

Improving care by delivering the Chronic Care Model for diabetes

Heather L Stuckey¹, Alan M Adelman² & Robert A Gabbay[†]



Practice Points

- The Chronic Care Model provides the best evidence-based framework for organizing and improving chronic care delivery to ensure productive interactions between an informed, activated patient and a proactive prepared practice team.
- The Chronic Care Model defines six domains that require attention in order to optimize outcomes: delivery system design, self-management support, clinical information systems, decision support, community and health system-related issues.
- The most robust results are obtained when multiple elements of the Chronic Care Model are incorporated together.
- Team-based care is a particularly effective strategy to improve diabetes outcomes.
- Future models for diabetes care will need to continue to involve patients in designing the experience of the visit and various aspects of care improvement.
- Future diabetes care will continue to be delivered mainly in the primary care setting.
- Efforts must continue to bridge the gap between evidence-based recommendations and the current outcomes of patients with diabetes.

SUMMARY Despite robust evidence-based guidelines for diabetes care goals, the majority of patients do not reach these goals. This is not so much a shortcoming of providers or patients, but rather reflects our healthcare delivery system. Implementation of the Chronic Care Model has been shown to improve outcomes for diabetes by providing a system for productive interactions of a prepared proactive practice team and an informed empowered patient. The Chronic Care Model is the most evidence-based approach to transform primary care, where most patients with diabetes are seen. Increased focus on healthcare professionals implementing this robust model of care across different practice settings is needed to improve diabetes outcomes. In the future, appointments for patients with diabetes will also evolve to become more patient centered.

¹Pennsylvania State College of Medicine, Division of General Internal Medicine, 500 University Drive, H034, Room C6830C, Hershey, PA 17033, USA

²Penn State Milton S. Hershey Medical Center, Internal Medicine, Division of General Internal Medicine, 500 University Drive, PO Box 850, H034, Hershey, PA 17033-0851, USA; Tel.: +1 717 531 0003 ext. 287632; Fax: +1 717 531 7726

[†]Author for correspondence: Pennsylvania State Institute for Diabetes & Obesity, Pennsylvania State College of Medicine, Division of Endocrinology, Diabetes Program, 500 University Drive, H044, Room C6630, Hershey, PA 17033, USA; Tel.: +1 717 531 3592; Fax: +1 717 531 5726; rgabbay@psu.edu

Chronic diseases are the leading cause of death and disability in the USA, accounting for 70% of deaths or 1.7 million annually. Almost a half of Americans live with one or more chronic disease. Owing to the complexity and intense self-management required for diabetes, this disease serves as an example of how chronic care delivery can be implemented. The purpose of this article is to describe the elements of the Chronic Care Model (CCM), provide a vision of the future for chronic care, and support the widespread application of the CCM for diabetes care in the USA.

The future of diabetes care will be shaped by the frightening projections of increased incidence, producing more devastating complications and higher costs of care. Worldwide prevalence of diabetes mellitus is predicted to increase from 171 million in 2000 to 366 million in 2030 [1]. Current healthcare costs associated with diabetes and its complications total more than US\$174 billion in the USA. Despite the necessary efforts towards diabetes prevention, it is clear that the millions of individuals with diabetes with spiraling healthcare costs will require better care models.

As evidenced in the recent heated debate of healthcare reform in the USA, many drivers for new care models have been highlighted, the foremost of which appear to be high costs and suboptimal quality of care. This is true whether the payer is a government authority, private insurer or purchaser of healthcare. Nearly a decade after the Institute of Medicine's report describing 'Crossing the Quality Chasm' [2], momentum continues to build for implementation of better models of chronic illness care. Diabetes is at the forefront of these efforts. In many ways, diabetes is the hallmark disease for studying quality improvement because of prevalence and associated morbidities (i.e., hypertension, hyperlipidemia and retinopathy), cost and strong evidence-base for specific quality goals. The challenge remains that despite strong agreement about goals for A1c, low-density lipoprotein (LDL) cholesterol, and blood pressure (BP), only 7.3% of Americans with diabetes in 1999–2000 achieved the recommended target for all three goals, and only 37% of participants achieved the target goal of A1c less than 7.0% [3,4]. Fortunately, some improvements in A1c have been made over time, with the predictive margin for having A1c less than 7.0% increasing from 37% in

1999–2000 to 49.7% in 2001–2002 and to 55.7% in 2003–2004 [5]. This trend is encouraging for future reduction of diabetes-related complications, and may represent the ability of improved diabetes care to impact clinically significant outcomes.

For patients with Type 2 diabetes mellitus and those at risk of developing the disease, medical professionals in primary care are a critical foundation of the healthcare delivery system and will most likely continue to be. In general, patients with Type 2 diabetes are seen by primary care physicians and not by endocrinologists. In the USA, Type 2 diabetes patients consulting a primary care physician outnumber those consulting an endocrinologist by almost ten to one [6]. Starfield and others have shown that residents of countries with strong primary care foundations have improved health outcomes and lower mortality with lower costs and with fewer health disparities [7,8]. Despite the highest cost expenditure (\$7000 per capita), the USA has a weak primary care base and approximately 50 million uninsured citizens. It comes as no surprise that in a comparison of eight developed western nations, the USA had the most negative ratings for access, coordination and safety experiences [9]. As a result, any reorganization of care for diabetes will need to focus on the primary care settings.

In the crossnational Diabetes Attitudes Wishes and Needs (DAWN) study, attitudes towards diabetes care were assessed across 13 countries from Asia, Australia, Europe and North America [10,11]. Although variation existed among countries, in terms of both provider and patient perspectives of diabetes care, all respondents (primary care physicians, nurses and specialists) noted lack of care coordination and implementation of chronic disease strategies as areas in need of improvement worldwide. The payment system was also identified as a barrier in most of the countries surveyed, with the USA, Germany and Japan leading the way. Patients reported high ease of access to providers; however, patients' ratings of team collaboration among their providers were relatively low. By the same token, primary care physicians noted a lack of multidisciplinary care and a need for more coordination of care. This article will focus on the most promising models for diabetes care, provide current examples, and project into the future how these systems may evolve.

Elements of the CCM

Although several approaches have been utilized to translate evidence-based recommendations into clinical practice, the CCM has been the most effective model that has been implemented in a variety of healthcare settings in the USA and internationally, often with diabetes as the focus disease [12]. The CCM proposes that the productive interactions of a prepared proactive practice team and an informed empowered patient and family will lead to improved outcomes (Figure 1). An activated patient is one who has the motivation, information, skills and confidence necessary to make self-management decisions about their diabetes. Likewise, a prepared practice has the patient information, decision support and resources necessary to deliver high-quality care. The CCM provides a conceptual framework and roadmap for redesigning care from the typical acute, reactive system to one that is transformed to population-based, proactively planned care of individuals with chronic diseases such as diabetes.

The CCM has been employed for diabetes in a number of healthcare settings and it has demonstrated improvement in cardiovascular

risk factors and reductions in A1c [13,14], along with improvements in complication screening. Although simpler interventions would be attractive, the evidence suggests that high performing practices do best when they incorporate multiple elements of the CCM in a systematic approach [15–19]. The CCM focuses on six elements, including: first, delivery system design, which relates to the systems for delivery of care, such as team-based approaches to patient care, and patient-centered approaches that attend to the need of the patient both during a clinical visit and follow-up care; second, self-management support, focused on providing the knowledge, effective strategies and support for patients to successfully manage their disease; third, clinical information systems, which are the systems that leverage information technology to provide timely reminders to patients and providers, as well as searchable information on diabetes populations; fourth, decision support, used to embed evidence-based guidelines into clinical practice and share the information with patients to encourage their participation; fifth, community, where patients are encouraged to

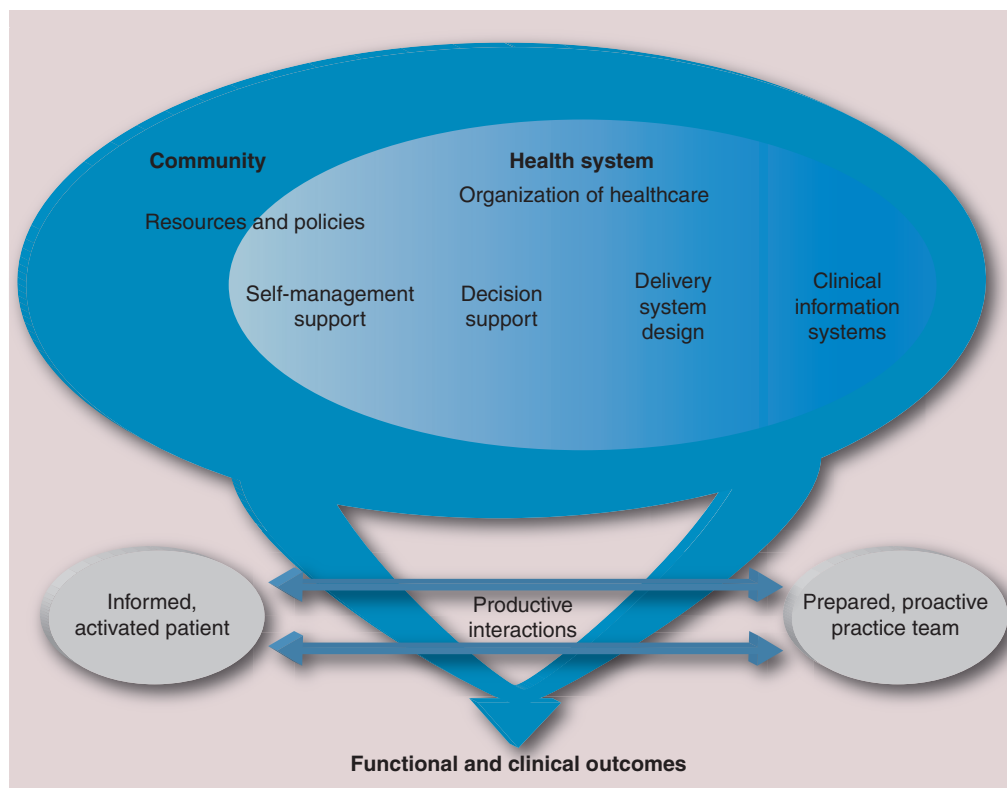


Figure 1. The Chronic Care Model.

Reproduced with permission from [12].

participate in effective community programs and providers partner with the community to fill gaps of care; and sixth, health systems, which focuses on promoting effective improvement strategies, such as better reimbursement models and leadership that stresses the importance of optimal care. Each of these elements are discussed below, as well as evidence of their effectiveness that supports the CCM.

Evidence of the usefulness of the CCM based on the six elements

Mounting evidence from comparison of high and lower performing practices, evaluation of large-scale quality improvement efforts and randomized intervention trials have demonstrated that the implementation of the CCM is feasible by busy practices with resultant improved disease outcomes. This article is not intended to be a comprehensive review of the literature on the CCM, as a recent CCM review has been published [20]; rather, the evidence has been synthesized from articles, abstracted from Medline from 1996 to present, representing current perspectives that highlight key concepts of the CCM. Although the CCM has been studied in a variety of populations, including chronic pulmonary disease [21], obesity [22], osteoarthritis [23] and colorectal screening [24], the model has been studied most extensively in diabetes [25].

In a rural population, quality improvements in the CCM were measured by conducting chart reviews to determine providers' adherence to the American Diabetes Association (ADA) Standards of Care, including recording of demographics, practice process measures (annual A1c testing, BP measurement, lipid profile, microalbumin tests, dilated eye examination, foot examination and monofilament testing) [26]. Published research shows that populations experiencing health disparities are particularly likely to benefit from implementation of the CCM [27,28] and the Health Disparities Collaboratives that focused on CCM implementation in Federally Qualified Health Centers (FQHC) [29–31]. These populations are often in most need of connecting with community resources and fostering for self-management and would benefit greatly from enhanced case management and delivery of culturally competent care in the delivery system design. However, the literature is inconclusive on the impact of CCM on diabetes patients.

Improvements in processes were noted in two separate studies [29,31], while both lower hemoglobin A1c and lower LDL cholesterol were also reported by the first study. In a randomized controlled trial of diabetes patients, using the CCM in an underserved community led to a marked decline in A1c (-0.6% ; $p = 0.008$) compared with other groups (usual care or provider education only) [18]. While some studies have had less robust clinical outcomes, others have shown significant impacts. For example, the aim of the Veracruz Initiative for Diabetes Awareness (VIDA) study was to improve the quality of diabetes in primary health centers directed at four components of the CCM: self-management support, decision support, delivery system design and clinical information systems [32]. The proportion of patients achieving three or more quality improvement goals increased from 16.6 to 69.7% ($p < 0.001$) among the intervention group, while the usual care group experienced a nonsignificant decrease. In this collaborative learning process, the focus on the primary care team and the participation of people with diabetes were strategic elements incorporated into the methodology, expected to ensure sustainability of continued improvement of health outcomes.

Each of the six elements interconnect and can be applied as a whole to diabetes management (Table 1). Elements of complex systems, such as those described in the CCM, interact dependently and are at times unpredictable. To adapt to the changes necessary to be effective, systems require a democratic, open and networking style of management [33]. In the CCM, this interlocking complexity can be seen in the flexibility of delivery system design, a team-based approach to self-management and decision support, and reliance on community resources.

■ Delivery system design

Although the best results are obtained when multiple facets of the CCM are implemented together, probably the most effective quality improvement intervention in diabetes care involves delivery system design to incorporate a team-based approach [34], partly because it is the healthcare system of delivery, rather than individual physicians, that needs to be transformed. No longer can a system based on the physician as the sole leader and implementer of all care plans be a high functioning medical organization. The care team needs to be expanded to care for the complex needs of

Table 1. Evidence of the Chronic Care Model in diabetes.

Elements of the Chronic Care Model	Examples of the Chronic Care Model in diabetes management
Delivery system design	Team-based patient care Standing orders for routine laboratory tests Automated letters to patients overdue for diabetes screening tests
Self-management support	Motivational interviewing Web-based diabetes education Problem-solving skills and support
Clinical information systems	Patient registries to identify high-risk patients Tracking referrals and identify gaps in care
Decision support	Prompts to providers for overdue care Providing patients with evidence-based goals and data summaries (e.g., report cards)
Community	Referrals to local gyms, studios or exercise facilities and programs Referrals to healthy food memberships or programs (i.e., Weight Watchers®)
Health systems	Establishing a culture that supports quality Pay for performance, quality-driven care

those with diabetes. In many ways, team management has long been considered a central feature of superior diabetes care. Diabetes educators and dietitians have long been part of standard diabetes care and the roles of these and other individuals within the healthcare system must expand. In the delivery system design, defined roles and distribution of tasks among team members becomes even more critical as the coordination of care increases in complexity.

In our experience, diabetes team-based care allows task distribution to identified team members to: first, track longitudinal information through flowsheets or registry data; second, perform BP and foot examinations; and third, ask patients about self-care goals and barriers prior to the primary healthcare provider meeting the patient. Standing orders can be used to empower office staff to order overdue laboratory screening and eye examination referral, and can even extend to provider-approved algorithms for medication intensification. Appropriate communication between team members is the key, and the incorporation of clinic ‘huddles’ at the beginning of the day can ensure that appropriately planned care is delivered to all individuals with diabetes. It is imperative to identify the critical elements for effective teams to transform healthcare workplaces into effective team-based environments that focus on improved diabetes outcomes [35].

A central tool for delivery system design is care management. Diabetes has been a fertile testing ground for case management approaches

in which usually either a nurse or pharmacist meets regularly with high-risk patients to provide intensified care [34,36]. Care populations are segmented based on needs to ensure that appropriate care intensity is provided. Key elements of care management include: first, defining and identifying high-risk patients; second, case assessment; third, individualized care plans; and fourth, development, implementation and monitoring of outcomes.

Diabetes registries are an ideal source for identifying high-risk patients either based on clinical parameters (e.g., A1c levels), low self-management skills or overdue visits. Intensification of therapy can be facilitated by empowering other healthcare providers through standing orders to implement changes and by clearly assessing health management needs and support. Care management is most effective when incorporated within the primary care clinic as opposed to ‘carve out’ models where an outside entity provides telephonic care management for patients and which may subsequently lead to ineffective communication with the primary healthcare provider. Integration of care management within the primary care practice ensures appropriate information exchange, shared goals and coordination of care and patient follow-up.

Diabetes nurses are eager to increase their involvement and take on more responsibility for diabetes care, as recently surveyed internationally through the DAWN study [10]. Pharmacists have also been working with primary care

physicians in a case management role in the Asheville Project, a disease management program that offers the added healthcare benefit of monitoring services provided by community pharmacies to patients with diabetes [37]. This long-term study is unique because it is the first to provide an up to 5-year assessment of the clinical and economic outcomes of pharmaceutical care services provided by community pharmacies to patients with diabetes mellitus. Recent reimbursement changes within the US Medicare system have facilitated billing for these pharmacist services based on nonrandomized trials in which this case has been found to be cost effective.

One controversy has been the extent to which case management permits medication titration. Two models have been used: one in which the case manager advises the primary care physician who then makes the medication change; the second in which a standing order treatment algorithm enables a case manager to intensify treatment without routinely checking with the primary care provider. Although studies suggest that standing order algorithms are more effective in lowering A1c levels [34,36], some physicians have concerns about nurses or pharmacists making these changes without routine provider input. As more studies and appropriate training programs are developed to allow other health professionals to assist in medication titration, this approach will continue to show promise in improving clinical outcomes whilst not overburdening the already overtaxed primary care system.

Shared care is defined as “the joint participation of primary care physicians and specialty care physicians in the planned delivery of care for patients with a chronic condition, informed by an enhanced information exchange over and above routine discharge and referral” with the potential to improve the management of chronic diseases and lead to better outcomes than either primary or specialty care on their own [38]. At present, when most patients are referred to endocrinologists, care is subsumed by the specialists and true comanagement is rare. In a recent Cochrane review that examined shared care across multiple chronic illnesses, limited data was available on effective models [39]. Better coordination of care between primary care providers and endocrinologists will be needed for models of the future. In addition, the healthcare system will need to address the shortage of endocrinologists to meet the growing diabetes epidemic [40], as well as the shortage of primary care providers to whom

patients are referred for ongoing care [41]. Given the demand for diabetes healthcare professionals, it is even more critical for primary care providers to receive patient information to coordinate care efficiently across the spectrum of the healthcare delivery system.

■ Self-management support

Traditional diabetes patient education and self-management support emerged from two different philosophies regarding the role of the physician and the patient. Traditional education conveys disease-specific information and technical skills, in relation to diet, exercise and medications. Patients are taught the techniques of blood-glucose monitoring and insulin injections from a professional. Analogous to traditional care, healthcare professionals decide what information and skills to teach, and the physician–patient relationship consists of the patient presenting their illness and the physician providing knowledge.

By contrast, self-management support permits and encourages patients to problem solve and make their own decisions, act on appropriate measures and moderate measures taken based upon negative or positive encounters in conditions or disease [42]. At the core of self-management support is the patient-generated short-term action plan, made either in conjunction with, or independent of, healthcare professionals. One of the most important elements of action plans and diabetes self-management overall is the self-efficacy of the patient. The concept of self-efficacy, based on Bandura’s social cognitive theory, states that a patient’s confidence in their personal ability to perform a health behavior (e.g., exercise or take appropriate medication) influences the behaviors in which he/she will actually engage [43–45]. Overall, the two most important identifiers in self-management are: first, patients learn problem-solving skills in order to administer plans for solutions; and second, those skills are applied to the three tiers of chronic illness, which are medical, social and emotional. With the information provided by their physicians and outside resources, patients are able to solve their own problems from their own developed point of view [42]. Self-management support assists patients in accomplishing particular tasks and behaviors in relation to their disease by providing regular assessment of progress and problems, goal setting and problem-solving

support [101]. Self-management support has led to short-term improvements, such as self-efficacy, self-rated health, cognitive symptom managements and frequency of exercise. Other improvements are associated with reductions in pain, disability, fatigue, depression, anxiety and health distress [46].

One promising approach to self-management through behavioral change is motivational interviewing. Initially utilized in the addiction field, motivational interviewing is now being applied to a number of chronic diseases, including diabetes [47–49]. Motivational interviewing is a teachable, evidence-based approach that holds significant promise to improve team-based support for patient diabetes self-management [50]. It is a directive, patient-centered counseling style for eliciting behavior change by helping patients to explore and resolve ambivalence toward their diabetes self-management. It is a collaborative, patient–provider model, which stresses that motivation must come from the patient, not the provider. The responses that the patient gives are used in the direction and treatment of their care. For example, if a patient has a suboptimal A1c, the provider would ask what the patient believes may be contributing to the higher number. From there, a plan is developed on how to make steps to improve overall glycemic control, directed by the patient.

Self-management support programs have been developed, such as the Stanford Diabetes Self-Management Program [102] and the Expert Patients Programme [103], and are available online, allowing accessibility to self-management support. Common elements in these programs include problem solving, decision making, utilizing available resources, developing relationships and partnerships with members of the medical team, and taking action steps to improve outcomes. In an Internet study of diabetes self-management, problem-solving methods included bulletin boards that allowed the participants to support each other and, thus, increase self-efficacy [51]. The participants were highly encouraged to share their action plans and activities with family and friends to build a supportive environment for progression. Moderators also served as coaches to push participants to do more than what they were doing at the time. The program proved to be accommodating and accessible to various styles of settings, as well as culturally feasible in different tribal and geographic communities.

Whether through the Internet or face-to-face, problem solving and peer support are desired methods of self-management support because it is easily implemented after studies are conducted. Self-management support is an integral part of the CCM, as the physician is not the only one making decisions about a patient's medical treatment. Instead, the healthcare provider's role is to generate a structure that provides sufficient diabetes knowledge, motivation to do well and recognition of the patient's central role in his/her care. The provider's responsibility is to listen to the needs of the patient and help to find resources to meet deficiencies to improve diabetes self-management. With self-efficacy, education and support, the patient is encouraged to recognize his/her potential in improving diabetes outcomes and reducing complications.

■ Clinical information systems

Clinical information systems leverage information technology to provide timely reminders to both providers and patients and to identify high-risk subpopulations for proactive care. Diabetes registries that provide searchable information on diabetes populations have proliferated in many healthcare settings involving municipalities, academic health centers, third-party payers, rural community health centers and the US Veterans Affairs Health System [52]. The well-designed registry lists all members of the patients' health team, and provides key information for patients and providers. Data in the registry can provide snapshots of care that can collate the various elements needed for optimal care (e.g., last eye examination, foot examination, nephropathy screen, A1c, cholesterol and BP) and can include prompts for care (Figure 2). The critical impact of the registry is that it can allow timely identification of high-risk subpopulations, permitting the healthcare team to intensify treatment. For example, data from the Chronic Disease Electronic Management System (CDEMS) study were used to determine whether national and state objectives for diabetes care were met to monitor the status of care [53]. The conclusion of the CDEMS study was that data from clinical information systems could be combined to address deficiencies in state-level diabetes surveillance and capture clinical biometric values to measure intermediate health outcomes. In an analysis using data from a rural community health center, the registry assisted in significantly improving 12 of 13 care processes (annual examinations, screens to promote wellness, education

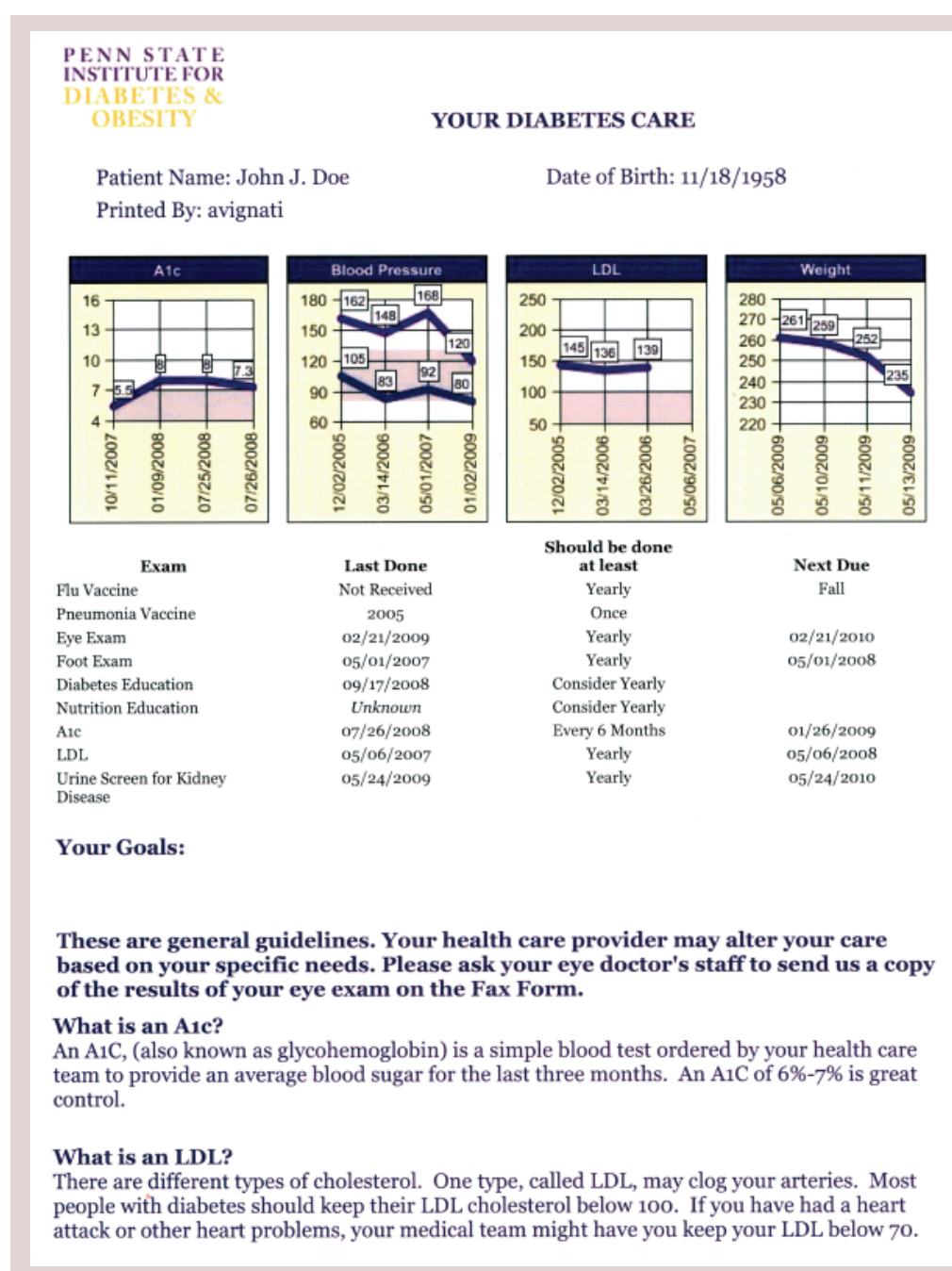


Figure 2. Pennsylvania Institute for Diabetes and Obesity (PA, USA) for Diabetes and Obesity registry patient-provider care sheet.

LDL: Low-density lipoprotein.

and self-management goal setting) and three of six clinical outcomes (A1c, LDL and cholesterol) for patients exposed to at least medium levels of registry utilization [54]. This study determined that basic registry utilization may be sufficient to drive improvements in provider-patient care processes and in patient outcomes. Individuals

with poorer A1c control could be identified and targeted for more intensive treatment by the use of diabetes registries.

Although the use of health information technology may lead to more efficient, safer and coordinated care for chronic illnesses in particular, the primary challenge to further adoption of

registries is cost and compatibility of different electronic health record systems [55,56]. In a survey of acute care hospitals, respondents cited high capital and maintenance costs as the primary barriers to implementation [55]. Furthermore, the programming and implementation of patient registries is time consuming. Caution is needed to avoid wasting time and resources on implementing information technology solutions to diabetes care without attending to some of the more fundamental practice redesign issues of caring for patients in a team-based environment to provide self-management support.

The widespread availability of the Internet makes it an attractive communication tool among patients and providers. The Internet has been useful in multiple areas ranging from videoconferencing for diabetes education to tele-ophthalmology, to patient support and education websites. Many patients desire to communicate regularly with their providers and share feedback and receive advice in a timely manner [57]. Web-based management of diabetes through patient-initiated glucometer uploads can facilitate provider treatment intensification and has demonstrated mixed results in different patient populations [58]. One benefit is that glucometer uploading is more accurate than patient-recorded values. It is easier for patients to give their meters to their provider's office or through an electronic upload over the Internet than to keep a written log of blood glucose values. There is also less opportunity for patients to falsify records, whether intentional or not.

A potential advantage of between-visit care offered by this type of telemedicine approach is an improvement in the 'velocity to goal' (i.e., how fast the patient reaches good diabetes control). Studies suggest that the average time between treatment intensification in some cases may be as long as 27–35 months [59]. Telemedicine provides a significant opportunity to give providers updated clinical data for more appropriate and timely medication adjustments. However, enthusiasm is tempered by the data burden presented by the frequent communication between patients and providers related to blood glucose values, which is often not reimbursed by payers. Reimbursement could facilitate greater adoption of this approach, and future advances could provide clinicians with treatment algorithms that can assist clinical decisions by interpreting data from these glucometer downloads.

■ Decision support

Embedding evidence-based guidelines into daily clinical practice and sharing those guidelines and information with patients to encourage their participation are the keys to decision support. The first step is identifying clinical care goals, followed by the response to help patients achieve minimum goals. The ADA and national bodies, such as the National Institute for Health and Clinical Excellence (NICE), provide detailed best practices guidelines [60] to ensure positive clinical outcomes. Decision support, however, goes beyond the distribution or acceptance of consensus guidelines and focuses on the implementation of those guidelines in everyday practice. Although provider education regarding guidelines is important, these interventions typically have had limited impact beyond processes of care (i.e., ensuring that more patients are screened for complications). To help integrate the guidelines into practice, providers can explain what the guidelines mean and distribute copies to those individuals who are interested. Self-directed patients can be led to websites, such as the ADA for clinical guidelines or Improving Chronic Illness Care organization [104], to help them understand the elements of their care in the CCM. Educated and activated patients can be given the same information as providers, to help make appropriate, team-based, self-management decisions.

For providers, examples of guideline implementation can include incorporating decision support into electronic health records or reviewing charts prior to a planned visit to identify gaps in care and strategies to intensify the treatment plan. Although provider knowledge of guidelines is critical, these guidelines also need to be shared with patients to encourage their participation. Empowering patients to 'know their numbers' (i.e., A1c, BP, LDL and weight) provides the basis for a negotiated treatment plan to achieve those goals. This approach can be adapted beyond the traditional primary care setting to include other specialists integral to diabetes care, such as nephrologists or ophthalmologists [61].

Given the evidence that BP control can reduce both microvascular and macrovascular complications, future efforts will clearly focus on identifying better approaches for monitoring this outcome. Self or automated BP monitoring offers many of the same advantages as glucose monitoring. Increased number of BP recordings

increases the accuracy of the measurement. It may also empower patients to discuss their BP with their physician [62]. Home monitoring, in conjunction with other interventions such as patient education, internet communication, nurse or pharmacist follow-up, does lead to improved BP control [62–64]. Telemonitoring of BP may lead to reductions in both systolic and diastolic BP [65]. It is important for patients and providers to have productive communication in decision support, and the sharing of guidelines could help patients become more active requesters of evidence-based care.

■ Health systems

The diabetes care culture must promote effective improvement strategies and support optimal diabetes care, particularly through effective leadership and incentives to get better. In suggesting solutions to improve the healthcare system, Berwick *et al.* provide insight into important aspects of the healthcare delivery system that translate into improved outcomes [66]. They propose that an effective healthcare system that produces outstanding health outcomes pursues three primary goals, referred to as the ‘triple aim’: first, improving the patient’s experience of health; second, improving the health of a defined population; and third, reducing the costs of care for populations. To implement a healthcare organization successfully, three preconditions must be satisfied. First, the healthcare system must be focused and responsible for the health of a defined population. Second, the system does not have unlimited resources; thus, monetary and related constraints are placed on the system. The USA has experienced unrestrained healthcare costs and spends far more than any other developed country’s health system, yet its health outcomes lag behind other countries [105]. Third, there is an over-arching entity that is responsible for the health of the population and pursues the goals of the triple aim.

Several approaches have been utilized from perspectives to improve clinical outcomes for different diabetes patients. Disease management programs have proliferated in the USA, and worldwide there has been enthusiasm for pay-for-performance (P4P) models that alter reimbursement based on achievement of quality goals. Reimbursement of providers of care may be a mechanism for improving health outcomes of individuals with diabetes. Recently P4P has been touted as a way of incenting clinicians to

improve the quality of care that they deliver, but P4P programs may have both benefits and adverse effects. Adverse effects can include focusing on only those elements measured and avoiding severely ill patients who may adversely affect performance measures [67]. In a study of the effects of P4P on intermediate outcomes for patients with diabetes in the UK, Millett *et al.* found that while improvements were made, the magnitude of improvements differed according to ethnic group [68]. Comparing P4P between primary care practices in the USA and UK, McDonald and Roland reported that there were unintended consequences due to the implementation of P4P [69]. Physicians in the USA were more likely to report that P4P had little impact on their office and voiced feelings of resentment, lack of understanding of the program, loss of autonomy and less satisfaction than their British counterparts. Design elements such as who is incented (individual clinicians, medical groups or hospitals) and what is incented (documentation of process of care measures or outcome measures) may be important. Fundamentally, the challenge has been a mismatch between who bears the costs of implementation (typically the provider or practice) and who benefits from potential cost savings from better care and reduction in diabetes complications (the payer).

Another reimbursement model being explored is providing patients with monetary incentives to engage in appropriate self-care and/or removing financial barriers to care. A municipality in Asheville, NC, USA, eliminated pharmaceutical costs for diabetes patients in return for mandated regular pharmacist visits and noted significant savings in healthcare costs [70,71]. Large corporations have been examining other models whereby patients are incentivized to engage in various programs or activities, such as those offered in the community. However, to date there is limited data regarding the efficacy of these initiatives despite their potential promise.

■ Community

Community resources are often overlooked and not integrated into care for diabetes patients, as they are viewed as an external part of the system. In the CCM, community resources are essential to patient care, particularly in limited resource environments where it is necessary to extend care beyond the clinic. Community programs, such as Active Living by Design, encourages the

implementation of best practices in the community for active living, and includes those who could most benefit through a strategic composition of the community partnership [72]. In this way, progressive programs and policies can be adopted by a diverse spectrum of neighborhoods and organizations, not just those that are affluent or better resourced.

In diabetes care, community peer-led support groups are an effective approach in reaching populations who need additional support between clinic appointments [73–76]. Community healthcare worker programs that provide support and self-management training may also be effective in promoting more effective diabetes care in diverse populations [77–80]. Many important services and resources for people with chronic illness are not part of the medical system, such as peer support and exercise programs. Resources in the community can assist in helping patients fill gaps in their medical care and support that are not available or are not accessible. For those who have Internet access, disease-specific and community-based programs have become available to improve educational knowledge, social support, and decrease emotional distress and depression that may accompany chronic illness. In a study involving both Internet and cellular phone technology, A1c was improved at 6 months postinitiation in patients with Type 2 diabetes, thus indicating that the use of a convenient web-based education system could be more effective for glycemic control than traditional education [81]. To improve access to diabetes self-management resources for patients, health providers can become more familiar with resources in the community and work collaboratively to make patients and patient families aware of opportunities, such as safe exercise groups, healthy food availability, social programs and support services, that are available.

Future perspective

Evidence now suggests that the simultaneous incorporation of multiple components of the CCM is synergistic and more effective than traditional single intervention approaches [15,34]. Too much of past research focused on only a single intervention and, therefore, missed the potential value of the concurrent implementation of multiple interventions for true ‘transformation of care’. As healthcare

reform will produce new reimbursement models for quality care, a greater incentive for implementation of the CCM may exist. This transformation of care should become an issue of chronic care management research for at least the next 5–10 years.

Transformation of care, according to the CCM, has been accomplished through ‘learning collaboratives’ either through the Breakthrough Series Collaborative [82] or through other similar experiences. Widespread implementation in the USA has generally occurred in large organizations, in part, based on supportive reimbursement systems. Nevertheless, external support for practice transformation is being explored in several regional improvement programs [83,106]. Recent position statements from many professional societies, such as the ADA [84] and the American Association for Diabetes Educators [85], have strong support for the CCM. Alternatives to the time-consuming learning collaborative model, such as practice coaching and web-based learning networks, are being developed and tested at the Institute for Health Improvement and the MacColl Institute for Healthcare Innovation, MA, USA.

Another closely aligned initiative to improve chronic disease management has focused on the Patient-Centered Medical Home (PCMH) [86,87]. The PCMH combines the principles of primary care (continuity of care, whole person orientation, quality/safety, prevention and timely access to care) with many of the elements of the CCM (coordinated/integrated care, teams and population health). One of the driving forces behind this concept is to revitalize primary care in the USA.

Several states have explored integrated approaches to adopt the CCM and PCMH [88–90]. The foremost of these has been the initial experience in Pennsylvania, where a coordinated multipayer supported implementation of CCM and PCMH is occurring based upon a recommendation of the Pennsylvania Chronic Care Commission and is supported by the state’s Governor’s Office for Healthcare Reform (GOHCR) [105]. The GOHCR convened multiple insurers to establish incentives for a PCMH implementation that included enhanced payments for infrastructure and resources. Provider performance incentives are paid for the implementation of the PCMH, as defined by the National Committee for Quality Assurance PPC–PCMH certification

program. The GOHCR serves the unique function of not having regulatory oversight over the insurers and, therefore, can act as a convener while avoiding antitrust issues. Therefore, the Pennsylvania GOHCR successfully brought together payers, providers and patients and overcame issues of trust to make this a groundbreaking government reform effort.

The initial focus of the state-wide PCMH initiative has been diabetes with planned expansion to other chronic illnesses over time. Five key elements of the Pennsylvania PCMH initiative supported the implementation: first, breakthrough series learning collaboratives where groups of practices (25–30 in each region) meet quarterly to plan and implement aspects of the CCM; second, monthly reporting of quality indicators using a registry system; third, improving performance through practice coaches that meet with practices individually to problem-solve implementation efforts; fourth, physician practice connection (PCMH certification by the National Commission for Quality Assurance); fifth, multipayer enhanced financial reimbursement with inclusion of all key payers in the state.

Clinics are required to report on clinical outcomes and care changes on a monthly basis, and payers have agreed to provide funding for required practice changes, such as case management, in the hopes of containing spiraling healthcare costs [19]. With Pennsylvania being at the forefront of change in practice, the future of chronic care delivery for diabetes is moving in a positive direction.

In order to transform care to be truly patient centered, future models for diabetes care will need to continue to involve patients in designing the experience of the visit and various aspects of care improvement. As care becomes more patient-centered, a key need is for health professionals to involve patients in designing the type of care and how it could be implemented. The patient's perspective is needed because, without the inclusion of the affected individual's perspective, the information, from the provider's perspective may be incomplete or misleading [91]. For example, opportunities exist to improve the prearrival visit so that patients could spend quality time speaking with their provider, as opposed to providing data that could be obtained through clinical information systems. To accomplish this, patients could utilize kiosks in waiting

rooms to search for specific disease conditions and receive tailored messages about their health that prompt questions they may want to ask their provider during the visit. Creating such opportunities for 'patient activation', which enables patients to become collaborative partners in managing their health have had some promising results [92–94]. Where kiosks are not feasible, low-tech (paper) methods to capture current medical histories, patient concerns and symptom screening (e.g., depression) would give patients more time with the provider to focus on the issues they want to address. During the appointment, less time would be spent talking about factual information that could be captured electronically (e.g., medications, insurance information, address changes and phone numbers) and more time talking about what matters most to the patient.

In the future of diabetes care, health professionals will want to critically examine those things that prevent our clinical practice from being successful. By asking patients what they want and need from us will improve upon the productive interaction between patients and providers, which is the primary goal of the CCM. We want to ask ourselves and our patients "What are the barriers that prevent us from achieving success?" and take action based upon those recommendations. This process will help us redesign our practice to meet needs and provide self-management improvement for our patients.

Optimal care lies in developing integrated systems of care that are responsible for the outcomes and in getting individuals to take more responsibility to manage their own disease. Diabetes has been the focus of many CCM implementations in part because it represents a costly disease reaching epidemic proportions. Therefore, there are many evidence-based goals of care that can prevent long-term complications, the source of most of the overall costs of diabetes. Driven by the need to control healthcare costs and narrow the diabetes quality chasm, implementation of the CCM is likely to expand in the near future as an optimal care delivery model.

Conclusion

The CCM has been implemented in a number of practice settings with improvements in diabetes quality of care. The model provides a conceptual framework to promote productive interactions

between a proactive, prepared practice team and an informed, activated patient. The assignments of this model to different clinical practice settings and further dissemination of the model are needed to support the widespread application of the CCM for diabetes care in the USA. Since the development and delivery of health-care will become more patient-centered, collaboration between patients and practice teams will be required to improve clinical outcomes, and subsequently costs. Understanding the needs of patients, creating the ideal environment for their care and using system-based approaches to optimize their care will converge to improve the lives of those with diabetes in the future. Supporting self-management will be critical to achieving these outcomes, both for clinicians and for the patients who depend on the support of the system to manage chronic illness.

Bibliography

Papers of special note have been highlighted as:

- of interest
 - of considerable interest
- 1 Wild S, Roglic G, Green A, Sicree R, King H: Global prevalence of diabetes. Estimates for the year 2000 and projections for 2030. *Diabetes Care* 27(5), 1047–1053 (2004).
 - 2 *Committee on Quality of Health Care in America: crossing the quality chasm: a new health system for the 21st century*. National Academy Press, Washington DC, USA (2001).
 - A detailed review of the literature on the quality of care; identifies strategies for raising the awareness of quality concerns and environmental forces that encourage or impede efforts to improve quality; develops strategies for fostering greater accountability for quality; and identifies important areas of research that should be pursued to facilitate improvements in quality.
 - 3 Saydah SH, Fradkin J, Cowie CC: Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. *JAMA* 291(3), 335–342 (2004).
 - 4 Hoerger TJ, Zhang P, Segel JE, Gregg EW, Narayan KM, Hicks KA: Improvements in risk factor control among persons with diabetes in the United States – evidence and implications for remaining life expectancy. *Diabetes Res. Clin. Pract.* 86(3), 225–232 (2009).
 - 5 Hoerger TJ, Segel JE, Gregg EW, Saaddine JB: Is glycemic control improving in U.S. adults? *Diabetes Care* 31(1), 81–86 (2008).

Acknowledgements

The authors wish to acknowledge their collaborators and colleagues, whose support has made the present and future work in diabetes possible, particularly Christopher N Sciamanna and Robert C Aber. We also wish to acknowledge Chelsea A Doub, Pennsylvania State University biobehavioral health student, who assisted with editing and review of references.

Financial & competing interests disclosure

The authors have no relevant affiliations or financial involvement with any organization or entity with a financial interest in or financial conflict with the subject matter or materials discussed in the manuscript. This includes employment, consultancies, honoraria, stock ownership or options, expert testimony, grants or patents received or pending, or royalties.

No writing assistance was utilized in the production of this manuscript.

- 6 Saudek CD: The role of primary care professionals in managing diabetes. *Clinical Diabetes* 20, 65–66 (2002).
- 7 Starfield B, Shi L, Grover A, Macinko J: The effects of specialist supply on populations' health: assessing the evidence. *Health Aff. (Millwood)* Jan–Jun; Suppl. Web Exclusive: W5.97–W5.107 (2005).
- 8 Starfield B, Shi L, Macinko J: Contribution of primary care to health systems and health. *Milbank Q.* 83(3), 457–502 (2005).
- 9 Schoen C, Osborn R, How SK, Doty MM, Peugh J: In chronic condition: experiences of patients with complex health care needs, in eight countries, 2008. *Health Aff. (Millwood)* 28(1), W1–W16 (2009).
- 10 Siminerio LM, Funnell MM, Peyrot M, Rubin RR: US nurses' perceptions of their role in diabetes care: results of the cross-national Diabetes Attitudes Wishes and Needs (DAWN) study. *Diabetes Educ.* 33(1), 152–162 (2007).
- 11 Peyrot M, Rubin RR, Lauritzen T *et al.*: Patient and provider perceptions of care for diabetes: results of the cross-national DAWN study. *Diabetologia* 49(2), 279–288 (2006).
- 12 Wagner EH: Chronic disease management: what will it take to improve care for chronic illness? *Eff. Clin. Pract.* 1(1), 2–4 (1998).
- Describes a model for improving chronic illness care that incorporates these and other successful interventions. The Chronic Care Model (CCM) suggests that the patient–provider interactions resulting in care that improves outcomes are found in health systems that have well-developed processes and incentives for making changes in the care delivery system, assure self-management support, reorganize team function, implement evidence-based guidelines and enhance technology to facilitate the development of disease registries.
- 13 Wagner EH: A survey of leading chronic disease management programs. *Manag. Care Q.* 7(3), 56–66 (1999).
- 14 UK Prospective diabetes study (UKPDS) Group: Intensive blood-glucose control with sulphonylureas or insulin compared with conventional treatment and risk of complications in patients with Type 2 diabetes. *Lancet* 352(9131), 837–853 (1998).
- 15 Wagner EH, Austin BT, Davis C, Hindmarsh M, Schaefer J, Bonomi A: Improving chronic illness care – translating evidence into action. *Health Aff. (Millwood)* 20(6), 64–78 (2001).
- Developed more than a decade ago, the CCM is a widely adopted approach to improving ambulatory care that has guided clinical quality initiatives in the USA and around the world. Accumulated evidence appears to support the CCM as an integrated framework to guide practice redesign. Although work remains to be done in areas such as cost–effectiveness, these studies suggest that redesigning care using the CCM leads to improved patient care and better health outcomes.
- 16 Bodenheimer T, Wagner EH, Grumbach K: Improving primary care for patients with chronic illness. *JAMA* 288(14), 1775–1779 (2002).

- Case studies are provided describing how components of the CCM have been implemented in the primary care practices of four healthcare organizations.
- 17 Wagner EH, Austin B, Von Korff M: Improving outcomes in chronic illness. *Manag. Care Q.* 4(2), 12–25 (1996).
- 18 Piatt GA, Orchard TJ, Emerson S *et al.*: Translating the Chronic Care Model into the community: results from a randomized controlled trial of a multifaceted diabetes care intervention. *Diabetes care* 29(4), 811–817 (2006).
- 19 Siminerio LM, Piatt G, Zgibor JC: Implementing the Chronic Care Model for improvements in diabetes care and education in a rural primary care practice. *Diabetes Educ.* 31(2), 225–234 (2005).
- 20 Coleman K, Austin BT, Brach C, Wagner EH: Evidence on the Chronic Care Model in the new millennium. *Health Aff. (Millwood)* 28(1), 75–85 (2009).
- To guide quality improvement, the authors describe the CCM, its use in intensive quality improvement activities, with more than 100 healthcare organizations, and insights gained in the process.
- 21 Adams SG, Smith PK, Allan PF, Anzueto A, Pugh JA, Cornell JE: Systematic review of the Chronic Care Model in chronic obstructive pulmonary disease prevention and management. *Arch. Intern. Med.* 167(6), 551–561 (2007).
- 22 Ely AC, Banitt A, Befort C *et al.*: Kansas primary care weighs in: a pilot randomized trial of a Chronic Care Model program for obesity in 3 rural Kansas primary care practices. *J. Rural Health* 24(2), 125–132 (2008).
- 23 Rosemann T, Laux G, Szecsenyi J, Grol R: The Chronic Care Model: congruency and predictors among primary care patients with osteoarthritis. *Qual. Saf. Health Care* 17(6), 442–446 (2008).
- 24 Strickland PA, Hudson SV, Piasecki A *et al.*: Features of the Chronic Care Model (CCM) associated with behavioral counseling and diabetes care in community primary care. *J. Am. Board Fam. Med.* 23(3), 295–305 (2010).
- 25 Warm EJ: Diabetes and the Chronic Care Model: a review. *Curr. Diabetes Rev.* 3(4), 219–225 (2007).
- 26 Siminerio LM, Piatt G, Zgibor JC: Implementing the Chronic Care Model for improvements in diabetes care and education in a rural primary care practice. *Diabetes Educ.* 31(2), 225–234 (2005).
- 27 Jenkins C, Pope C, Magwood G *et al.*: Expanding the chronic care framework to improve diabetes management: the REACH case study. *Prog. Community Health Partnersh.* 4(1), 65–79 (2010).
- 28 Welch G, Stark A, Gabbay RA, Zagarins S, Lendel I: The impact of case management interventions on blood glucose control (A1c) in diabetes: results of a meta-analysis of clinical trials. *Diabetes* 57, A248 (2008).
- 29 Chin MH, Cook S, Drum M *et al.*: Improving diabetes care in midwest community health centers with the health disparities collaborative. *Diabetes care* 27(1), 2–8 (2004).
- 30 Chin MH, Drum M, Guillen M *et al.*: Improving and sustaining diabetes care in community health centers with the health disparities collaboratives. *Medical care* 45(12), 1135–1143 (2007).
- 31 Landon BE, Hicks LS, O'Malley AJ *et al.*: Improving the management of chronic disease at community health centers. *N. Engl. J. Med.* 356(9), 921–934 (2007).
- 32 Barcelo A, Caferio E, De Boer M *et al.*: Using collaborative learning to improve diabetes care and outcomes: the VIDA project. *Prim. Care diabetes* 4(3), 145–153 (2010).
- 33 Battram A: *Navigating complexity. The Patterns of Organisation.* The Industrial Society, London, Chapter 1, 4–40 (1998).
- 34 Shojania KG, Ranji SR, McDonald KM *et al.*: Effects of quality improvement strategies for Type 2 diabetes on glycemic control: a meta-regression analysis. *JAMA* 296(4), 427–440 (2006).
- 35 Bosch M, Faber MJ, Cruijsberg J *et al.*: Effectiveness of patient care teams and the role of clinical expertise and coordination: a literature review. *Med. Care Res. Rev.* 66(Suppl. 6), S5–S35 (2009).
- 36 Norris S, Engelgau MM, Narayan KM: Effectiveness of self-management training in Type 2 diabetes: a systematic review of randomized controlled trials. *Diabetes care* 24(3), 561–587 (2001).
- 37 Young D: Asheville project improves patient outcomes, cuts medical costs. *Am. J. Health Syst. Pharm.* 60(9), 868–871 (2003).
- 38 Smith SM, Allwright S, O'Dowd T: Effectiveness of shared care across the interface between primary and specialty care in chronic disease management. *Cochrane Database Syst. Rev.* 18(3), CD004910 (2007).
- 39 Milnes JP, Cochrane S, Henderson J: Chronic disease in institutionalised patients. Using liaison nurses can improve follow up and care. *BMJ* 315(7121), 1540 (1997).
- 40 Stewart AF: The United States endocrinology workforce: a supply–demand mismatch. *J. Clin. Endocrin. Metabolism* 93(4), 1164–1166 (2008).
- 41 Cooper RA, Getzen TE, Mckee HJ, Laud P: Economic and demographic trends signal an impending physician shortage. *Health Affairs* 21(1), 140–154 (2002).
- 42 Bodenheimer T, Lorig K, Holman H, Grumbach K: Patient self-management of chronic disease in primary care. *JAMA* 288(19), 2469–2475 (2002).
- 43 Lorig K, Holman H: Self-management education: history, definition, outcomes, and mechanisms. *Ann. Behav. Med.* 26(1), 1–7 (2003).
- 44 Griffiths C, Foster G, Ramsay J, Eldridge S, Taylor S: How effective are expert patient (lay led) education programmes for chronic disease? *BMJ* 334(7606), 1254–1256 (2007).
- 45 Bandura A: Self-efficacy: toward a unifying theory of behavioral change. *Psycholog. Rev.* 84(2), 191–215 (1977).
- 46 Lorig KR, Ritter PL, Dost A, Plant K, Laurent DD, Mcneil I: The Expert Patients Programme online, a 1-year study of an internet-based self-management programme for people with long-term conditions. *Chronic Illn.* 4(4), 247–256 (2008).
- 47 Rollnick S, Miller WR, Butler CC: *Motivational interviewing in health care: helping patients change behavior.* The Guilford Press, New York, USA (2008).
- 48 Hetttema J, Steele J, Miller WR: Motivational interviewing. *Ann. Rev. Clin. Psychol.* 1, 91–111 (2005).
- 49 Stuckey HL, Dellasega C, Graber NJ, Mauger DT, Lendel I, Gabbay RA: Diabetes Nurse Case Management and Motivational Interviewing for Change (DYNAMIC): study design and baseline characteristics in the Chronic Care Model for Type 2 diabetes. *Contemp. Clin. Trials* 30(4), 366–374 (2009).
- 50 West DS, Dilillo V, Bursac Z, Gore SA, Greene PG: Motivational interviewing improves weight loss in women with Type 2 diabetes. *Diabetes Care* 30(5), 1081–1087 (2007).
- 51 Jernigan VB, Lorig K: The internet diabetes self-management workshop for American Indians and Alaska natives. *Health Promot. Pract.* DOI: 10.1177/1524839909335178 (2010) (Epub ahead of print).
- 52 Gabbay RA, Khan L, Peterson KL: Critical features for a successful implementation of a diabetes registry. *Diabetes Technol. Ther.* 7(6), 958–967 (2005).

- 53 Kemple A, Hartwick N, Sitaker M, Harmon J, Clark K, Norman J: Exploring the feasibility of combining chronic disease patient registry data to monitor the status of diabetes care. *Prev. Chronic Dis.* 5(4), A124–A138 (2008).
- 54 Pollard C, Bailey K, Petitte T, Baus A, Swim M, Hendryx M: Electronic patient registries improve diabetes care and clinical outcomes in rural community health centers. *J. Rural Health* 25(1), 77–84 (2009).
- 55 Jha A, Desroches C, Campbell E *et al.*: Use of electronic health records in U.S. hospitals. *N. Engl. J. Med.* 360(16), 1628–1638 (2009).
- 56 Khan L, Mincemoyer S, Gabbay R: Diabetes registries: where we are and where are we headed? *Diabetes Technol. Ther.* 11(4), 255–262 (2009).
- 57 Fuertes JN, Mislowack A, Bennett J *et al.*: The physician–patient working alliance. *Patient Educ. Couns.* 66(1), 29–36 (2007).
- 58 Azar M, Gabbay RA: Web-based management of diabetes through glucose uploads: has the time come for telemedicine? *Diabetes Res. Clin. Pract.* 83(1), 9–17 (2009).
- 59 Whitlock W, Brown A, Moore K *et al.*: Telemedicine improved diabetic management. *Mil. Med.* 165(8), 579–584 (2000).
- 60 Clark MJ, Sterrett JJ, Carson DS: Diabetes guidelines: a summary and comparison of the recommendations of the American Diabetes Association, Veterans Health Administration, and American Association of Clinical Endocrinologists. *Clin. Ther.* 22(8), 899–910 (2000).
- 61 Gardner TW, Gabbay RA: Diabetes and obesity: a challenge for every ophthalmologist. *Arch. Ophthalmol.* 127(3), 328–329 (2009).
- 62 Mcmanus R, Glasziou P, Hayen A *et al.*: Blood pressure self monitoring: questions and answers from a national conference. *BMJ* 338, 38–42 (2009).
- 63 Cappuccio FP, Kerry SM, Forbes L, Donald A: Blood pressure control by home monitoring: meta-analysis of randomised trials. *BMJ* 329, 145 (2004).
- 64 Green BB, Cook AJ, Ralston JD *et al.*: Effectiveness of home blood pressure monitoring, web communication, and pharmacist care on hypertension control: a randomized controlled trial. *JAMA* 299(24), 2857–2867 (2008).
- 65 Paré G, Jaana M, Sicotte C: Systematic review of home telemonitoring for chronic diseases: the evidence base. *J. Am. Med. Inform. Assoc.* 14(3), 269–277 (2007).
- 66 Berwick DM, Nolan TW, Whittington J: The triple aim: care, health, and cost. *Health Affairs* 27(3), 759–769 (2008).
- Describes how an effective healthcare system that produces outstanding health outcomes pursues three primary goals, referred to as the Triple Aim: improving the patient's experience of health; improving the health of a defined population; and reducing the costs of care for populations.
- 67 Mannion R, Davies H: Payment for performance in health care. *BMJ* 336, 306–308 (2008).
- 68 Millett C, Netuveli G, Saxena S, Majeed A: Impact of pay for performance on ethnic disparities in intermediate outcomes for diabetes: a longitudinal study. *Diabetes Care* 32(3), 404–409 (2009).
- 69 McDonald R, Roland M: Pay for performance in primary care in England and California: comparison of unintended consequences. *Ann. Fam. Med.* 7(2), 121–127 (2009).
- 70 Cranor CW, Bunting BA, Christensen DB: The Asheville project: long-term clinical and economic outcomes of a community pharmacy diabetes care program. *J. Am. Pharm. Assoc. (Wash.)* 43(2), 173–184 (2003).
- 71 Cranor CW, Christensen DB: The Asheville project: factors associated with outcomes of a community pharmacy diabetes care program. *J. Am. Pharm. Assoc. (Wash.)* 43(2), 160–172 (2003).
- 72 Glasgow RE, King DK: Implications of active living by design for broad adoption, successful implementation, and long-term sustainability. *Am. J. Prev. Med.* 37(6), S450–S452 (2009).
- 73 Comellas M, Walker EA, Movsas S, Merkin S, Zonszein J, Strelnick H: Training community health promoters to implement diabetes self-management support programs for urban minority adults. *Diabetes Educ.* 36(1), 141–151 (2010).
- 74 Parikh P, Simon EP, Fei K, Looker H, Goytia C, Horowitz CR: Results of a pilot diabetes prevention intervention in East Harlem, New York City: Project HEED. *Am. J. Public Health* 100(Suppl. 1), S232–S239 (2010).
- 75 Tudor-Locke C, Lauzon N, Myers AM *et al.*: Effectiveness of the first step program delivered by professionals versus peers. *J. Phys. Act. Health* 6(4), 456–462 (2009).
- 76 Klug C, Toobert DJ, Fogerty M: Healthy changes for living with diabetes: an evidence-based community diabetes self-management program. *Diabetes Educ.* 34(6), 1053–1061 (2008).
- 77 Culica D, Walton JW, Harker K, Prezio EA: Effectiveness of a community health worker as sole diabetes educator: comparison of code with similar culturally appropriate interventions. *J. Health Care Poor Underserved* 19(4), 1076–1095 (2008).
- 78 Heisler M, Spencer M, Forman J *et al.*: Participants' assessments of the effects of a community health worker intervention on their diabetes self-management and interactions with healthcare providers. *Am. J. Prev. Med.* 37(6 Suppl. 1), S270–S279 (2009).
- 79 Gary TL, Batts-Turner M, Yeh HC *et al.*: The effects of a nurse case manager and a community health worker team on diabetic control, emergency department visits, and hospitalizations among urban African Americans with Type 2 diabetes mellitus: a randomized controlled trial. *Arch. Intern. Med.* 169(19), 1788–1794 (2009).
- 80 Philis-Tsimikas A, Walker C, Rivard L *et al.*: Improvement in diabetes care of underinsured patients enrolled in project DULCE: a community-based, culturally appropriate, nurse case management and peer education diabetes care model. *Diabetes Care* 27(1), 110–115 (2004).
- 81 Noh JH, Cho YJ, Nam HW *et al.*: Web-based comprehensive information system for self-management of diabetes mellitus. *Diabetes Technol. Ther.* 12(5), 333–337 (2010).
- 82 Kilo CM: A framework for collaborative improvement: lessons from the Institute for Healthcare Improvement's breakthrough series. *Qual. Manag. Health Care* 6(4), 1–13 (1998).
- 83 Newman SP: Chronic disease self-management approaches within the complex organisational structure of a health care system. *Med. J. Aust.* 189(10 Suppl.), S7–S8 (2008).
- 84 American Diabetes Association: Standards of medical care in diabetes. *Diabetes Care* 33(S1), S11–S61 (2010).
- 85 Siminerio LM, Drab SR, Gabbay RA *et al.*: Diabetes educators: implementing the Chronic Care Model. *Diabetes Educ.* 34(3), 451–456 (2008).
- Since diabetes requires active self-care methods to promote and provide diabetes self-management education, the growing population of those with diabetes needs to be examined, and a more appropriate healthcare model needs to be engaged.
- 86 Nutting PA, Miller WL, Crabtree BF, Jaen CR, Stewart EE, Stange KC: Initial lessons from the first national demonstration project on practice transformation to a Patient-Centered Medical Home. *Ann. Fam. Med.* 7(3), 254–260 (2009).

- 87 Carney PA, Eiff MP, Saultz JW *et al.*: Aspects of the Patient-Centered Medical Home currently in place: initial findings from preparing the personal physician for practice. *Fam. Med.* 41(9), 632–639 (2009).
- 88 Tufano JT, Ralston JD, Tarczy-Hornoch P, Reid RJ: Participatory (re)design of a sociotechnical healthcare delivery system: the group health patient-centered medical home. *Stud. Health Technol. Inform.* 157, 59–65 (2010).
- 89 Crabtree BF, Nutting PA, Miller WL, Stange KC, Stewart EE, Jaen CR: Summary of the National Demonstration Project and recommendations for the patient-centered medical home. *Ann. Fam. Med.* 8(Suppl.1) S80–S90 (2010).
- 90 Goldberg DG, Kuzel AJ: Elements of the patient-centered medical home in family practices in Virginia. *Ann. Fam. Med.* 7(4), 301–308 (2009).
- 91 Ravenscroft EF: Diabetes and kidney failure: how individuals with diabetes experience kidney failure. *Nephrol. Nurs. J.* 32(5), 502–509 (2005).
- 92 Hibbard JH, Mahoney ER, Stock R, Tusler M: Do increases in patient activation result in improved self-management behaviors? *Health Serv. Res.* 42(4), 1443–1463 (2007).
- 93 Mosen DM, Schmittiel J, Hibbard J, Sobel D, Remmers C, Bellows J: Is patient activation associated with outcomes of care for adults with chronic conditions? *J. Ambul. Care Manage.* 30(1), 21–29 (2007).
- 94 Williams GC, McGregor H, Zeldman A, Freedman ZR, Deci EL, Elder D: Promoting glycemic control through diabetes self-management: evaluating a patient activation intervention. *Patient Educ. Couns.* 56(1), 28–34 (2005).
- 102 Diabetes Self-Management Program <http://patienteducation.stanford.edu/programs/diabeteseng.html>
- 103 The Expert Patients Programme www.nhs.uk/conditions/Expert-patients-programme-/Pages/Introduction.aspx
- 104 Improving Chronic Illness Care www.improvingchroniccare.org
- 105 The Commonwealth Fund Commission on a High Performance Health System: Why not the best? Results from the National Scorecard on US Health System Performance, 2008 www.commonwealthfund.org/~media/Files/Publications/Fund%20Report/2008/Jul/Why%20Not%20the%20Best%20%20Results%20from%20the%20National%20Scorecard%20on%20U%20S%20%20Health%20System%20Performance%20%202008/Why_Not_the_Best_national_scorecard_2008%20pdf.pdf (Accessed 30 December 2010)
- 106 Pennsylvania Chronic Care Management and Cost Reduction Commission: The Pennsylvania Chronic Care Management, Reimbursement, and Cost Reduction Strategic Plan, 9 (2008) www.rxforpa.com/assets/pdfs/ChronicCareCommissionReport.pdf (Accessed 30 November 2010)

Websites

- 101 Pearson M, Mattke S, Shaw R, Ridgely M, Wiseman S: Patient self-management support programs: an evaluation. Final contract report (prepared by RAND health under Contract No. 282-00-0005), AHRQ Publication No. 08-0011 (2007) www.ahrq.org/pub/uploads/ptmgmt.pdf (Accessed 30 November 2010)