



Health Care 2020: Reengineering Health Care Delivery to Combat Chronic Disease

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ABSTRACT

Chronic disease has become the great epidemic of our times, responsible for 75% of total health care costs and the majority of deaths in the US. Our current delivery model is poorly constructed to manage chronic disease, as evidenced by low adherence to quality indicators and poor control of treatable conditions. New technologies have emerged that can engage patients and offer additional modalities in the treatment of chronic disease. Modifying our delivery model to include team-based care in concert with patient-centered technologies offers great promise in managing the chronic disease epidemic.

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Chronic disease represents the major driver of illness and health care utilization in the US, and its prevalence in the population is increasing. In 2010, chronic disease was responsible for 7 of every 10 deaths in the US and accounted for over 75% of total health care costs.^{1,2} In just a 5-year span, from 2005 to 2010, the prevalence of chronic disease increased from 46% to 47% of the US population, equivalent to an additional 8 million Americans, and by 2020 it is projected to increase by an additional 16 million, comprising 48% of the population.³ It is noteworthy that over half of these individuals, or approximately 81 million of the US population, will have multiple chronic conditions.⁴ Total cost of health care also has increased steadily over this period, and it is estimated that two-thirds of this escalation is due to the increased prevalence of chronic disease.⁵

As a rule, the proportion of the population diagnosed with chronic conditions will increase with age, and today there are more Americans age 65 years and older than at any

other time in US history.⁶ According to the Census Bureau, there were 40.3 million people age 65 years and older in 2010, up 15.1% from 35 million in 2000 (compared with just a 9.7% increase for the total US population).⁷ By 2020, the US population aged 65 years and older is projected to reach 53 million, with continual increases to 89 million by 2050.⁸ More significantly, the proportion of Americans age 65 and older who report having one or more chronic diseases also rose, from 86.9% in 1998 to 92.2% in 2008.⁶ With the combination of increasing longevity and high rates of obesity and physical inactivity, this trend is expected to continue.^{6,9}

Current projections suggest that by 2020, there will probably be an additional 15 million Americans with hypertension, 12 million with diabetes, 4 million with coronary heart disease, 2 million with stroke, and 2 million with heart failure.^{10,11} According to the World Health Organization and the Centers for Disease Control and Prevention, the root cause of the epidemic in chronic disease is lack of physical activity and poor nutrition, which alone or in combination contributes to obesity and its attendant consequences. In the past 30 years, adult obesity rates in the US have more than doubled, and today, more than two-thirds of American adults are either overweight or obese.¹² Nationally, 38% and 23% of adults, and 36% and 37% of adolescents report consuming fruits and vegetables, respectively, less than one time

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daily.¹³ These risk factors coupled with tobacco use and excess alcohol consumption represent the major lifestyle factors leading to the pandemic of chronic disease in the US and globally.¹⁴

TREATMENT OPTIONS IN CHRONIC DISEASE

Although chronic disease represents the leading cause of death in the US, 40% of all premature death is due to behaviors amenable to change. Maximizing disease outcomes will therefore require the necessary time and expertise needed for a careful assessment and modification of lifestyle factors.¹⁵ In the primary care setting, the median length of a physician visit is <15 minutes, during which a median of 6 topics will be covered, leaving little if any time to formally assess and address the root causes of many chronic diseases, including poor nutrition and physical inactivity.^{16,17} A survey conducted in 2006 revealed, for example, that only 65% of obese patients were provided advice to lose weight by their physicians, and recommendations for physical activity also are rarely addressed.¹⁸ However, when lifestyle modification advice is provided, patient adherence rates regarding weight loss, smoking cessation, or dietary changes are remarkably low, and health care professionals have identified a lack of knowledge, skills, and practical tools as major barriers to successful intervention.¹⁹ Higher success rates for lifestyle modification have been achieved, however, through group programs utilizing nonphysician personnel such as cardiac rehabilitation and exercise training. A contributing factor in the success of these programs is related to the impact of the group dynamic and social support created when patients are exposed to other individuals with the same condition at various stages of lifestyle change.^{20,21} Although these formal structured programs have proven successful in effecting lifestyle change and result in significant improvements in excess weight, smoking cessation, exercise capacity, blood pressure, insulin sensitivity, and lipids, they are unfortunately limited to a small number of patients who present following a cardiac event.

Because assessment and treatment of lifestyle behaviors for chronic disease are infrequent, and when provided, poorly adhered to, physicians are often limited to the sole therapeutic option of medication in order to treat the secondary conditions created from poor lifestyle such as hypertension or diabetes. Although medication is clearly a proven and much needed therapeutic in the management

of many chronic diseases, an unfortunate consequence of its overreliance is that medication-related events have now become a major health concern, particularly among the elderly where chronic disease is most prevalent. On average, individuals aged 65-69 years take 14 prescriptions per year (80-84 years take 18 prescriptions per year), and medication-related problems are now one of the top 5 causes of death in this age group. It is estimated that 28% of hospitalizations among seniors are due to adverse drug reactions, and 32,000 seniors suffer hip fractures each year due to falls caused by medication-related problems.^{22,23} These issues would be best addressed by additionally providing non-pharmacologic alternatives, and the use of emerging technologies recently has demonstrated potential in this regard.¹⁹

Health-focused mobile application software (apps) and wearable devices (wearables) designed for increasing exercise, nutrition education and counseling, smoking cessation, and weight loss programs have demonstrated positive results in effecting lifestyle change in patients presenting with chronic disease.²⁴⁻²⁶ Apps and wearables have the opportunity to provide appropriate-level, tailored education, patient-friendly data visualization tools, exciting gamification strategies, regular feedback with prompts, and other impactful tactics to positively create healthy behaviors. Many apps also encourage patients to engage in social networks where patients have the option of interacting with other individuals seeking similar behavioral change; these social interactions are not trivial, and have been shown to be important in maintaining motivation, a key component of successful behavior change.²⁷⁻²⁹ Apps and wearables have now been successfully implemented in secondary prevention as a virtual form of cardiac rehabilitation and exercise training programs, and have demonstrated promising results.³⁰ Utilization of these technologies has been shown to better engage patients in the care process, leading to improved satisfaction with the health care system, and converts the patient from a passive recipient to an active partner on the health care team.³¹ This is in keeping with the Office of the National Coordinator's 2020 vision for health information technology: *the power of each individual is developed and unleashed to be active in managing their health and partnering in their health care, enabled by information and technology.*³² The opportunities afforded by apps and wearables will significantly expand the physician armamentarium, and provide a cost-effective,

CLINICAL SIGNIFICANCE

- Chronic disease is responsible for 75% of total health care costs and the majority of deaths in the US.
- Existing delivery models are poorly constructed to manage chronic disease, as evidenced by low adherence to quality and control indicators.
- New technologies have emerged that can engage patients and offer additional modalities in treating chronic disease.
- Modifying health care delivery to include team-based care combined with patient-centered technologies offers great promise.

nonpharmacologic strategy that can create positive behavior change.

CHRONIC DISEASE OUTCOMES AND PRIMARY CARE SERVICES

Physician adherence to the current evidence base in the management of chronic disease is poor, and patients diagnosed with a chronic disease typically receive only half of the recommended process of care.^{33,34} In the case of the 2 most common chronic diseases impacting the population, fewer than 1 in 3 patients with hypertension and hypercholesterolemia attain control of both disorders.³⁴ These gaps in care have been shown subsequently to lead to higher clinical events and added health care costs. The causes for this deficiency in care are multifactorial, but are primarily due to 4 factors: physician time demands, rapidly expanding medical database, therapeutic inertia, and lack of supporting infrastructure.

The current US model for delivery of chronic disease care typically rests on the back of the primary care physician, whose time for face-to-face patient care has become progressively constrained; it is estimated that direct patient care accounts for only 55% of the average workday.^{16,35} Studies evaluating the time necessary to achieve the recommendations of national practice guidelines for just 10 chronic diseases estimate that this alone would require 10.6 hours a day, more time than primary care physicians have available for patient care overall.³⁶ Compounding these data are the expected shortage of primary care physicians in the US; by 2025 it is estimated that an additional 52,000 primary care physicians will be needed to care for the growing and aging population, yet there is little evidence to suggest that these needs will be met.³⁷

The second factor compromising chronic disease care is the rapidly evolving medical database, which has grown logarithmically in the last 4 decades. In the mid-1960s, there were approximately 100,000 peer-reviewed articles

published in the medical literature per year. By 2012, there were 28,100 active scholarly peer-reviewed journals collectively publishing about 1.8-1.9 million articles a year.^{38,39} Further confounding the widening breadth of medical information is that a significant percentage of published studies contradict current medical practice, or what has been labeled a *medical reversal*.⁴⁰ The ability, therefore, to keep up with the current and accepted evidence base across the broad range of medical conditions comprising chronic disease is clearly a major challenge for any busy practicing clinician.

The third factor influencing poor chronic disease care is due to what has been labeled *therapeutic inertia*, which occurs when a provider fails to increase or modify therapy when treatment goals are unmet.⁴¹ In uncontrolled hypertension, the prevalence of therapeutic inertia has been reported to be as high as 86.9% of visits when the blood pressure was $\geq 140/90$ mm Hg.⁴² Failure to intensify therapy in patients with abnormal blood glucose, blood lipids, or blood pressure technically fits the definition of a medical error as defined by the Institute of Medicine, and contributes to the widespread failure to achieve evidence-based goals. The causes of therapeutic inertia are multiple, and involve the clinician, the patient, and the health care system (Table 1).

The fourth and final factor is the care model supporting the patient and physician, including the reactive and episodic nature of care delivery.⁴³ Studies covering a variety of medical conditions consistently show that providing the primary care physician with a team-based infrastructure of specialized, nonphysician caregivers whose role is to provide a continuous framework of monitoring and management, improves adherence to quality measures and yields superior outcomes, cost, and patient satisfaction.⁴⁴ Moreover, nonphysician caregivers following evidence-based guidelines are less likely to be impeded by therapeutic inertia.^{35,45,46} Management of warfarin is an excellent case in point. When compared

Table 1 Factors Leading to Therapeutic Inertia		
Clinician	Patient	Health System
Failure to initiate treatment	Medication side effects	Lack of clinical guideline
Failure to titrate to goal	Too many medications	Lack of care coordination
Failure to set clear goals	Cost of medications	No visit planning
Underestimation of patient need	Denial of disease	Lack of decision support
Failure to identify and manage comorbid conditions (such as depression)	Denial of disease severity	Poor communication between physician and office staff
Insufficient time	Forgetfulness	No disease registry
Insufficient focus or emphasis on goal attainment	Perception of low susceptibility	No active outreach
Reactive rather than proactive	Absence of disease symptoms	Perverse incentives
	Poor communication with physician	
	Mistrust of clinician	
	Depression, mental illness, substance abuse	
	Low health literacy	

Adapted from: Milani RV, Lavie CJ. Lipid control in the modern era: an orphan's tale of rags to riches. *J Am Coll Cardiol*. 2013;62:2185-2187.⁴¹

with physician-management, pharmacist-directed care resulted in the highest attainment of quality indicators and patient satisfaction while yielding the lowest adverse clinical events and cost.⁴⁷ Similarly, management of hypertension, chronic obstructive lung disease, diabetes, and heart failure also have demonstrated superior process measures and clinical outcomes when supplementing the primary care physician with a supporting infrastructure of specialized, nonphysician caregivers working in a focused factory model of care delivery.^{45,48,49}

SOCIAL NETWORKS

The importance of social network influences on behavior is now well established, having demonstrated considerable impact on smoking, diet, exercise, depression, medication adherence, and obesity.^{50,51} Decisions to quit smoking, begin an exercise program, and other health-related behaviors are not made completely by isolated persons, but rather, reflect choices made by groups connected to each other.⁵⁰ This influence can be extensive, often reaching up to 3 degrees of separation. The fact that patients are embedded within social networks suggests that both good and bad behaviors could spread over a range of social ties, and that network involvement in health improvement or disease management could lead to positive and sustainable effects over time.⁵¹ A recent study in patients with either chronic heart disease or diabetes revealed that higher levels of social network involvement was linked to the maintenance of healthy behaviors over time, leading to reductions in hospitalizations and total cost of care.⁵² Social networks appear adaptable and responsive to levels of health need, thus, harnessing and sustaining the capacity of these networks offers promise as a cost-effective way of supporting behavior change and long-term chronic disease management.^{52,53} Use of electronic communications and disease-centric social networks permit large-scale unobtrusive measures of network activity along with behavior change information that can accelerate improvement in health behaviors and disease management.⁵³ Recent innovations such as patient portals offer health care providers a new avenue of accessing large groups of patients and favorably influencing health behaviors.⁵⁴ Successful disease management strategies may utilize the potential of social networks in creating sustainable and cost-effective solutions for patients with chronic disease.

INFRASTRUCTURE REQUIREMENTS GOING FORWARD

As health care moves from a volume-to-value strategy, the need to collect and manage data will increase continually, and with it, the necessity to provide analysis, data visualization tools, and education/training surrounding the use of new technologies and the data they generate. Health care systems that develop both discipline and efficiency in data analytics and reporting (as well as the ability to train its staff

in the capabilities of these ever-evolving systems) will best manage both sides of the value equation. Real-time, metric-driven process improvement utilizing outcome measures will facilitate a continuously learning health care system (Table 2). Decision support software and knowledge management tools incorporated as key components of the delivery system can ensure that decisions are informed by the best evidence.⁵⁵ Payments should reward desired care outcomes with incentives to provide the best care at lower cost.^{44,55,56} Physicians will willingly utilize nonphysician support services as long as such services deliver superior outcomes in an efficient, patient-focused, cost-effective manner.⁴⁷

Changing the current delivery model by incorporating a *generalized* care-team supporting the primary care physician (medical home model) unfortunately has demonstrated limited improvements in quality and overall outcomes.⁵⁷ More successful approaches have utilized *specialized* integrated practice units (IPUs), each employing nonphysician personnel who are dedicated to a specific disease condition for the full cycle of care.^{56,58} Members of the care team may include pharmacists, advanced practice clinicians, nurses, health educators, dieticians, social workers, counselors, and therapists, all organized around the patient’s medical condition. In this model, patients can be connected more frequently and effectively to the health delivery system utilizing apps as well as home-based and wearable devices, and communication can be consistent and at regular intervals between the care team and the patient (Figure).^{45,48,59} IPUs will have the capacity to care for the spectrum of patients within a disease category, but may concentrate greater efforts in high-risk patients who often consume the highest percentage of health care resources. Patients can achieve a higher level of engagement in the care process via enhanced education, real-time feedback via wearable and home-based devices, and enriched communication with both the care team and other patients via social networks, thus achieving a higher level of satisfaction with the health care system. This

Table 2	Characteristics of a Continuously Learning Health Care System
Science and Informatics	Real-time access to knowledge Digital capture of the care experience
Patient–clinician relationships	Engaged, empowered patients
Incentives	Incentives aligned for value Full transparency
Culture	Leadership-instilled culture of learning Supportive system competencies

Adapted from: Smith MD, Institute of Medicine (US). Committee on the Learning Health Care System in America. *Best Care at Lower Cost: The Path to Continuously Learning Health Care in America*. Washington, DC: National Academies Press; 2013.⁵⁵

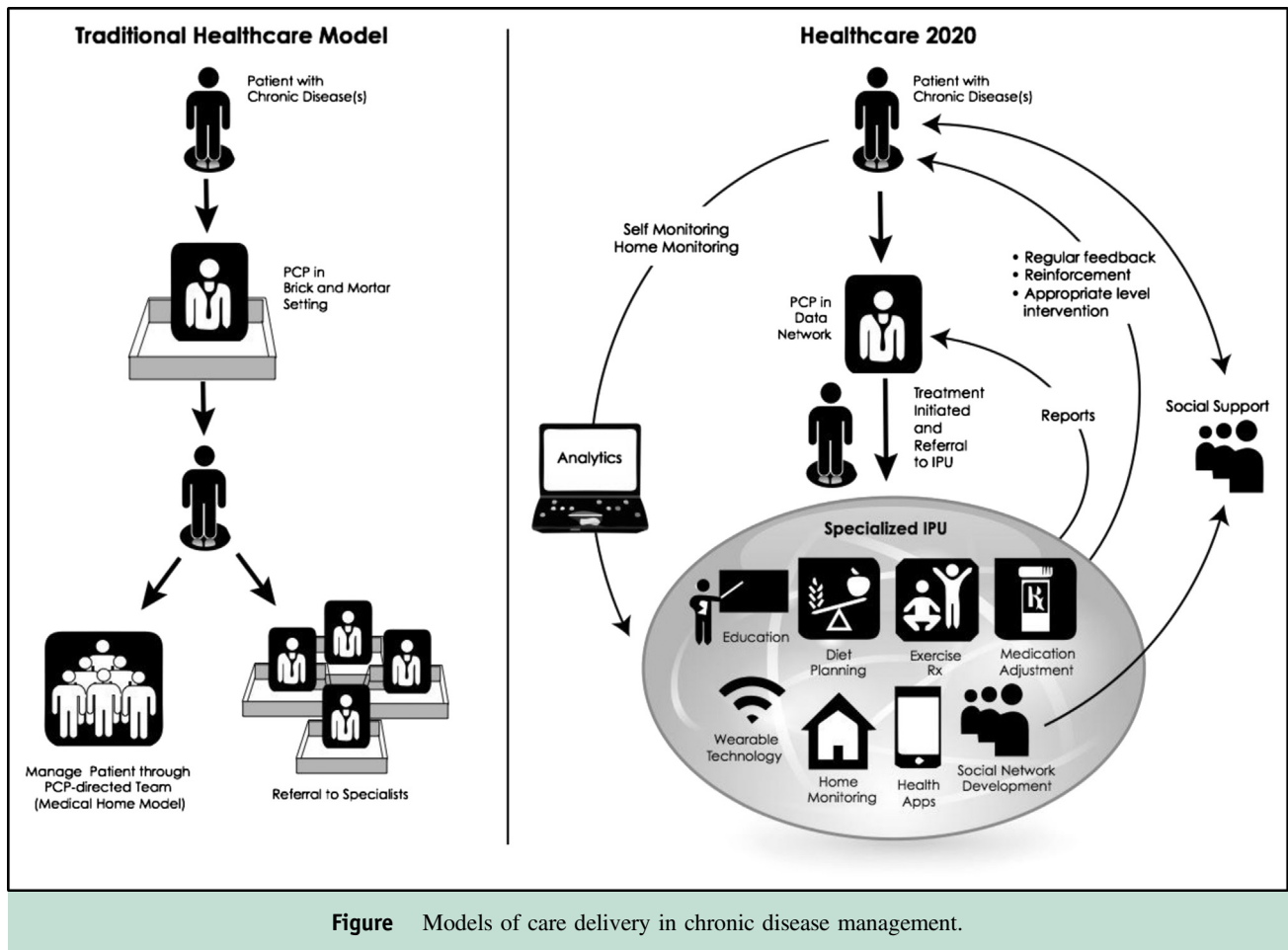


Figure Models of care delivery in chronic disease management.

new delivery model is in keeping with current patient expectations; results of a recently released global study of health care suggest that individuals worldwide want to see their biological makeup and individual behaviors used to make receiving care more effective and efficient.⁶⁰ Systems and just-in-time communication will be capable of delivering customized care efficiently across broad populations with chronic disease cost-effectively when delivery systems are compensated using value-based payment models. Moreover, broadening the care team will reduce waste and improve primary care access and capacity at a time when the primary care workforce is diminishing.

CONCLUSION

Throughout history, the health care system has reengineered itself continually to meet the medical needs of the time. Isolation wards were created in the late 19th and early 20th centuries to meet the crisis in infectious disease, particularly during the typhoid and influenza epidemics, and mobile army surgical hospitals were crafted in 1945 to better manage surgical emergencies during war. Today, health care must reengineer its care delivery model to manage the chief medical crisis of the 21st century, chronic disease. The capacity of the stand-alone physician to produce high-

quality, evidenced-based care, yielding meaningful and lasting change in lifestyle behaviors, has proven elusive. A new model of team-based care organized as an IPU will have the ability to deliver comprehensive consistent treatment and advice using a focused-factory approach. The IPU will employ the latest in technology innovation, thus better engaging patients, in addition to providing high-quality, consistent, personalized care delivery, and accelerate consequential lifestyle change.

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