these systems remain untested by large populations in home and related care settings. Practical research should be conducted to assess the integrated effective-

ness of these technologies to monitor patient health, manage costs, and motivate profound behavioral change simultaneously in disease categories that begin with the comers today and provide a foundation for their care in old age tomorrow.

No risk-prediction or identification methodology, no matter how precise and timely, no technology solution for DM and telecare, regardless of its features and functions, can yield bottom-line clinical and financial results unless the process and content of care are changed for the better. The experience, skills, and diligence of disease and care management nurses will always be critical, indeed essential, to the success and improvement of the quality of life of older people and those who care for them.

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