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Toward A Strategic Application of Information Systems and Technology for Disease Management in Health Care

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Abstract

Health care in the United States faces an uncertain future with the rising costs of care, the growth of the aging population, the chronic health conditions associated with the aging, and a predicted shortage in the physician workforce, among other issues. Health care costs are rising at an annual rate of 13% to 15%; health insurance premiums continue to rise at an incredible rate as well. The number of persons living with chronic conditions is expected to increase by nearly 20% during the next ten to fifteen years; while at the same time there is an impending shortage of physicians due to a number of factors affecting the physician workforce, including a desire by many young physicians to reduce their workloads.

What does this mean for the quality of health care that will be available and the cost of care in the coming years? A number of emerging concepts and emerging technologies may be able to help address these issues. Among these concepts and emerging technologies are disease management programs, which have been touted to be an effective approach to reducing costs and improving patient health. This paper aims to review the literature for an overview and relevance of disease management vis-à-vis physician shortage, to highlight several barriers to organizational adoption of disease management; to outline information technology utilized in program management and delivery; and to propose areas for future research.

Key Words: Disease Management; Physician Shortage; Systems Integration; HealthCare Program Management; Tele-Health; Tele-Medicine; Barriers to IT Integration.

INTRODUCTION

The United States faces an uncertain future in terms of health care with the rising costs of care, the growth of the aging population and the chronic health conditions associated with that population, and a predicted shortage in the physician workforce, among other issues (Salsberg and Forte, 2002; Coile, 2003; Blumenthal, 2004). Health care costs are rising at an annual rate of 13% to 15%; health insurance premiums continue to rise at an incredible rate as well (Cooper, 2003; Blumenthal, 2003). The number of persons living with chronic conditions is expected to increase by nearly 20% during the next ten to fifteen years; while at the same time there is an impending shortage of physicians due to a number of factors affecting the physician workforce, including a desire by many young physicians to reduce their workloads (Glabman, 2003; Blumenthal, 2003).

What does this mean for the quality of health care that will be available and the cost of care in the coming years? While we do not have a crystal ball to see the future, there are a number of concepts and emerging technologies that may be able to address many of these issues. Among these concepts and emerging technologies are disease management programs, which have been touted to be an effective approach to reducing costs and improving patient health (Walker, Landis, Stern, and Vance, 2003). The purpose of this paper is to review the literature to provide an overview of the disease management concept including how this approach is being delivered and by whom; to discuss several barriers to organizational adoption of disease management; to outline information technology utilized in program management and delivery; and to propose areas for future research.

BACKGROUND

Patients with chronic illness account for nearly three-quarters of the \$1.6 trillion spent on medical care in the United States (Levit, et al., 2004). Over the past twenty years, two main models have emerged to address the issue of outpatient care for the chronically ill: disease management and the chronic care model (Casalino, 2005). This paper focuses on the more

comprehensive and patient-centric disease management concept. Disease management (DM) “is a system of coordinated healthcare interventions and communications for populations with conditions that require significant patient self-care efforts, includes elements of population-based identification of target conditions, guideline-based care, collaboration with providers and patient self help” (DMAA, 2005). Disease management 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/surveillance);
- Process and outcomes measurement, evaluation, and management;
- Routine reporting/feedback loop (may include communication with patient, physician, health plan and ancillary providers, and practice profiling).

Disease management covers a range of activities that attempts to address perceived shortcomings of medical practice (Congressional Budget Office, 2004). These include untreated chronic conditions that lead to acute complications, a gap between evidence-based practice guidelines and actual practice, and a lack of coordination of care for the individual patient seeing multiple physicians or providers (CBO, 2004). Health care organizations have the opportunity to “make or buy” disease management programs. There are well over 100 disease management vendors in existence, offering a wide range of services from total process management to tools such as information systems and home-monitoring devices that can augment programs built by providers (Leider and Krizan, 2001). Virtually every disease management program relies on three basic strategies to impact clinical and financial outcomes for a population with a given disease: (1) improving patient compliance with medications and adoption of healthier lifestyles, (2) improving physician compliance with established guidelines or standards of care, and (3) actively monitoring patients so that clinical interventions can occur before hospitalization becomes necessary (Leider and Krizan, 2001).

Origins and Evolution of DM

DM is not a new concept, having its origins in the programming of staff model health maintenance organizations (HMOs) more than twenty years ago before the term “disease management” existed (Leider and Krizan, 2001). Until recently, disease management was largely confined to highly sophisticated health care organizations, which were relatively easily able to develop and implement programs because of the strong structure of physician leadership, sophisticated data systems, employed physicians and nurses, financial risk for populations, and a culture that valued continuous improvement of quality care (Leider and Krizan, 2001; Erwin and Musa, 2006).

During the 1990s, managed care organizations (MCOs) accelerated the adoption of disease management as a central component of their efforts to control costs while providing high-quality care (Villagra, 2004). The growth of disease management was in part a reaction to the unpopularity of managed care cost control measures like utilization review and to the need for more education and self-management support for patients with chronic diseases (Villagra, 2004). In 2005, the Center for Medicare and Medicaid Services (CMS) began a series of randomized, controlled trials to determine if disease management could save money and improve care. The Medicare Prescription Improvement and Modernization Act of 2003 requires CMS to create large regional chronic care improvement programs for chronically ill patients in traditional Medicare fee-for-service (Casalino, 2005). The act encourages CMS to expand these programs nationally by 2007 (Casalino, 2005). Other environmental and political factors that may promote the adoption and implementation of disease management programs include an initiative that began in 2003 in the Department of Veterans Affairs. The initiative established an initial set of standards for cooperative electronic exchange of health information among private payers, health plan and Medicare (Kash, et. al, 2005).

A broad range of health care organizations have tried to develop and implement disease management programs, including individual practice association (IPA) model HMOs, physician hospital organizations (PHO) and risk-bearing physician organizations (Leider and Krizan, 2001). However, the rapid diffusion of DM has primarily occurred through private and public insurance companies (Felt-Lisk and Mays, 2002; Foote, 2003). The primary drivers for these efforts have been identified as financially risky for a specific population, and a desire to improve the quality of care and to reduce medical costs and utilization (Fitzner, Fox, Schmidt, Roberts, Rindress, and Hay, 2005; Leider and Krizan, 2001). These organizations are

less integrated than the traditional HMO and often fail at successful implementation of disease management programs (Leider and Krizan, 2001). For the CMS trials that began in 2005, nine organizations were awarded contracts, including four health plans and five disease management companies. Medical groups and physician organizations were invited to submit proposals, but none were awarded contracts (Casalino, 2005).

BARRIERS TO ADOPTION OF DM

It has been proposed that the failure of any medical group or physician organization to be selected to participate in the CMS project is probably attributable to several factors, among which is the lack of sophisticated information systems, as well as managers and organizational capabilities especially dedicated to disease management programs (Casalino, 2005). Leider and Krizan (2001) have suggested that there are three barriers to the successful implementation of disease management in health care organizations. These are: (1) lack of strong physician leadership, (2) failure to align incentives, (3) failure to identify and address operational issues, and (4) physicians' concerns about their income and work conditions.

Physician Leadership

Physicians are an integral part of any health care organization, whether or not they have a formal employment relationship. In practice, physicians have significant influence over resource utilization, deliver and influence the quality of medical care, and effect the speed and extent to which changes occur in the delivery of care (McAlearney, Fisher, Heiser, Robbins, and Kellehe, 2005). Successful health care organizations must be able to leverage the influence of physicians if they are going to adapt and innovate in the dynamic field of health care.

One of the components of disease management programs is the adherence to evidence-based practice guidelines (DMAA, 2004). In a review of the literature, it was found that the most common barriers to physician adherence to practice guidelines were lack of awareness, limited familiarity, lack of agreement with the guidelines, self-efficacy, and the inertia of previous practice (Cabana, Rand, Powe, Wu, Wilson Abboud, and Rubin, 1999). It was also found that the involvement of local opinion leaders significantly influenced adoption of guidelines among their peers (Cabana, et. al, 1999).

According to Leider and Krizan (2001), endorsement from a local opinion leader is critical to the successful implementation and adoption of DM, and suggest that this support may be obtained by a number of strategies including involvement of local physicians on a DM program advisory board, utilization of a local physician as medical director, and provision of evidence to assure local physicians that a DM program will not adversely impact their private practice by decreasing referrals or patient visits.

Financial Incentives

Although disease management programs may be able to simultaneously improve quality of care and produce savings net of cost for the insurer, the incentives for physicians and managed cared organizations are usually not aligned (Leider and Krizan, 2001). Unless third-party reimbursement for patient care is structured in a way to promote and reward the disease management approach, there is little incentive for physicians and many health care organizations to commit the time and resources necessary to adopt the innovation.

The government's interest and involvement in DM is significant because of its role as a principal payer for health services for the elderly and Medicaid populations, as well as its role as the largest payer and the regulator of health services (Kash, Gamm, Bolin, and Peck, 2005). Perhaps with the serious consideration that CMS is giving disease management programs through its new initiative, reimbursement for the educational and self-management components of disease management will become the norm for most insurers. Health care advocacy organizations like the American Diabetes Association have published position statements recommending that all employers that purchase coverage for their employees should insist that the services that are considered standards of care for chronic diseases should be a part of the coverage in their health care plans (Anonymous, 2003). Additionally, there is growing utilization of disease management programs for the Medicaid population with approximately twenty-four states having implemented disease management requirements within their Medicaid programs and contracts (Kash et. al, 2005).

Operational Issues

The operational issues identified by Leider and Krizan (2001) as barriers to successful implementation of DM include the selection of a disease process to address, the identification of the target population for the program, defining financial and clinical outcomes, obtaining data, analyzing data, duplicating services, developing a comprehensive plan with a multi-disciplinary team, communicating effectively between patients and physicians, identifying necessary interfaces within the system, and providing for post-implementation support. One common thread among each of these issues is the need to

access and analyze information. Survey data has shown that the key resources identified by organizations that have adopted DM as being of great or significant importance to the DM process are information in the electronic medical record (EMR), DM personnel's access to EMR, personnel's communication with physicians regarding patients, information on the DM program for comparison with other programs, and information from DM program reports (Kash, et. al, 2005).

The literature suggests that access to information and the ability to communicate via various information systems appear to be key determinants of an organization's ability to adopt and successfully implement DM programs. The next section of the paper will discuss the utilization of information technology in program management and delivery.

INFORMATION SYSTEMS/TECHNOLOGY AND DM

The terms information system and information technology are often used interchangeably. An information system (IS) is an arrangement of information (or data), processes, people, and information technology that interact to collect, process, store and provide as output the information needed to support the organization (Whitten, Bentley & Dittman, 2004). Information technology (IT) describes the combination of computer technology (hardware and software) with data and telecommunications technology (data, image, and voice networks) (Wager, Lee and Glaser, 2005). The modern health care organization is critically dependent on information technology to accomplish many of its clinical and administrative functions (Gunasekaran and Garets, 2003).

Health care information systems are designed to support the collection and dissemination of health care information. This information can be viewed in a broad framework of two categories: internal and external. Internal information is generated within a health care organization and includes patient-specific clinical and administrative information as well as aggregate clinical and administrative data. External information includes outcome measures and health care data sets that are comparatively used by a health care organization as well as expert or knowledge-based information found in the scientific, management and clinical literature.

The health care industry is one of the most information intensive and technologically advanced industries in modern society (Wager et al., 2005). Yet, despite the need for timely clinical and administrative information, many health care organizations function using pen-and-paper or insufficient information systems (Wager, et al., 2005). According to Wagner, et al., the complexity and the fragmented nature of the health care industry make implementation of a health care information system difficult. They go on to suggest that "among the factors that contribute to the complexity are the presence of large numbers of organizations, such as physician practices, hospitals, and home health agencies, that are often overlooked by major IT vendors because of the lack of profitability in servicing those companies; the misalignment of financial incentives by the payers to encourage or promote investment in IT; a lack of standards for health care data and transactions; the complexity of the process of care; the complexity of health and medical data; and the nature of provider health care organizations, which have two parallel power structures: administration and the medical staff" (Wager, et al., 2005). Although the industry is complex, advances in health care information technology are being made, and there is a growing demand from health care consumers, payers, and purchasers that more be done to equip providers with the information they need to help improve the delivery of care and control costs.

Information Systems and Applications

Disease management incorporates a number of clinical information systems and applications. Among these are:

(1) Electronic medical record (EMR): The patient medical record is the hub of the health care organization, and is used for documenting a patient's care, communicating with the various providers of the patient's care, and to support reimbursement and research. It is more than a passive storage device; it is an active tool that can provide the clinician with decision-support capabilities and access to resources, reminders and alerts such as a warning of a possible drug interaction or allergy for the patient (Wager et al., 2005). There are various definitions of the electronic medical record, depending on country, context, networks, etc. (Toyoda, 2005). The Medical Record Institute (2005) has categorized the EMR into five levels of computerization, with the EMR being viewed as a tool used at the individual organization level (Level 3). Further enhancement of the EMR beyond the organizational level enables the patient to have an electronic patient record (Level 4) that is a compilation of his or her clinical information from all providers, and moving even beyond that level is the electronic health record (Level 5) which incorporates wellness information and other information not routinely maintained by health care organizations. This might include information about the patients smoking habits, nutrition, fitness, dental health and alcohol use (Wager et al., 2005).

(2) Computerized Order Entry: The ordering process is critical in the patient care process. The physician may order a number of diagnostic tests and therapeutic plans during the patient visit. It is at this juncture that many medical errors may

occur, such as a medication error or adverse drug event. This is also a point at which the use of a computerized order entry system (CPOE) can often prevent medication errors and improve adherence to clinical practice guidelines (Wager et al., 2005). At its most basic level, CPOE is a computer application that accepts physician orders electronically, replacing handwritten or verbal orders for tests, procedures or prescriptions. Most CPOE systems also provide some decision support assistance to the physician, an example being an alert to a drug allergy for the patient and a recommendation for an alternative drug. CPOE systems can also provide other clinical decision support, such as recommendations for the standards of care for a particular diagnosis (Wager et al., 2005). Recent reports suggest that overall usage of CPOE among hospitals ranges from five to thirteen percent (Leapfrog Group, 2002; Brailer and Terasawa, 2003).

A survey in 2003 conducted by the Health Care Information and Management Systems Society (HIMSS) indicated a direct relationship between organization size and CPOE use; larger organizations, those with budgets greater than \$500 million, were far more likely to utilize CPOE than smaller organizations with annual budgets of less than \$100 million (HIMSS, 2003). CPOE is touted not only for its ability to improve patient safety and outcomes, but also for its ability to save costs associated with medication, radiology, laboratory and adverse drug-related expenditures and to enhance provider revenue by helping reduce the number of rejected claims for outpatient visits (AHRQ, 2001; Johnston, Pan, Walker, Bates and Middleton, 2003 & 2004).

(3) Tele-medicine: Telemedicine is the use of telecommunications to provide clinical care for patients, which may involve various electronic delivery mechanisms (Wager et al., 2005). The terms “telemedicine” and “telehealth” are sometimes used interchangeably, although “telehealth” was originally used to describe administrative or educational functions related to telemedicine but has recently emerged as an umbrella term for the wide range of uses of telecommunications to deliver health care services (Brown, 2002). Patients using the internet to access health information or to fill a prescription are examples of tele-health. The term “telemedicine” more commonly refers to the direct provision of clinical care to a patient via telecommunications, including diagnosing, treating and following up with the patient at a distance (Brown, 2002).

Telemedicine services and technology are delivered by two primary means: 1) digitally stored and forwarded upon request and 2) two-interactive television (Wager et al., 2005). Common application of telemedicine include home monitoring of vital signs, automated scheduling and medication reminders, and replacing home visits by a provider with videoconferencing (Celler, Lovell, and Basilakis, 2003).

(4) Tele-health: In recent years, individuals have begun to increase their use of the internet to access health care information and to seek health care services. Many patients are also interested in communicating directly with physicians via email, although physicians have not adopted this tool as readily (Wager et al., 2005). Email communications between patients and physicians can be used for a variety of reasons including follow-up patient care, clarification of advice, prescription refills and patient education. In one of the largest studies to date on the use of email between patients and physicians, it was found that physicians were most amenable to email communications from patients when there was some sort of triage system in place (MacDonald, 2003). This might be entail a nurse or other staff member screening the messages and passing along those that warranted a response from the physician. It is recommended that before adopting the use of email communications between physicians and patients an organization should consider six critical areas: complexity of the infrastructure, the degree of integration into an existing system such as an EMR, the structure of messages, cost, security, and reimbursement (MacDonald, 2003). The American Medical Association (2003) has published guidelines for on-line communication as a resource of health care organizations.

Integration into DM

The use of information technology is integral to disease management. Effective management of chronic disease requires a close partnership between the patient and the healthcare providers (Bodenheimer, Lorig, Holman, and Grumbach, 2002). Patients with chronic disease are inevitably personally responsible for their daily care, and can often best gauge the severity of their symptoms and treatment efficacy (Celler, et al., 2003). They must be active participants in their treatment, and must adopt self-management as a life-long task (Bodenheimer, et al., 2002). Unfortunately, compliance with self-management regimens is often poor (Lorig, Sobel, Stewart, et al., 1999). The problem of compliance along with the need for effective communication between patients and providers to enhance care highlights the need for the use of appropriate and cost-effective information and communications technology (Celler, et al., 2003).

Most DM programs are designed to help participants to improve their self-care and to provide better clinical information support for their physicians (Foote, 2003). A fully-integrated DM program may offer a multidimensional strategy incorporating many tools to address the six components of comprehensive disease management as outlined in Figure 1. DM

program vary widely, but they typically offer participants periodic phone calls from program staff (e.g., from a registered nurse), personalized goal-oriented feedback on self care, access to nurse call centers staffed around the clock, and educational materials via various electronic sources (email, web-based, or video). In addition, high-risk participants may also receive home visits, biometric monitoring equipment or daily phone contact to monitor vital statistics (Foote, 2003). Other features of DM programs may include alerts for physicians when a patient needs medical attention, reminders for overdue preventive services and periodic patient status reports (Foote, 2003). Access to expert clinical information systems is also used in DM programs to integrate evidence-based clinical guidelines with participants' data from multiple services (Foote, 2003). Some have developed Internet applications that give participants immediate access to their data (Foote, 2003).

SUMMARY AND FUTURE RESEARCH

In this paper, an overview of disease management has been presented, along with a discussion of barriers to the adoption of the DM approach and an outline of information systems and technologies used in DM. Disease management consists of a system of coordinated healthcare interventions and communications for populations with conditions that require significant patient self-care efforts, and has been shown to improve the quality of care and is proposed to reduce the cost of care. Disease management programs are designed to provide effective management of chronic illness and have been touted for improving patient care, reducing hospitalizations, and reducing costs. In an extensive review of the DM literature, the Congressional Budget Office (2004) concluded that there is some preliminary evidence of the improvement of patient care and outcomes, however there is insufficient evidence of any cost savings as a result of DM. One of the difficulties in determining the impact on costs is the lack of a universal analytical framework or measurement standards among existing studies, which prevents effective comparisons from being made (CBO, 2004; Villagra, 2004).

Numerous opportunities for future research exist in the disease management arena. The Disease Management Association of America (2005) has a comprehensive research agenda that the organization is seeking to promote in its quest to be recognized as the DM community leader. Included in its agenda are initiatives to consolidate unpublished outcomes research into a database for benchmarking, develop standardized definitions and terminology for outcomes researchers, develop evaluation designs and methods that will become standards for DM research, and develop a predictive modeling technique for patient identification, among others.

In particular, the need for the development of measurement standards for outcomes and cost effectiveness has been identified by numerous sources (CBO, 2004; Villagra, 2004; DMAA, 2005). Other areas of for future research that focus more specifically on the information systems and technologies used in DM include assessment of patient satisfaction with disease management and an assessment of patient access and utilization to the information technologies used in disease management. Additional topics of interest include the effectiveness of the DM approach and the use of telemedicine, in particular, work for different demographic groups, (e.g., age, race/ethnicity, education, socioeconomic, and others).

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