Prospective Medicine: The Next Health Care Transformation

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ABSTRACT

The introduction of science into the practice of medicine in the early 20th century was a transforming event for the profession. Now, breakthroughs in science and know how make it possible to transform care once again and to fix the broken U.S. health care system. To realize this potential, new models of *prospective health care* must be created and validated. Prospective health care would determine the risk for individuals to develop specific diseases, detect the disease's earliest onset, and prevent or intervene early enough to provide maximum benefit. Each individual would have a personalized health plan to accomplish this. Current knowledge is already sufficient to implement this approach, but there are no effective practice models, delivery systems, and appropriate reimbursement mechanisms.

The authors describe the mechanisms of managing care prospectively, describe the components of a personalized health plan, and show how prospective care could relate to a community or group of covered individuals. They conclude by stressing that all interested parties, including academic health centers, insurers, and payers, will need to work together to develop innovative applications of new technologies and appropriate delivery models. At their own institution, pilot programs to foster prospective health care have already begun, and another initiative to develop models to use genomic medicine is also underway. Bipartisan political support will also be needed to help achieve rational reimbursement between providers and payers, so that prospective care can fulfill its promise of being the best cost-effective model to improve the nation's health.

Acad Med. 2003;78:1079–1084.

The practice of medicine has existed since earliest recorded history, yet the ability of science to affect the profession did not emerge in earnest until the latter part of the 19th century. The potential applications of physiology, chemistry, immunology, and physics to medicine were profound; however, medical practice at that time was virtually untouched by this new and expanding knowledge. Rather, it remained anecdotal, unscientific, and unregulated, with hundreds of "storefront" medical schools granting licenses with virtually no scientific training. In 1910, a study on medical education termed the "Flexner Report" was highly critical of medical training and concluded that medical education should be well grounded in science.[1] This report changed medical practice and helped define the structure of the contemporary academic health center; that is, an institution with a medical faculty involved in research and affiliated with a teaching hospital where the practice of medicine is learned by medical students and residents in training. The introduction of science into the practice of medicine was a transforming event for the profession. It enabled the understanding of disease processes, the development of many effective therapeutics, and the emergence of an increasingly specialized medical practice focused on the treatment of disease.

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This article is based in part on the Chair's Address to the National Meeting of the Association of American Medical Colleges, November 10, 2002, San Francisco, California.

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THE DILEMMA

Since World War II, the United States has invested over a trillion dollars in biomedical research and development. This has fueled medical advances that resemble the leading edge

of a great tsunami. Emerging fields of genomics, proteomics, metabolomics, and diagnostic imaging can facilitate early diagnosis and effective prevention and treatment of the major chronic diseases such as cancer, cardiovascular disease, neurodegenerative and neuropsychiatric diseases, diabetes, asthma, and musculoskeletal disorders. These account for the greatest burden of human suffering and the greatest expenditure of health care resources.[2] Advances in medical capabilities have spawned health-related industries, accounting in aggregate for current expenditures for health care of $1.5 trillion per year. Yet despite the dedication of this vast sum to the health of the nation, 40 million Americans lack ready access to health services,[3] effective therapies are inconsistently and ineffectively applied, and our current system is frustrating to users and providers alike. Similar to a century ago, science has once again created breakthroughs that could be used to improve health outcomes in a timely and cost-effective manner, but once again, these opportunities are not being developed.

Health care is, of necessity, on the national political agenda. Unfortunately, virtually no aspect of the current debate addresses the core issue of how to improve the practice of medicine itself. Absent a change in how medicine is practiced, proposed changes can only provide marginal benefits in an inefficient way. A major problem with our current delivery of medical care is that it is largely reactive: people see their doctor only when they are sick. As physicians, we have been trained to identify the pathogenic defect, whether it's molecular or structural, and fix it. Interventions are sporadic and are heavily directed by physicians with little or no active participation on the part of the patient in their own care. We have a fragmented delivery system, and the relationships among the parts are poorly coordinated. Care is expensive and inefficiently deployed.

Many thoughtful and informed leaders of American medicine are concerned that our current system of health care is wasteful and financially unsustainable. Soaring costs strain industry and government as we struggle to emerge from the current economic slowdown. Prospects for containing double-digit inflation in health care expenses are limited under pressures of expensive new medical technologies, an aging population in search of more services, and millions of uninsured or underinsured individuals. Left as it is, the future of health care appears clouded, even amidst an explosion of knowledge and technological capabilities for improving health. Importantly, the problem in health care today is clearly grounded in how care is delivered and paid for. Our fractionated health care system doesn't use available knowledge effectively to either prevent disease or treat it more effectively, and current reimbursement mechanisms actually punish innovators seeking improvements that could lower costs. Through advances in science and know-how, we currently have the means to fix our broken health care system. However, neither politicians nor insurers are capable of fixing health care without the leadership of those who provide care.

CONFRONTING THE DILEMMA: PROSPECTIVE CARE

Personalized Health Planning

To address our current dilemma, we need to create and validate fundamentally new models of *prospective health care* that determine the risk for individuals to develop specific diseases, detect the disease's earliest onset, and prevent or intervene early enough to provide maximum benefit. Current scientific knowledge is already sufficient to implement this approach, and such knowledge is increasing rapidly, but we lack effective practice models, delivery systems and appropriate reimbursement mechanisms.[4] The current medical record is a strong indication of the reactive way physicians are currently trained to practice. The initial focus is to determine the patient's chief complaint. Even the term "chief complaint" is prejudicial. From the chief complaint, we move on to the history of the present illness through a differential diagnosis and plan of treatment. This is an excellent way to develop a "root cause analysis" of disease, but it does not force us to think about a plan for disease prevention and health promotion. To practice rationally and prospectively, in addition to seeing patients when they develop symptoms, each individual should have a plan formulated for his or her health. Importantly, those formulating the plan must first assemble a risk analysis based on genetic, environmental, and lifestyle considerations. Sophisticated risk-assessment tools are currently available[5,6] and will certainly improve through further epidemiological and genomic research. A plan then needs to be developed to provide the best countermeasures for each individual to minimize the probabilities for development or progression of major chronic disease. In short, we should provide *personalized health planning* for our patients. As indicated above, such a personalized health plan would include a health profile, a description of the individual's current health status, a health risk analysis (genetic, environmental, and lifestyle aspects), and countermeasures, those to be employed over a one-year interval and those to be employed over a longer interval. Personalized health plans and the mechanisms for implementing them are a fundamental component of prospective health care and could form the basis of the contemporary transformation of health care.

Medical knowledge to implement prospective care is burgeoning. The emerging field of genomics, stimulated by the recent sequencing of the human genome, will further help to

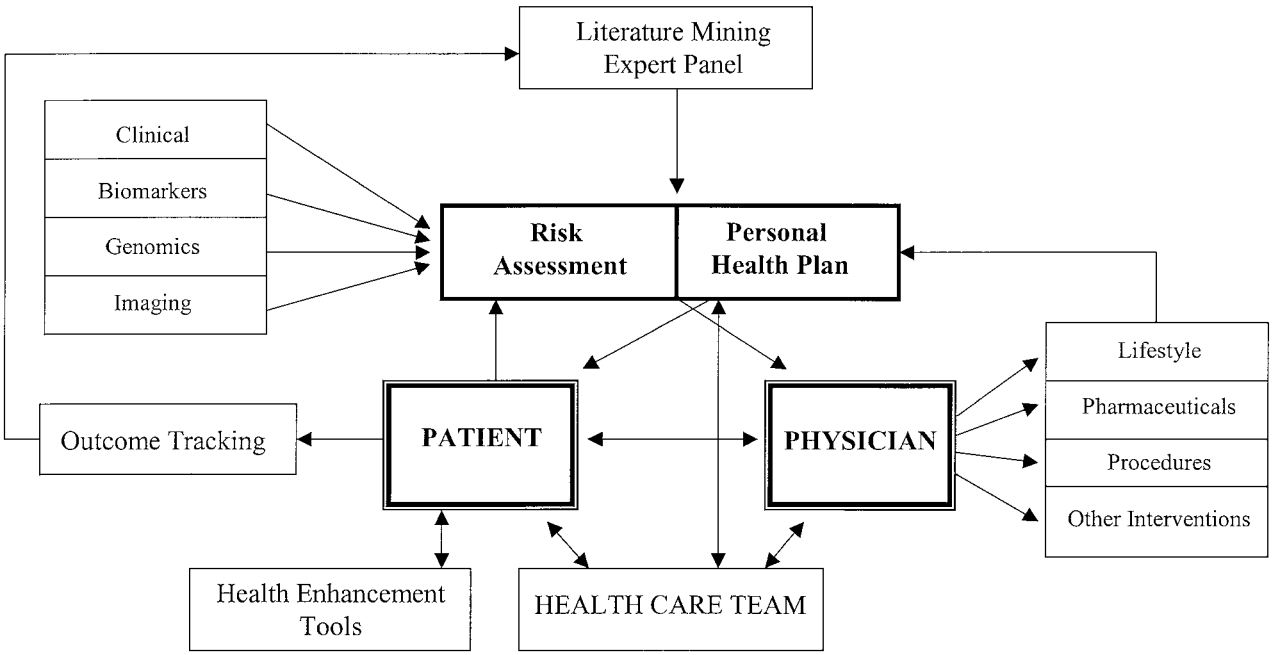

Figure 1. Model for personalized health care and the relationship between the patient and other components of the delivery system. See text for details.

identify high-risk individuals for intensive surveillance and allow aggressive application of preventive strategies at preclinical stages of disease. In addition, genomics will provide additional therapeutic proteins, new molecular targets for small molecules, and more focused direction of drug therapies to those individuals who are most likely to benefit and are least likely to be harmed. The ability to identify those individuals most at risk for developing chronic diseases and to provide a customized means to prevent or slow that progression are emerging competencies and provide the foundation for prospective care. Even without the input of genomics, we already have the capability to determine a person's risk for many diseases. For example, with coronary artery disease, risk assessment based on family history, lipids and other laboratory tests, stress tests, ultrasound, imaging, and angiography allow intervention before a myocardial infarction occurs.

Managing Care Prospectively

This concept of managing care is not new, but "managed care" didn't work. Why? When managed care was introduced some 30 years ago, the capabilities for predicting risk and deploying effective interventions were just emerging. Managed care was driven almost entirely by the perceived need to reduce expenditures and was not focused on improving the quality of health. Importantly, it dealt with controlling health care costs of populations, rather than focusing on personalized care for individuals. Appropriate delivery systems to integrate and manage care were not generally available. Additionally, it had little support from physicians, who often recoiled at withholding treatments they thought were best for their patients. Most doctors were not prepared to understand the rationale and theoretical benefits of managing care.

Prospective care is fundamentally different. If done right, the development of a health care system that focuses on personalized health planning will be every bit as transformational as the coupling of science to medicine was in the early 20th century. The successful execution of the personalized health plan is driven by several mechanisms. A schematic representation of relationships between a patient and component parts of a prospective health care system is illustrated in Figure 1. A central feature of our proposal is the creation of an advanced information system that integrates multiple streams of information about the patient to generate both a personalized risk profile and a set of recommendations of measures to reduce that risk. The risk assessment tool employs data from conventional clinical assessments, genomic and biomarker analyses, and, where appropriate, advanced imaging studies. Data-mining techniques, filtered through an expert panel, provide iterative updates and refinement of the risk prediction algorithms and health plan strategies. The risk profile for each individual and an evidence-based set of

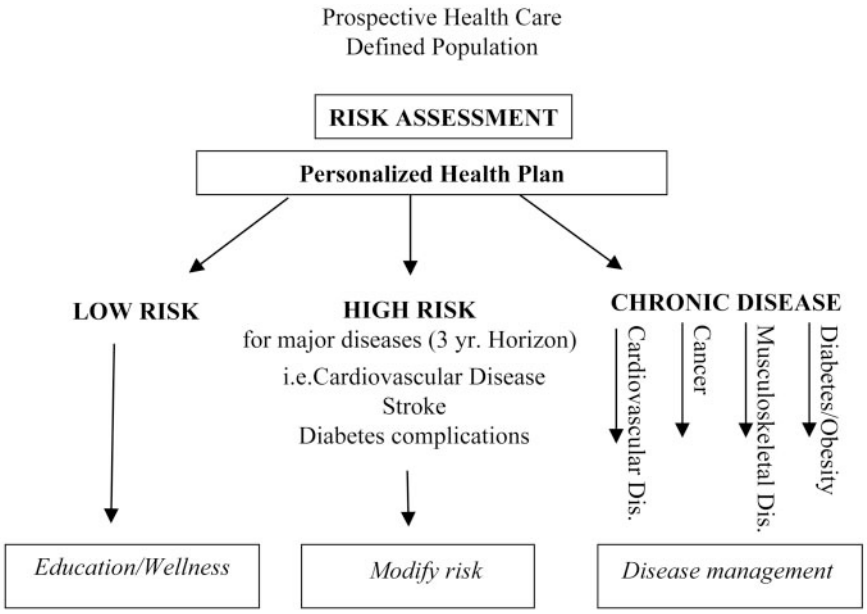

Figure 2. Application of prospective care to a community. A key feature will be stratification of patients in terms to their risk and providing them with access to those components of the health system that fit their individual needs.

recommendations for risk reduction generated by the information system is reviewed by the physician, who communicates with the patient and either confirms or modifies the recommendations. The personalized health plan is created using risk assessment along with the appropriate choices of lifestyle modifications, drugs, therapeutic procedures, and/or other intervention to enhance health and reduce risk. Direct conversations between physician and patient assure the appropriateness of the plan and an understanding of its recommendations. After the initial assessment, however, communication with the patient will often be driven by interactions with the information system and with health care or disease management teams specific to their needs. Members of care teams serve as health coaches, monitor progress toward goals of the personalized health plan, and alert the physician to adverse trends or events. Importantly, we will need continuously to develop more accurate risk assessment tools and adapt them to medical practice. A new medical record containing a personalized health plan will need appropriate information systems to support the continuum of care that each individual will require over the course of a lifetime. The development of appropriate health care delivery teams and systems that allow patients to have access to the specific level of care they need, and to take a larger measure of responsibility for managing their own care, is essential to prospective care.

A model for how prospective care could relate to a community or group of covered individuals is depicted in Figure 2. The first pilot programs should focus on individuals with chronic diseases at early stages of progression or at highest risk for developing signs or symptoms within a three to five year period. Such illnesses account for the majority of health care expenditures and are most likely to engender effective patient compliance. At least 125 million Americans have one or more chronic conditions, and we have an aging population that will increase this figure.[7] Chronic diseases already account for roughly $1 trillion worth of health care expenditures.[8] Chronic disease develops over time and often exists for years before symptoms lead patients to seek medical intervention (Figure 3). For example, patients with type 2 diabetes are at risk for the development of blindness, renal

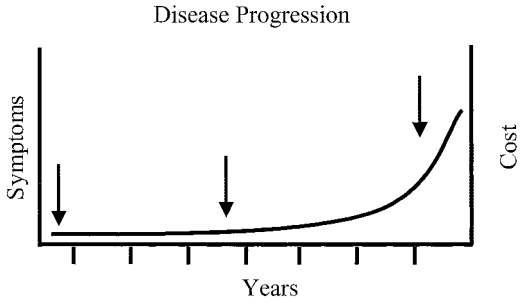

Figure 3. Chronic disease progression. Hypothetical plot of disease progression and costs of treating the disease over time. The arrow on the right is when the current system generally intervenes, the middle arrow is what is now possible, and the arrow to the left is what will be empowered by genomics.

failure, or peripheral vascular disease, but complications do not appear until years after the onset of glucose intolerance. This presymptomatic period establishes a window of opportunity to delay or prevent these complications.[9] To take advantage of this opportunity, physicians will need to use the best-available risk-assessment tools for the development of major chronic diseases and assign their patients to appropriate primary or early secondary prevention programs.[10–13] Unfortunately, our health care system often does not encourage or reward physicians to intervene effectively until symptoms become severe, at which time the disease has progressed to the point where effective therapy may only be palliative and incapable of reversing the underlying process. In caring for patients with chronic disease or high risk of developing them, we need to provide patients with the best means for mitigation of their risk. Physicians need to use the best practice models and standards of care along with provider teams that facilitate the earliest possible implementation of needed secondary prevention (e.g., for congestive heart failure or diabetes). Patients will need access to a point of coordination of their care, active involvement in their own care, and where indicated, a care coordinator, or "coach." There have been documented reports showing that prospective care really does work for patients with congestive heart failure,[14,15] diabetes,[16] and asthma.[17]

Adapting Medical Education and Culture

The incorporation of science into medical education a century ago led to a revolution in the practice of medicine. Once again, it is critically important to alter medical education so that our students and residents are prepared to deliver prospective care. Culturally, we must encourage thinking about the maintenance of wellness as well as treatment of disease. Our current value system revolves largely on acute intervention in a physician-driven system. Health promotion requires establishing a far greater role for patient responsibility and physicians working with teams. We suggest beginning with leadership from the deans, chairs, and course directors. To be effective in training for prospective care, leaders of medical schools and teaching hospitals must believe and espouse its principles. Adapting undergraduate and graduate medical training to enable prospective care will require creative work on the part of curriculum committees and course directors. More specifically, emphasis is needed on garnering understanding of the impact of genetics, environment, and lifestyle in determining risks for disease. Perhaps this can be accomplished by a new course in health risk assessment offered late in the basic science portion of the curriculum. Alternatively, it could be part of a course on clinical genetics if the appropriate orientation is developed. Better understanding of the natural history of disease from its inception along with awareness of the impact of prevention or early intervention must be conveyed to support the goal of teaching students how to assess each patient's health risk and to develop a personalized health plan. A prospective medical record that incorporates health risk assessment and planning is essential. Importantly, prospective clinical practice models will be needed in primary care settings. In such clinics, patients will be assessed for their personal health risk and a personalized health plan formulated. The role of the patient as a leader of the implementation of his or her health plan will need to be understood and facilitated. The responsibility of health care teams in enabling patients to fulfill their plans will be prominent. In specialty training, learners will benefit from participating in state-of-the-art disease management programs whenever possible.

WORKING TOGETHER FOR PROSPECTIVE CARE

To accomplish prospective health care, interested parties, including academic health centers, insurers, and payers (both public and private) will need to work together to develop innovative applications of new technologies and appropriate delivery models.[18] At Duke, we have been preparing our institution to start dealing with prospective health care and have already initiated pilot programs. To facilitate the ability of genomic information to improve health risk assessment and predict outcomes, we have recently begun a major collaboration with The Center for Advancement of Genomics.* State-of-the-art sequencing technologies and know-how will be studied and used to develop models for empowering genomic medicine, one element that will surely improve personalized health planning and prospective medicine. Hopefully, rational reimbursement can be negotiated between providers and payers, but bipartisan political support must be mobilized to accomplish this. Ultimately, universal health coverage will be needed to support the development of personalized health plans for all, as well as access to the appropriate level of care on a continuing basis. Leaders of medicine are once again capable of transforming the practice of medicine based on necessity and opportunity. Prospective care, we suggest, is the answer to providing the best cost-effective model to improve our nation's health.

The authors thank Dr. Huntington Willard for his critical review of the manuscript and excellent suggestions. The authors are grateful to Ms. Vicki Saito, whose editorial advice and help made possible the writing of this article.

* The Center for Advanced Genomics, founded by Craig Venter, is a not-for-profit genomics policy and research center dedicated to advancing science and medicine through education and enlightenment of the general public, elected officials and students.

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