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Aligning health information technologies with effective service delivery models to improve chronic disease care

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Abstract

Objective—Healthcare reforms in the United States, including the Affordable Care and HITECH Acts, and the NCQA criteria for the Patient Centered Medical Home have promoted health information technology (HIT) and the integration of general medical and mental health services. These developments, which aim to improve chronic disease care have largely occurred in parallel, with little attention to the need for coordination. In this article, the fundamental connections between HIT and improvements in chronic disease management are explored. We use the evidence-based collaborative care model as an example, with attention to health literacy improvement for supporting patient engagement in care.

Method—A review of the literature was conducted to identify how HIT and collaborative care, an evidence-based model of chronic disease care, support each other.

Results—Five key principles of effective collaborative care are outlined: care is patient-centered, evidence-based, measurement-based, population-based, and accountable. The potential role of HIT in implementing each principle is discussed. Key features of the mobile health paradigm are described, including how they can extend evidence-based treatment beyond traditional clinical settings.

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Conclusion—HIT, and particularly mobile health, can enhance collaborative care interventions, and thus improve the health of individuals and populations when deployed in integrated delivery systems.

Keywords

Health Information Technology; Delivery of Health Care; Mental Health Services; Primary Health Care; Community Health Services; Patient Care Management

Introduction

In the wake of national health care reform in the United States, numerous state and federal initiatives have begun to implement integrated care approaches for chronic diseases into primary care medicine. These initiatives are meant to increase access to high quality care for patients and to assist clinicians in improving quality of care for chronic diseases. Nearly two decades ago, Wagner and colleagues articulated the need to organize services for more effective delivery of care for chronic conditions, by outlining key elements of the "chronic care model".[1] The collaborative care model is one example of how these elements have been operationalized and implemented with an emphasis on improving care for common mental disorders such as depression in primary care.[2,3]

With the expansion of health insurance through the Affordable Care Act, the anticipated demand from newly insured patients with needs related to chronic medical and mental health conditions will present a significant challenge for healthcare systems. Collaborative care can effectively leverage limited mental health specialty resources and address this need in high risk patients. Such patients often have combinations of comorbid medical and mental health conditions, limited health literacy, and inadequate provider-patient communication, all factors that can impede effective chronic disease care.[4–9] Health information technology (HIT) can play an important role in addressing these potentially modifiable factors in the context of delivery models such as collaborative care.

HIT, defined as "the application of information processing involving both computer hardware and software that deals with the storage, retrieval, sharing, and use of health care information, data, and knowledge for communication and decision making"(p. 38)[10], encompasses a variety of electronic tools including electronic and personal health records, patient registries, mobile health (mHealth) applications, and remote monitoring devices.[11] Consumer health technologies have greatly expanded in the last 5 years and have the potential for mitigating some critical barriers to quality care. For example, nearly 100,000 mHealth applications are now available for consumers to download.[12,13] Although evidence for their effectiveness lags far behind,[14,15] some mHealth applications are already in widespread use by the general public.[16] With this growth, mHealth is emerging rapidly with the potential to become a significant component of HIT and of health service delivery and an important tool in extending the population impact of traditional clinical services, including among underserved patients and those with limited health literacy.[7,17]

Despite the increasing availability of many mHealth technologies, several factors may limit their adoption and subsequent impact on chronic disease management. Older adults, who are frequently the target of chronic disease management programs, are less likely to have access to portable devices[18] and may have limited literacy in health technologies. Both older adults and those with limited financial resources may be unable or unwilling to pay for equipment or access fees (such as broadband internet access), and patients in rural areas may not even have such services available. Individuals with cognitive impairments [19] or mental health issues might be unwilling to use novel approaches to disease management. While it is important to consider potential limitations such as these, their actual impact remains uncertain. Among primary care patients, recent data suggests that mHealth use is less common among older adults but not related to such factors as the presence of chronic diseases, depression, or health literacy limitations.[20] Web-based and mobile technologies have been successfully designed and deployed in research settings among individuals with serious mental illness and their use has not been hampered by cognitive impairments or limited general or health literacy.[21–23] Home-based monitoring systems and video game interventions have been used among older adults, including those with cognitive impairments and chronic diseases, with some evidence for overall healthcare cost-savings associated with home monitoring.[24–27] Importantly, in order to be adopted, any technology for health improvement must meet the user's specific needs and people with chronic diseases may have other more pressing personal or social needs which preclude attention to health improvement. [28] If users are not interested or motivated, then mHealth technologies, no matter how well-designed, will have no benefits for them, and thus will not be used.

In light of the opportunities and limitations, this paper addresses how HIT can support the implementation of evidence-based collaborative care models and in particular how programs that leverage HIT can potentially ease concerns health care systems and providers have regarding the anticipated volume of newly insured patients as coverage expands. Digital health tools and information management systems for providers and patients are reviewed, including how their integration into health systems can address mental health, health literacy and communication barriers to effective care. The collaborative care model of integrating mental health into primary care is used to illustrate the need to align HIT to appropriate health service delivery models; however, these principles may be relevant for care management for chronic conditions more generally and may also have relevance outside the United States among systems that have implemented similar models for organizing chronic disease care.

What is collaborative care (CC)?

The collaborative care (CC) model is one of the most widely researched and disseminated models for delivering evidence-based mental health services in primary care settings.[2,3,29–33] The empirical support for the model is clear: there are more than 79 randomized controlled trials that demonstrate the effectiveness of this model for improving outcomes for common mental disorders including depression and anxiety.[32,33] Studies have been conducted in a wide range of settings, nationally and internationally, and represent a diverse array of patients, target conditions, medical comorbidities, and treatment strategies.[31] As a result, this model has been identified as a best practice for nearly 15 years at a national level.[34,35] The scalability of this practice model is supported by large-scale implementations in 'real-world' healthcare settings, including by organizations that serve predominantly disadvantaged patients. These include the Mental Health Integration Program, which was implemented in 2008 and has served over 35,000 patients in safety net primary care sites across Washington State, large integrated care programs in the Department of Defense, the DIAMOND program in Minnesota, and other settings.[36,37]

CC consists of longitudinal care provided in a primary care setting by a multidisciplinary care team, which includes a primary care provider and a care manager (e.g., nurse, clinical social worker, or psychologist), with support from a psychiatric consultant. A structured approach is applied to diagnosis and treatment in which care managers perform comprehensive patient assessments, help engage patients in self-management with educational tools and negotiation regarding patient views about their illness and treatment expectations, and provide brief evidence-based behavioral interventions. Patients' progress is monitored through proactive outreach and follow-up, monitoring outcomes with standardized tools (measurement-based care), along with systematic review of patients' outcomes based on an electronic registry. Through systematic caseload review with care managers, psychiatric consultants may assist with diagnosis, provide treatment recommendations for the primary care-based team to implement, and suggest modifications to treatment for patients who are not engaged in care or are not improving. Care managers assist with care coordination and communication between care team members, patients, and other healthcare providers. Such team-based, longitudinal care for a defined patient population is facilitated by a patient registry tracking system.

The CC model was designed and extended in order to improve patients' mental health and health outcomes in part through improved communication among patients and care team members. Although not explicitly designed to target health literacy, CC is compatible with the 'health literate care model'[38] and employs several recommended health literacy improvement strategies. For example, effective care managers provide educational materials, negotiate explanatory models of illness, and frequently conduct brown bag medication review (in which patients bring all of their prescribed and over-the-counter medications, supplements and herbal medicines to their appointment for review) and use teach-back techniques. Such strategies are likely a major reason why CC improves self-management activities such as medication adherence.[31,39] Moreover, proactive monitoring and care coordination help patients overcome health literacy limitations to navigate healthcare systems effectively, receive appropriate evidence-based care, and adhere to their care plans. By improving the accessibility of evidence-based care at a population-level, CC provides a disproportionate benefit to precisely those groups who are typically underserved and thus, the implementation of CC can function as part of a solution to ameliorate racial/ethnic disparities in service use and outcomes of care.[40–43]

Health information technology supports effective collaborative care

The delivery of effective CC is based on 5 key principles: care is patient-centered, evidence-based, measurement-based, population-based, and accountable.[44] Effective HIT is vital to the delivery of effective CC. The key principles of effective CC, the associated clinical processes, and the corresponding HIT tools that can support these activities are described in detail below and summarized in Table 1.

Patient-centered care

According to the Institute of Medicine, care is patient-centered when it is “respectful of and responsive to individual patient preferences, needs, and values, and [ensures] that patient values guide all clinical decisions”.[45] Effective CC programs implement this principle through coordinated and collaborative team-based care with care plans that are effectively shared between the patient, primary care and mental health providers on the care team.

Patient engagement is central to facilitating self-management. Addressing health literacy is essential to ensure a patient understands the illness and its treatment, and collaborates in the choice of treatment. Consistent with the ‘universal precautions’ approach to health literacy, patients are provided with accessible, simple education materials in video format or written to account for literacy limitations.[2,29,46] Such materials may be made available through clinic-based kiosks, DVDs, the internet, or mobile devices. Patients are encouraged to ask questions and discuss their understanding of their condition with their care manager during visits that can occur in person, by telephone or secure video, or through email depending on patient preference. Through secure patient portals, patients are granted access to their medical records and care plans and have the ability to communicate securely with providers and contribute information to their own records.

Because mobile devices are readily accessible, features including SMS, mobile web, and mobile apps may be used to support more complex self-management activities that promote behavior change and support adherence to care. Functions include alerts (such as reminders for medications, appointments, and other self-management activities), symptom monitoring and feedback, and algorithms to help patients identify or even troubleshoot if barriers arise. Mobile devices can support these functions through interactive and multimedia programs using touchscreen interfaces, auditory guidance, or in a patient’s own language. Voice recognition and emerging automated speech translation technologies may eventually facilitate synchronous or asynchronous communication across languages.[47] A recent study supports patients’ receptivity to using mobile devices for these purposes by documenting patients’ high expectations for the potential of mHealth tools to change how they seek information, self-manage, and communicate with providers in the near-term.[48]

Evidence-based care

In effective CC programs, treatments with evidence of efficacy are explained to and offered to patients. Clinical decision support and evidence-based treatment algorithms can be incorporated into electronic health records (EHRs) and/or patient registries to guide treatment decisions. Although tools such as these are targeted toward providers, the importance of patients’ demands for evidence-based care should not be underestimated, particularly as accessible information about effective treatment becomes more widely available to patients through the internet, mobile tools, and social media. Technology-enabled delivery of behavioral interventions may also increase the accessibility of evidence-based practices by increasing patient acceptance and/or extending the workforce capacity to deliver such interventions.[50,51]

Measurement based care

Outcomes are monitored systematically and treatments are adjusted by a 'stepped-care' approach for patients who are not improving. Patients are provided education about different ways to monitor their condition, including how standardized measurement tools are used, and patients are actively involved in monitoring their progress and the course of treatment.

Standardized measurement tools can be incorporated into providers' EHRs and patient registries and are currently available as mobile applications. Patient registries are used to track patients' progress so that treatment can be adjusted for patients who are not progressing. The registry can allow providers to sort an entire caseload of patients and can trigger alerts to providers for rapid identification of patients not improving or meeting the clinical targets defined by the program. The specific data used to monitor progress may come from standardized instruments for symptom self-report, patients' vital signs, laboratory data, or patient-generated goals. Such data traditionally has been collected in clinical settings, however through mHealth applications and remote monitoring devices, certain types of data may be collected in ecologically-valid contexts during the patients' daily life. Symptom self-reports and data that are passively collected through sensors (e.g., monitors for physical activity, blood pressure or blood glucose) may have utility for measurement-based care, although much work remains to determine how such data would need to be aggregated and how real-time data can improve clinical decision-making. Treatment adjustment based on monitoring outcomes may involve troubleshooting barriers for patients with insufficient adherence or modifying treatment for patients who do not improve despite adhering to care plans. Care plans are modified iteratively, with ongoing monitoring and adjustment over time until improvement occurs.

Population-based care

A defined population of patients is tracked in a registry, allowing providers to target care toward patients who are in the greatest need. Patients who have not been seen in clinic can receive outreach to improve engagement and retention in care. No one 'falls through the cracks'.

Patient registries are critical to track and monitor a defined group of patients in effective CC programs. Although simple spreadsheets can support some basic functions necessary for a registry, superior registries are centralized and cloud-based, supporting access by multiple users, including care managers and consultants, at all times.[52] The registry should allow sorting and actively alert providers through prompts that identify patients who have not been following up or who are not improving, so that outreach efforts can focus on these patients. Telemedicine can also facilitate population-based care, as services can be delivered to difficult-to-reach patients with sessions offered via telephone and/or secure video or webcam. As mobile video improves, the possibility for direct patient contact to occur in non-clinical settings is expanding and future applications of automated behavioral interventions may also support population-based care.

Accountable care

Healthcare providers are accountable for the care they deliver and payment models reward the delivery of effective care and good patient outcomes. Patient registries can quickly aggregate data on clinical processes and patient outcomes in support of quality improvement. Such information on quality of care can be used as a basis for compensating providers not only for the quantity but also for the quality and outcomes of services provided, a payment model that has been associated with improved patient outcomes in the Washington state Mental Health Integration Program.[53]

Effective clinical care models support appropriate health information technology

Federal initiatives and information technology development are creating new opportunities to improve health services and expand the reach of evidence-based practices beyond traditional clinical settings. Research to date suggests that patient-facing HIT tools are less effective when they are provided as stand-alone interventions, rather than in the context of a relationship with a counselor or healthcare provider.[54–56] Human support may increase the effectiveness of HIT tools by providing accountability and supporting patient engagement,[57] whereas stand-alone interventions demand greater motivation and commitment on the part of patients. This is particularly relevant given that most patients have at least some health literacy limitations and many have comorbid mental disorders, and thus may need additional assistance to engage and participate in care effectively. Efforts to incorporate HIT tools into healthcare delivery will be most successful when technologies are developed in the context of effective models of health service delivery that foster successful relationships between patients and their providers.

The Health Information Technology for Economic and Clinical Health (HITECH) Act, passed in 2009 as part of the Recovery Act, invests $26 billion in HIT by providing financial incentives for adoption of EHRs, as well as providing the Office of the National Coordinator with authority to define standards for their use. This legislation, considered an important foundation for US healthcare reform, seeks to promote the spread of EHRs to improve healthcare, with implementation scheduled in 3 phases from 2011–2016. Medicare and Medicaid provide incentives, which combined amount to more than $100,000 for every eligible healthcare provider, that are coupled with penalties beginning in 2015 for providers who fail to adopt EHRs that meet standards defined by the CMS Incentive Programs as ‘Meaningful Use’.[58] Specific requirements of Meaningful Use include evidence of patients’ use of HIT, which grants patients direct access to their own medical records, most often through a patient portal. Consequently, HIT is no longer just for healthcare providers’ use; the inclusion of patients as HIT users creates a need for well-integrated patient-facing and provider-facing tools.[11,49] With full implementation, HIT is intended to support patient empowerment, care coordination, improved patient outcomes, population-based care, and quality-improvement. These goals share substantial overlap with the principles and activities characteristic of effective collaborative care models and demonstrate the need to pair HIT with appropriate service delivery models.

The widespread adoption of mobile phones, and the particularly rapid rise of smartphone ownership, has created new opportunities to deploy mHealth tools to empower patients with both knowledge and skills to improve self-management that are accessible to patients in their daily life.[59,60] Because smartphone adoption by racial/ethnic minorities is happening at a much greater pace than among the general population, mobile technology has narrowed the pre-existing ‘digital divide’.[61,62] Furthermore, the near-ubiquity of mobile phones means that mHealth tools have the potential to reach populations that have not been accessible by traditional health services.

The vision for HIT, particularly mHealth, extends the reach of healthcare into patients’ lives to include ecologically valid patient assessments, care that is delivered remotely, continuously, and just-in-time, and interventions that are adaptive, personalized, and social, integrating formal and informal care in community-based or home-based settings.[59,63–65] The technical obstacles to full realization of this vision have been acknowledged;[63,65] however there has been less attention to the importance of the healthcare service delivery model as a facilitator or barrier. The potential for HIT tools to transform and complement clinical care cannot be fully realized in systems providing traditional healthcare services via standard clinical care pathways because such systems are not equipped to monitor populations of patients, provide proactive outreach, or to respond to real-time data on patients’ progress. Traditional delivery systems have limited experience with the use of decision-support tools or measurement-based care that is essential for systematic outcomes monitoring. In contrast, to make full use of current and emerging HIT tools, providers will need to be equipped to monitor a population of patients, track patients’ status and respond in a timely and appropriate manner. Standard workflows in traditional primary care overload physicians with tasks that can be performed by nonphysician clinical staff and therefore practices need to reorganize workflows and add clinical support staff who can help physicians utilize HIT to their advantage.[66] Care managers in a CC program have the requisite skills and an established clinical workflow that can help primary care providers make good use of the clinical information generated by HIT tools, particularly patient-generated data from mHealth tools. Thus, to realize the full potential that HIT can offer to extend care beyond traditional clinic settings *presupposes* delivery models that implement the principles of effective collaborative care (Table 1). The move toward service models that provide effective chronic disease care represents a major paradigm shift in medicine that is in its early stages. HIT tools can naturally extend the chronic care paradigm and enhance the resolution of effective models such as CC to provide treatments that are truly adaptive, and delivered in real-time. When coupled with appropriate health services, these technologies offer new avenues to extend the therapeutic process outside the clinic and into patients’ lives.

Despite incentives, less than half of US hospitals had an EHR in 2012[67] and healthcare systems have been slow to adopt HIT, which has led to the depiction of the field of medicine as “remarkably conservative to the point of being properly characterized as sclerotic, even ossified”[64] and a call for patients to drive transformation in healthcare. Accessible information about effective care will play an important role in stimulating patient demand for high-quality care. Patients already believe that HIT and mHealth tools will be an important force in achieving healthcare's Triple Aim, which includes improving accessibility, convenience, and quality of care, while simultaneously reducing healthcare costs.[48] Such consumer demand represents a potent change agent. Leveraging novel technologies to empower patients and extend the benefits of traditional clinical services represents a new direction for translational health sciences with the potential to make important advancements in healthcare delivery at a time when the need for such change is acute.

Conclusion

Transformations in US healthcare fueled by the Affordable Care and HITECH Acts are driving practice redesign and the adoption of HIT in parallel. These transformations coincide with advances in consumer technologies and shifts toward patient empowerment and shared decision-making in managing health. The most promising opportunities for progress emerge from the alignment of HIT functions with effective clinical models, such as the evidence-based collaborative care model. Such alignment of practice models with HIT will be necessary to take advantage of current and emerging technologies, to create new opportunities for patient care, research and quality improvement, and eventually to realize their transformative potential as part of the solution to pervasive disparities in healthcare delivery and patient outcomes in the United States, and may also be applicable internationally for systems seeking to leverage HIT in the service of chronic disease care.

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Highlights

- US health reform is driving practice redesign and health information technology use
- Health information capabilities should align with effective clinical care models
- Five key principles guide collaborative care, an effective model of chronic care
- Health information technology can support implementation of each principle
- Leveraging technology can extend evidence-based care beyond clinical settings

Table 1

Synergy between principles of effective collaborative care and health information technology to support clinical processes

Principle	**Clinical Processes or Tasks**	**Health IT Capabilities**
Patient-centered care	Patient education Patient engagement and activation Self-management support Shared decision-making to negotiate a care plan Effective coordination and collaboration among providers and patients	Education and self-management tools are delivered in multimedia format through the internet, mobile web, and mobile health apps and are accessible to patients at any time and from any location Patient medical records are accessible though patient portals Communication between patients and providers is facilitated through secure email Care plan and key patient outcomes relevant to the care plan are visible and can be shared effectively across providers and with patients
Evidence-based care	Shared decision-making to negotiate a care plan Accessible evidence-based behavioral interventions	Educational materials for patients and providers emphasize effective treatments Electronic health records or registries include clinical decision support and treatment algorithms for providers Technology-enabled delivery of evidence-based psychosocial interventions (by telephone, internet, mobile devices, or in computer-assisted formats) increases dissemination of evidence-based care
Measurement-based care, Treat-to-Target	Adjustment of care plan until clinical target achieved Systematic outcomes monitoring	Registry contains relevant data that may be entered by providers or by patients on clinical status and barriers. Data may be from standardized instruments for symptom self-report, vitals, labs, or passively collected sensor data Registry triggers alerts to providers for patients who are not improving
Population-based care	Systematic outcomes monitoring Proactive outreach	Registry tracks all patients initiating care – not only patients who present or return for services – and contains data on visits and outreach efforts, highlighting patients who are not engaged in care, and triggering alerts to providers for patients who are not improving Registry is accessible to care managers and consultants Telemedicine assessments and remote delivery of behavioral interventions can extend services to difficult-to-reach populations
Accountable care	Quality improvement	Registry aggregates data on processes and outcomes at the provider, practice, or organizational level