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Review Paper ■

Informatics Systems to Promote Improved Care for Chronic Illness: A Literature Review

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Abstract **Objective:** To understand information systems components important in supporting team-based care of chronic illness through a literature search.

Design: Systematic search of literature from 1996-2005 for evaluations of information systems used in the care of chronic illness.

Measurements: The relationship of design, quality, information systems components, setting, and other factors with process, quality outcomes, and health care costs was evaluated.

Results: In all, 109 articles were reviewed involving 112 information system descriptions. Chronic diseases targeted included diabetes (42.9% of reviewed articles), heart disease (36.6%), and mental illness (23.2%), among others. System users were primarily physicians, nurses, and patients. Sixty-seven percent of reviewed experiments had positive outcomes; 94% of uncontrolled, observational studies claimed positive results. Components closely correlated with positive experimental results were connection to an electronic medical record, computerized prompts, population management (including reports and feedback), specialized decision support, electronic scheduling, and personal health records. Barriers identified included costs, data privacy and security concerns, and failure to consider workflow.

Conclusion: The majority of published studies revealed a positive impact of specific health information technology components on chronic illness care. Implications for future research and system designs are discussed.

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Introduction

Over 100 million persons in the United States have one or more chronic illnesses and more than 30 million are disabled from their illness.[1] Costs for chronic illness care are approximately 75% of total health care costs, and rising. Senior patients are hardest hit, with 65% of Medicare recipients having 2 or more chronic illnesses and accounting for 96% of all Medicare expenditures.[2] Mental health care is especially pertinent to discussions of chronic illness care, since mental illnesses are growing in incidence (and yet still significantly under-diagnosed) and represent large costs.[3] Despite heavy expenditures, care for chronic illness is poor—treatments known to be beneficial are provided about 50% of the time and ineffective treatments may be given 20%–30% of the time.[4, 5]

Improving care for chronically ill patients requires a longitudinal, team-based approach. Models and change packages exist for reorganizing care to improve collaboration and quality of care, such as the Chronic Care Model[6] and two Veterans Administration (VA) Quality Enhancement Research Initiative (QUERI) projects, Enhancing Quality-of-care in Psychosis (EQUIP)[7] and Translating Best Practices for Depression Care into VA Care Solutions (TIDES).[8] Many models specify the use of health information technology (HIT) as a key component in managing populations and complex communications.[9] As part of the Creating Health*e*Vet Informatics Applications for Collaborative Care (CHIACC) study, a VA project to design and evaluate software that supports chronic illness care, we sought to understand the specific information technology components important for success.

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HIT can provide knowledge about guidelines and safety, information about patient conditions, treatments and other pertinent characteristics, and reminders to providers at the point-of-care of important quality steps. While important, these are not sufficient to ensure effective chronic illness care. According to chronic care models, special information-based tasks and processes are needed, including facilitating population-based care, tracking measures of health over time (such as depression scores), involving the care team, including the patient, and giving feedback about progress. Most systems fall short of providing the necessary support. Little is known about how to create and successfully implement a comprehensive system which incorporates all these components and will positively impact health care for patients with complex chronic illness.

Previous systematic reviews of chronic disease management and HIT provide insight but no clear answer. First, Hillestad et al. highlighted the promise of systems, basing an estimate of near and long term savings of over $150 billion on studies of successful implementations of HIT.[9] In a broad review of HIT, de Keiser and Ammenwerth reviewed studies for content (983 studies)[10] and outcomes (64 studies),[11] and found that 70% of process studies showed positive results and half of the outcome or efficiency reports were positive. Similarly, Chaudhry et al. reviewed information systems components in 257 studies and found improved adherence to protocols, reduced errors, and improved surveillance; however, most of these papers were from the same institutions and the generalizability was uncertain.[12] Weingarten et al., in a large meta-analysis of disease management studies, showed positive effect sizes for process and efficiency of provider reminders (0.52) and feedback (0.61) and for outcomes of patient (0.27) and physician reminders (0.22), although a large proportion of the studies showed no effect.[13]

Looking at individual system components, several studies of computerized decision support systems measured positive effects on process (58%–68%). Fewer (13%) reported positive outcomes for specific diseases.[14–18] Factors important for success in these studies were timeliness of alerts, automatic generation of alerts, and integration into workflow. Computerized patient education has shown mixed results; one study showed very successful knowledge transfer (21/22 articles)[19] while another showed little improvement.[20] Reviews of other system components (self-management, population-based care) did not specify attributes of HIT that contributed to success or failure. Thus, although HIT systems generally have high potential benefits and some demonstrated effect, specific components in chronic disease management associated with success are unclear.

To better understand how to build information systems to support collaborative, team-based, chronic illness care, we performed a novel literature review. Our primary goal was to understand which elements are necessary for software to facilitate best practices and which bring the highest likelihood of successful implementation in a broad network. The literature review targeted functions of health care information systems and improvements in processes and outcomes attributable to HIT and it sought to understand lessons learned from failures.

Methods

Search Strategy and Article Selection

Studies were identified by searching MEDLINE, PREMEDLINE, Business Source Premier, ABI, and the Cochrane Library for January 1, 1996–February 28, 2005 using search concepts (with appropriate synonyms): 1) informatics/information systems; 2) patient care management/collaborative care; and 3) chronic illness. This strategy was supplemented by articles identified as key in the reference sections of the studies received and from experts in the field.

Abstracts from identified articles were each rated separately by two reviewers into A (exact topic match), B (doubtful match), and C (no match) categories. Agreement was high (κappa=0.78, $p<0.01$) and consensus was used to resolve disagreements. All A articles were read and key information was abstracted from them unless: 1) information systems were not a major part of the study; 2) the study was wholly theoretical; or 3) the article did not describe what was done in enough detail to understand important components according to two or more reviewers. Review articles were analyzed separately. Only their general purpose and results were abstracted for comparison with current efforts.

Abstraction Method and Template Development

The primary units of analysis were the components of the system being studied, categorized using the eight Institute of Medicine (IOM) domains (Health Information and Data, Decision Support, Results Management, Communication/Connectivity, Population Health Management, Order Entry, Patient Support, Administrative Processes).[21] When articles compared two or more systems, each system was abstracted individually. Multiple articles discussing the same system were analyzed independently if the components under study were different.

An abstraction template and a data dictionary were developed by consensus and iterative review of the team. The abstraction template included study design, setting (clinic, hospital, etc.), disease addressed, information system components and quality of care components. Study quality was evaluated based on study design, with experiments defined as the highest quality. To be classified as an experiment, a study had to have a control or comparison group, measure outcomes, and make appropriate statistical analyses.[22] Other study designs included non-experiment observation, description, and case study.

Statistical Analyses

At least one reviewer of seven independently abstracted each study. The first author abstracted all review articles and independently re-reviewed 10% of all the articles as a verification step. Key verification variables included the study type, a summary variable for presence of each IOM domain (8 total), presence of quality, accuracy, and usability evaluations (3 total), and presence of cost-effectiveness analysis. A weighted kappa measurement was used to compare these 13 key indicators of consistency.

Several limitations precluded formal meta-analysis. These limitations included a paucity of randomized, controlled trials (RCTs) among the articles reviewed, varying definitions of positive outcomes, inconsistent outcomes measurement, and lack of complete information system descriptions. Therefore, article counting methods were used where appro-