

National Telemedicine Initiatives: Essential to Healthcare Reform

Rashid L. Bashshur, Ph.D.,¹ and Gary W. Shannon, Ph.D.²

Contributing authors: Elizabeth A. Krupinski, Ph.D.,³ Jim Grigsby, Ph.D.,⁴ Joseph C. Kvedar, M.D.,⁵ Ronald S. Weinstein, M.D.,³ Jay H. Sanders, M.D.,⁶ Karen S. Rheuban, M.D.,⁷ Thomas S. Nesbitt, M.D.,⁸ Dale C. Alverson, M.D.,⁹ Ronald C. Merrell, M.D.,¹⁰ Jonathan D. Linkous,¹¹ A. Stewart Ferguson, Ph.D.,¹² Robert J. Waters, J.D.,¹³ Max E. Stachura, M.D.,¹⁴ David G. Ellis, M.D.,¹⁵ Nina M. Antoniotti, Ph.D.,¹⁶ Barbara Johnston, M.S.N.,¹⁷ Charles R. Doarn, M.B.A.,¹⁸ Peter Yellowlees, M.D.,¹⁹ Steven Normandin,²⁰ and Joseph Tracy²¹

¹University of Michigan, Ann Arbor, Michigan; ²University of Kentucky, Lexington, Kentucky; ³University of Arizona, Tucson, Arizona; ⁴University of Colorado, Denver, Colorado; ⁵Harvard Medical School, Boston, Massachusetts; ⁶The Global Telemedicine Group, McLean, Virginia and the Johns Hopkins School of Medicine, Baltimore, Maryland; ⁷University of Virginia Health System, Charlottesville, Virginia; ⁸UC Davis Health System, Sacramento, California; ⁹University of New Mexico, Albuquerque, New Mexico; ¹⁰Virginia Commonwealth University, Richmond, Virginia; ¹¹American Telemedicine Association, Washington, DC; ¹²Alaska Native Tribal Health Consortium, Fairbanks, Alaska; ¹³Center for Telehealth and E-health Law, Washington, DC; ¹⁴Medical College of Georgia, Augusta, Georgia; ¹⁵State University of New York at Buffalo, Buffalo, New York; ¹⁶Marshfield Clinic Telehealth, Marshfield, Wisconsin; ¹⁷Medical Board of California, Sacramento, California; ¹⁸University of Cincinnati, Cincinnati, Ohio; ¹⁹UC Davis Health System, California, Sacramento, California; ²⁰AMD Global Telemedicine, Boston, Massachusetts; and ²¹Lehigh Valley Health Network, Allentown, Pennsylvania.

Executive Summary

This document reflects the strongly held views and perspective of a diverse group of healthcare academicians, researchers, providers, and industry representatives from across the country who share a belief in the necessity of healthcare reform and the centrality of telemedicine—or information technology-enhanced healthcare—in that reform.

The need for reform stems from long-standing problems in our health system, and the central role of telemedicine derives from an ever-expanding body of research and experience that attests to its merit in addressing these problems. Despite the fact that the United States spends more on healthcare than any other country, both in absolute numbers and on a per capita basis, the health status of Americans ranks relatively low when compared with that of people in other developed nations. Moreover, the general discrepancy between expenditures and health status indicators in the United States masks significant differentials among segments of the population, based on socio-economic, geographic, cultural, ethnic, and other factors. Hence, we continue to suffer from inequities in access to healthcare, inefficiencies in the delivery of care, escalating costs, and the prevalence of adverse lifestyles that exacerbate these problems.

Much attention has been devoted to the utility of the electronic health records (EHRs) as a means to improving the healthcare system. Yet, despite its potential benefits, the EHR represents only a partial solution to the problems we face. A broader focus on telemedicine (also frequently referred to as telehealth or e-health) that incorporates EHRs is a more prudent and effective approach. We believe that an exclusive concern with developing system-wide EHRs, while laudable and potentially valuable in improving one sector in healthcare delivery, would ultimately increase the cost of care without contributing to necessary changes in the rest of the system.

This article is accepted for publication in *Telemedicine and e-Health* (Official Journal of the American Telemedicine Association).

Telemedicine technology embodies the electronic acquisition, processing, dissemination, storage, retrieval, and exchange of information for the purpose of promoting health, preventing disease, treating the sick, managing chronic illness, rehabilitating the disabled, and protecting public health and safety. Telemedicine systems consist of collaborative health networks, facilities, and organizations dedicated to these objectives. Over the past several decades, telemedicine systems have demonstrated the capacity to do the following:

- *Improve access to all levels (primary, secondary, and tertiary) of healthcare for a wide range of conditions—including, but not limited to, heart and cerebrovascular disease, endocrine disorders such as diabetes, cancer, psychiatric disorders, and trauma; as well as services such as radiology, pathology, and rehabilitation.*
- *Promote patient-centered care at lower cost and in local environments that also contributes to stabilizing local healthcare and economies.*
- *Enhance efficiency in clinical decision making, prescription ordering, and mentoring.*
- *Increase effectiveness of chronic disease management in both long-term care facilities and in the home.*
- *Promote individual adoption of healthy lifestyles and self-care.*

Telemedicine has costs and benefits. However, the benefits accruing to providers, clients, and society at large far exceed the cost. These benefits include: providing primary care physicians with ready access to specialist colleagues; extending the reach of specialist providers at tertiary care centers; integrating medical services across multiple delivery sites; obviating unnecessary patient travel to distant specialists; enabling rational triaging of patients; minimizing duplication of diagnostic tests and clinical services; stabilizing rural providers and local economies; and enhancing access to care for institutionalized populations while reducing cost and enhancing public safety.

The tasks facing the nation in improving the health status of Americans through major reform of the health system are formidable. This reform must assure improved access to appropriate and quality healthcare while controlling costs. One necessary component of this reform is the provision of insurance coverage for people who are under- or uninsured. However, health insurance does not guarantee appropriate access to healthcare that is not distributed equitably. Hence, we acknowledge that telemedicine is not the panacea for healthcare reform. Rather, it is a cost-effective and clinically effective solution. A cornerstone of telemedicine development rests in the simultaneous requirement of parity in reimbursement between telemedicine and in-person care. The current context for reform presents an ideal opportunity for the full-fledged integration of telemedicine in the health system, with far-reaching benefits for this and future generations.

Key words: *healthcare reform, telemedicine/telehealth, electronic health records*

Introduction

The signatories to this document represent a diverse group of healthcare academicians, providers, researchers, and industry representatives from across the country who share a belief in the urgent need for healthcare reform coupled with a knowledge of and commitment to the potential of telemedicine/telehealth/e-health (hereafter referred to as telemedicine) as a necessary component of this reform. We submit this statement in the firm belief that the healthcare challenges facing the United States must be confronted comprehensively with a common purpose, ingenuity, and shared responsibility.

The necessity of healthcare in promoting health and preventing disease, in treating the sick and rehabilitating the disabled, and in alleviating pain and suffering is universally accepted. For several decades, however, inefficiencies and inequities in access to quality healthcare have been well documented. Healthcare costs continue to rise, rendering them beyond the reach of the average citizen who is not insured by a private or public program, and the number of the uninsured continues to climb. The escalating cost situation has been made more critical by the current national economic distress, increasing unemployment rates accompanied by loss of health insurance, and the growing economic challenges facing healthcare institutions.

Recently, the role of information technologies, particularly electronic health records (EHRs), has received increasing attention and emphasis as the means to improve the performance of the health system through their promise to reduce redundant and unnecessary medical tests, diminish medical errors, and improve clinical decision making. While laudable and a potentially valuable element in contributing to an improvement in a selective sector of healthcare delivery, ***the exclusive focus on the EHR as an end in itself may result in a substantial increase in the cost of healthcare without addressing the structural changes necessary to improve access to care, enhance quality, and contain cost.***

Whereas variations in the definition of telemedicine exist, there is consensus on a broad conception of this field as the delivery of personal and nonpersonal health services and of consumer and provider education as well as a means for safeguarding the living environment via information and communication technology (ICT).

In our view, innovative telemedicine systems have already demonstrated the potential to:

- Redress the inequities in access to all levels of health resources (primary, secondary, and tertiary);

- Enhance health system efficiency, clinical decision making, and prescription ordering.
- Promote patient-centered care, at lower cost, and in local environments.
- Increase the effectiveness of chronic disease management in long-term care institutions, and especially in the home environment.
- Promote individual adoption of healthy lifestyles and self-care.

Thus, the considerable promise of telemedicine in addressing issues of quality, efficiency, cost, and access to care should be placed at the forefront of our national effort to reform healthcare.

Framework

In this article, we present an analysis of the current problems facing healthcare in the United States and the potential role of telemedicine in addressing and alleviating them. Our purpose is to provide an impetus for discussions pertaining to the significant role that telemedicine can play in the development of effective healthcare reforms.

We also provide a cursory assessment of the current performance of the U.S. healthcare system, the previous attempts at healthcare reform and the underlying reasons for their limited success, and the role of telemedicine as a necessary component in healthcare reform.

The Promise of Telemedicine

Our expectations for the positive role of telemedicine in healthcare reform rest on its unique attributes and, more specifically, the manner in which it addresses each of the following problems in healthcare delivery:

- The prevailing inequities in access to care that reflect geographic, socioeconomic, and cultural disparities.
- The inefficiencies and limited coordination and integration of complex systems of healthcare.
- The uneven distribution of quality of care, uneven adherence to evidence-based medicine, high prevalence of medical errors, and the wide adoption of unhealthy lifestyles.

The technology of telemedicine consists of electronic tools for the acquisition, processing, dissemination, storage, retrieval, and exchange of information aimed at promoting health and preventing disease, treating the sick, rehabilitating the disabled, alleviating pain and suffering, and protecting the public's health and safety. The traditional boundaries between telemedicine, telehealth, and e-health have become blurred, partly as a result of a general liberalizing trend in modern society that normally starts with the nomenclature before it becomes manifest in actual practice and partly because of the overlapping functions between medicine and public health and their convergence on using the same technology in this instance.

Over the last decade or so, the changes led by the digital revolution have created a wave of new technologies that now pervade industrialized societies as well as less developed ones. In turn, these technologies have created pressures for changes in healthcare. For instance, the Internet has spawned a wealth of health information at the fingertips of providers, consumers, lay support groups, and special interests. It has also opened vastly expanded opportunities for increased access to information and sources of care that transcend the barriers of time and place.

Despite their immense promise, the diffusion of programs that rely on ICT in healthcare delivery has been selective and slow. Whereas large medical centers now rely on ICT in routine operations, such as billing, scheduling, and communications, there has been a general reluctance to broaden their applications to incorporate remote consultations with colleagues located in other places, in-home monitoring of chronically ill patients, triaging patients and coordinating their care throughout the system, remote mentoring of colleagues in complex surgical procedures, streamlining the clinical process between diagnostic and clinical services, and integrating multisite delivery systems. ***All of these are core functions in telemedicine.***

Most medical centers are currently facing a perilous financial situation from declining revenues. Some have found it expedient to reduce their investment in ICT. Moreover, the prospect of providing additional services via telemedicine is not inherently attractive to them because of significant limitations and restrictions on reimbursement for these services. ***As supported by scientific evidence, a fair reimbursement policy would equate services delivered electronically to those delivered in person.***

During the last two decades, the federal government has assumed the dual role of supporting telemedicine projects and also placing obstacles to the orderly deployment of sustainable programs. Several federal agencies have provided substantial grant funding for project start-ups and research in this field. At the same time, some federal programs, such as the Veterans Administration, the Department of Defense, and Bureau of Prisons, have adopted the use of telemedicine in their operations. On the other hand, the Centers for Medicare and Medicaid Services (formerly Healthcare Financing Administration) have imposed significant restrictions on reimbursement. This has hampered the diffusion of telemedicine nationwide since no medical practice can be sustained without reliable recurring revenue.

In the current economic environment, it would be futile to propose solutions in healthcare that simply add expenditures without having a clear and explicit expectation of significant returns on investment. Indeed, it would also be simplistic to assume that a single fix such as a massive infusion of funds for building the IT infrastructure in healthcare alone would result in a vastly improved health system that is affordable and accessible.

Inequities in Access

One of the key attributes of telemedicine systems is electronic connectivity, which transcends time and distance barriers. Newer advances in this technology enable the acquisition, transmission, processing, storage, and retrieval of vast amounts of information, including biometric data, medical records, medical history, images, educational material, and direct communication. With telemedicine technology, patients have ready access to a series of geographically and functionally disparate providers without having to travel to distant places and at times that are convenient for both patient and provider. Similarly, providers have access to colleagues for consultation, clinical advice, and guidance irrespective of where they live and work. Most of the opportunity costs of care normally borne by patients and providers (in travel, lost wages, and nonessential appointments, for example) are diminished substantially, if not eliminated.

The uninsured and the underinsured will not directly benefit from the introduction of telemedicine systems unless and until the cost savings are utilized to support structural changes to deal with this problem. *The cost-savings would accrue from the use of explicit protocols for patient triage, referral, treatment, and follow-up; from improved efficiencies in patient self-management and informed decision-making; and from the adoption of healthy lifestyles.*

Health System Inefficiency

Telemedicine's potential effects on health system efficiency derive mostly from providing *effective substitutions in locus and site of care, provider, and setting*. In addition, clinicians would be equipped with clinical decision support systems, and multisite networks would be given effective tools for integration.

In an ideal situation, patients would be able to receive the appropriate type and level of care they need, in proximity to their homes, from the appropriate provider, and in the appropriate setting. Indeed, an optimal and well-managed health system should not aim simply to reduce use of service through pricing or other control mechanisms. It should focus on encouraging appropriate use of care while discouraging frivolous or inappropriate use. Thus, while there is wide consensus that routine and self-limiting medical problems can be handled effectively by nurse practitioners or primary care providers, and the use of a specialist in most of these instances would be inappropriate, we have yet to develop explicit protocols for triaging patients to the appropriate sources of care from the outset, and for coordinating the process of care as indicated by professional standards and patient needs. *Telemedicine provides the most effective tools available for achieving these goals.*

Telemedicine technology also enables complex and multisite medical centers to achieve greater coordination, cohesion, and integration,

while assuring greater continuity of care for their patients and streamlining their clinical and administrative operations. It also reduces, if not eliminates, specialist travel to outlying areas.

Uneven Quality

Integration of telemedicine with EHRs is essential for realizing the full medical and economic benefits of both technologies. For providers, ready access to patients' presenting complaints and symptoms, medical history, and results from diagnostic tests would minimize medical errors, duplication, and unnecessary tests and procedures. Moreover, providers' ready access to expert second opinion and to authoritative sources of information relevant for the conditions under their care would help them deliver more competent care in their home communities. For patients, it represents an ideal situation whereby they can receive the most competent care from their usual primary care providers.

In summary, the available evidence to date clearly suggests that the appropriate deployment of integrated telemedicine systems throughout the country would have the potential to address the problems of access, cost, and quality simultaneously. However, *its success would ultimately depend on our ability to build and support local, regional, and national telemedicine networks, the removal of financial and technical barriers to the use of telemedicine by the mainstream, and the implementation of EHRs as part of these systems.*

Telemedicine systems are neither designed nor intended as substitutes for the prevailing system of healthcare. When implemented optimally, the tools of telemedicine complement the current system, enabling it to operate with greater efficiency, effectiveness, outreach, and shared responsibility.

Benefits of Telemedicine

The persistence of telemedicine in various forms and iterations over a period of several decades attests to its usefulness, versatility, and ever-expanding capabilities. The technological armamentarium for the practice of telemedicine includes enormous capabilities from virtual reality, to remotely operated robotics and haptic feedback devices, to high-speed computers and broadband links.

This versatile technology has benefits as well as costs, but there is a growing body of evidence demonstrating that the *benefits far exceed the cost*, and these benefits accrue to providers, clients, and society at large. For instance, telemedicine enables remote primary care providers to have ready access to expert colleagues at tertiary care centers. Specialist providers at tertiary care centers can serve more effectively a geographically dispersed patient population. Patients can receive an appropriate level of care nearest to their homes. Society benefits from

more rational shared decision making by consumers; effective substitutions among sites of care; rational triaging of patients to appropriate sources of care; and avoidance of unnecessary duplication and waste in diagnostic services and clinical procedures. Patients presenting with a variety of symptoms and problems can be triaged to the appropriate provider, at the appropriate time and place. Rural hospitals can be stabilized by their professional links to medical centers, thereby contributing to the economic stability of rural communities. Physicians in various practice locations can have ready access to efficient tools for clinical decision making and to evidence-based medicine. Chronically ill patients can be monitored in their home environments and given the tools necessary for their maintenance and self-management. Average citizens can be given access to the tools and educational resources for adopting and maintaining healthy lifestyles. Also, large comprehensive medical centers would be able to integrate their services across multiple delivery sites and facilities.

The limitations of nonintegrated acute care systems, unstable insurance schemes, and growing chronic illness in the population contribute to the problem. Acknowledging these issues begs the question of how to create a more effective system of care. Major government programs in the distant and recent past have focused on efforts to integrate care and contain costs, for example, through health planning and managed care, but they have met with limited success. Other initiatives have employed financial incentives to encourage better decision-making and efficiency, also with disappointing results.

An Illustrative Case for Telemedicine: Child and Adolescent Diabetes

The case for telemedicine can be best illustrated by focusing on a single disease entity, such as diabetes. Today, diabetes is the sixth leading cause of death in the United States.¹ The direct costs for the treatment of diabetes in 2007 were estimated at \$116 billion, and the total direct and indirect costs were estimated at \$174 billion.² Over the last several decades, concern for diabetes has extended to young children (under 5 years of age—type I) and adolescents (6–17 years of age—type II). This is one of the more important health issues facing this segment of the population today, marking a major shift in the epidemiology of childhood diseases.³ The American Diabetes Association recommends that diabetic children should be cared for by a pediatric endocrinologist (PE) as part of a diabetes management team.⁴

A state level study of the geographic distribution of PEs revealed a 19-fold difference in observed ratios of obese children to PEs.³ For example, Montana and Wyoming had no PEs. In Massachusetts, the ratio of children to PE was lowest at 5,312:1, while in Mississippi it was 99,984:1. Using Massachusetts as a reference (gold standard), an

estimated 1,500 additional PEs would be required and would need to be geographically distributed proportionately across the states to assure equitable access to their services. The authors contend that training adult diabetes providers to care for adolescents with type II diabetes is one option but a “reassessment of the current system of healthcare delivery for obese children is needed, along with the creation of sustainable models of care which can effectively improve health outcomes for the large numbers of obese children at risk for development of chronic diseases in childhood”.³

It is improbable that the requisite numbers and distribution of pediatric and adult endocrinologists will be forthcoming. In all likelihood, the current clustering of these specialties in major medical centers and large cities will not change significantly, leaving millions of children and adolescents at risk in medically underserved areas and among medically underserved populations. Even in Massachusetts, of the 37 PEs in the state, 28 (76%) are located in Boston, 4 (11%) in Worcester, and 3 (8%) in Springfield. The critical significance of the type of maldistribution is reflected in the higher prevalence of obesity in rural than in urban counties, and among African Americans, American Indians, and Alaska Natives.⁵ Certainly, in this and other similar situations, the effective development of telemedicine can help redress the inequitable distribution of specialists necessary to diagnose, treat, and manage diabetes and related chronic diseases.

Evidence for telemedicine’s potential in this regard comes from a number of sources. For example, a randomized control trial of Medicare recipients with diabetes⁶ found that telemedicine case management using data capture from home monitoring devices improved glycemic control, blood pressure levels, and total and low-density lipoprotein cholesterol levels at 1 year of follow-up (all of which are essential in the control of diabetes). In another study, diabetes education via telemedicine was equally effective as in-person education in improving glycemic control, and both methods were well accepted by patients.⁷ Additionally, reduced diabetes-related stress was observed in both groups. These studies demonstrate that telemedicine can be successfully used to provide diabetes education to patients. In addition, a pilot study of telemedicine technology to implement diabetes self-management education for people with diabetes in underserved rural communities in Arkansas determined that a significantly greater proportion of participants demonstrated improved knowledge, endorsed greater self-efficacy, and reported more frequent self-care practices to manage their diabetes at the conclusion of the study period.⁸ This example is applicable to a host of other chronic health problems, including asthma, heart failure, pulmonary disease, and others.

In the example provided here, the observed link between obesity and both types I and II diabetes for children and adolescents (as well as the

latter for adults) points to the promise of telemedicine by contributing to prevention through health behavior education as well as provision of accessible diagnostic, treatment, and health maintenance services for those with diabetes in medically underserved areas.

It is important to recognize that the health status of an individual and of a population cannot be attributed solely to medical intervention. Indeed, individual health status is the product of genetics/biology, lifestyle, environmental quality, and medical intervention. While it is difficult to ascertain the precise contribution of each of these factors to health status, the role of medical intervention in terms of enhancing preventive behavior as well as providing diagnostic, therapeutic, and support functions is central. Moreover, a truly effective plan for comprehensive healthcare reform must incorporate the major determinants of health status that may be amenable to change, especially when this can be accomplished at a reasonable cost. An optimal health policy would use these determinants as a rational basis for informed policy making in resource allocation and accountability.

Telemedicine has the potential to intervene at a range of points along the spectrum of health and illness behavior for many health conditions. An appropriate starting point is educational programming aimed at encouraging the adoption of preventive health behaviors such as healthy diets and exercise, childhood and adult vaccination, the use of screening programs for early detection and treatment, informed decision making with regard to treatment options, compliance with prescribed regimen, and supervised/self-management in chronic disease management programs. We know that by increasing accessibility to each of these programs, more people will take advantage of them, resulting in notable improvements in the health status of Americans.

As illustrated here, the United States has an obvious discrepancy between expenditures and achievements in health. This discrepancy has long been recognized, but we have yet to develop and adopt a comprehensive strategy to address it. The current environment calls for an innovative and sustainable national health policy that achieves positive results in a cost-effective manner. The significant advantages of telemedicine are clear. The following sections of this article provide supporting evidence for our contention that there are serious problems facing the current healthcare system today in the United States.

Problems in Health System Performance

The major problems in the health system of the United States are continuing cost inflation, inequitable and uneven access to appropriate and quality healthcare for large segments of the population, and the practice of unhealthy lifestyles by many Americans.

Cost Inflation

In the aggregate, when measured by per capita expenditures, as well as percentage of the gross domestic product¹ (GDP), U.S. health-care expenditures have increased dramatically over the last several decades, and are considerably higher than those of other developed countries. In 1960, the total U.S. health expenditure was 5.2% of the GDP. According to the most recent figures available, in 2007, the total U.S. health expenditure as a proportion of the total GDP was estimated at 16.3%. By 2017, should current trends continue, healthcare spending is expected to reach just over \$4.3 trillion, or 19.5% of the GDP.⁹ In terms of per capita expenditures, among 25 member countries of the Organization for Economic Cooperation and Development (OECD) that have comparable accounting systems, spending per person on healthcare in 2006 was highest in the United States (\$6,714) followed by Norway (\$4,250). For comparison, the per capita healthcare expenditure in Canada was \$3,678, about half that of the United States.

Furthermore, in 2001, according to OECD data, the United States' healthcare expenditures ranked highest in terms of purchasing-power-parity international dollars (PPPs): \$5,711.¹⁰ Switzerland—among OECD countries most similar to the United States in organization and financing of care—ranked second (\$3,756), spending only 66% as much as the United States. In terms of PPP\$, Canada spent \$2,982 or 52% of the amount spent by the United States.

Cost and Quality

National and/or per-capita expenditures are often used in conjunction with selected indicators of a population's health to reflect the relationship between investment and achievement in health at the national and international levels. While expenditure sources can be identified and measured fairly reliably, there is always a problem of attributing the health of the population to its appropriate sources. This is because individual lifestyle and the quality of the living environment have significant effects on people's health in addition to the quality of their health services.

The discrepancy between health expenditures and the two common indicators of quality—life expectancy at birth and crude infant mortality rates—has been used to indict the U.S. health system.¹¹ For example, over the past several decades most OECD countries have experienced substantial gains in life expectancy compared with modest increases in expenditures over the past several decades. These trends have not been matched in the United States, where life expectancy at birth increased by 7.9 years between 1960 and 2005, compared to over 14 years in Japan and 9.1 years in Canada during the same period. In 2005, life expectancy in the United States was 77.8 years, almost 1 year below

the OECD overall average of 78.6 years. According to the 2008 CIA World Fact book, the U.S. ranks 45th in the world in life expectancy, behind such places as Guam, Jordan, and Bosnia-Herzegovina.

Based on 2008 estimates of infant mortality among the 30 OECD countries, the United States was tied with Poland and the Slovak Republic for 26th place (at 6.9 deaths per 1,000). The infant mortality rate for non-Hispanic black Americans is about 13.6 per 1,000 and 5.8 for non-Hispanic whites (NHWs). If only infant mortality of the NHWs is considered, the United States ranking would improve to 22nd place.

It should be of considerable concern that the nation with the world's largest economy should trail so many less-developed countries in important indicators of population health.¹²

Furthermore, the overall rates do not tell the full story. There is considerable evidence illustrating the health experience diversity among Americans and the impact on health status and mortality. For example, a 2008 study conducted by Shugarman and associates determined that among Medicare beneficiaries, there was no evidence that lung cancer patients in rural areas had poorer survival rates than those living in urban areas. Rather than rural versus urban residence, individual (Medicaid versus Medicare coverage) and regional socioeconomic factors (lower median income at the census tract level) and a smaller supply of subspecialists per 10,000 individuals 65 years of age and older were positively associated with a higher risk of mortality. Nonetheless, rural residents were more likely to live in poorer areas with a smaller supply of healthcare providers, and therefore were less able to obtain needed care in a timely fashion. Similarly, a study of rural-urban differences in the management of breast cancer concluded that widespread use of state-of-the-art treatment would reduce mortality from breast cancer, and that differential access to state-of-the-art care is associated with area of residence.¹³

Additionally, the United States scored lowest among OECD countries with regard to safety. Thirteen percent of patients reported receiving the wrong medication or wrong dosage; 15% of patients believed a medical mistake was made in their treatment; 7% of hospitalized patients reported having an infection acquired in the hospital; and only 23% of doctors received computerized alerts or prompts about a potential problem with drug overdose or interaction. The United States also finished near the bottom in terms of the "patient-centeredness" of care and the coordination of care between multiple providers. Patients in the United States were most likely to visit an emergency department for a condition that could have been treated by a primary care physician. However, once discharged, patients in the United States were less likely to be re-hospitalized because of complications. Also, records and test results were the least likely to reach a doctor's office in time for an appointment, and U.S. patients were more likely to be sent for dupli-

cate tests compared with patients in four of the other countries—United Kingdom, New Zealand, Canada, and Australia.¹⁴

On the other hand, among the six OECD countries investigated in this analysis, per capita expenditures on healthcare were highest in the United States: nearly double those of Canada and Germany (\$6,102 versus \$3,165 and \$3,005 respectively).¹⁴

Past Attempts to Reform the U.S. Health System

A number of factors have been suggested as reasons for the disparity between expenditure and outcome in the U.S. health system. These include the wide variety and quality of compensation and reimbursement modes; the greater market power of the supply side of the health system that is reinforced by the highly fragmented organization of healthcare financing; the complexity of private health insurance schemes and associated high administrative overhead; the higher incremental cost-benefits (research and development) of high-technology medical care; and high, and sometimes exorbitant pharmaceutical prices.¹⁵

Historically, the basic structure and function of the health system was established early in the last century. Hospitals became dominant institutions because they facilitated the use of acute care technologies such as X-rays, anesthesia, antisepsis, and surgical suites. However, the cost of hospital-based acute care has continued to spiral to the point of becoming unsustainable, while primary care has received limited attention. Public health was systematically underfunded and essentially separated from clinical care, focusing on environmentally linked disease etiologies, such as sanitation, environmental sources, and communicable disease as well as health behavior. Thus, clinical interventions became the exclusive domain of medicine and medical institutions, whereas health promotion and disease prevention became the domain of public health.

Over the last century, considerable investment, sustained by historical inertia, has fortified these healthcare institutions, making them resistant to structural change and reform. Several attempts at reforming this system through legislation have failed to resolve long-standing problems. These have included (1) efforts to improve the availability of resources in underserved areas through facility construction; (2) medical education and training grants to attract health providers to underserved areas; (3) attempts to enhance health system efficiency and integration through regional programs and health planning agencies; (4) increasing access to care through entitlement programs; and (5) containing cost through prospective reimbursement and managed care. All of these approaches had substantial merit, but none proved sustainable and sufficient to meet the pressing national need for equitable access for all segments of the

population and for cost containment and universal quality assurance. Consequently, these past initiatives have spawned an uncoordinated system that is heavily focused on acute care, and increasingly overwhelmed by underlying inefficiencies and unintended consequences. The lessons learned from a history of patchwork reform should guide current efforts to find optimal sustainable solutions. These historical lessons can be summarized as follows:

1. The lack of a sustained national health initiative has created an entrenched system at various levels—local, regional, and national—characterized by organizations with strong vested interests in maintaining the status quo and resisting change. In addition, frequently the clinical, administrative, and legal structures needed in the past now create jurisdictional protections of inefficient practices and institutions.
2. The lack of a coordinated system of care has resulted in wide variations in clinical practice, discrepancies in adherence to evidence-based standards, and wide variability in performance. Moreover, some of the important lessons learned at some of the leading medical centers have not spread to the rest of the system because the paradigms of organizational or system change that are successful in these institutions often fail when applied in less sophisticated, rural, or simply different environments.
3. The task of reforming healthcare requires a systemwide approach wherein different initiatives are blended to achieve explicit goals. Limiting such efforts to a single fix, while maintaining the status quo in all other aspects, is likely to have little impact on major indicators of health system performance. Isolated solutions that may have worked in certain organizations are likely to face formidable barriers when they are implemented in other institutions and settings. For example, the deployment of electronic medical records can be done as effectively and efficiently on an intra-institutional or inter-institutional basis, but only in the proper context. Moreover, as with most other processes in the health system, the use of health information technology should be linked with and closely tied to the intended changes in performance objectives.
4. The unsuccessful and unsustainable health policies of the past cannot serve as an effective guide to meet current and/or future challenges. It is time to confront our challenges as a nation and as a people with ingenuity, creativity, renewed determination, and shared responsibility.

Barriers to Health System Performance

One of the major attributes of the prevailing system of healthcare delivery is the focus on acute and episodic care, and an unstable insur-

ance system that is linked to employment and hence subject to fluctuations in the business cycle. Prevention is relegated to traditional public health departments, but without a clear mandate and authority for protecting the health of the public, save for elementary public sanitation and childhood immunization. The changing health needs of the population, in conjunction with the emerging capabilities of information and communication technology, now create an unprecedented opportunity to rethink the priorities of the health system and to develop comprehensive plans and optimal structures to achieve explicit national goals.

The following is a brief summary of the major problems in the current system that calls for corrective action. They include fragmentation of care, limited attention to health promotion/disease prevention, health resource shortage, structural problems in manpower, the medical technology imperative, and changes in demographics and population health.

1. **Fragmentation of care.** Despite the growth of managed care, much of the care that patients receive is *episodic*, without effective means for coordinating the medical care process over time and across providers; *discontinuous*, without the necessary links and coordination between delivery sites and resources; and it is *inefficiently delivered* without explicit protocols for sharing patient-relevant information and compliance with evidence-based guidelines. This fragmented system has been described as “a collection of bits and pieces.”¹⁶

The acute care paradigm that has been prominent in medicine since the beginning of the last century was well served by clinical professionalism, with individual autonomous decision making and control of medical institutions. However, we now need to consider the appropriate paradigm shifts in providing health services to people to enhance efficiency and effectiveness not only for providers and systems of care but also for clients, patients, and their families.

2. **Little concern with health promotion/disease prevention.** It is widely recognized that medical intervention is not the sole determinant of the health of individuals and/or communities at large. Indeed, the choices that people make in their daily lives and the quality of the environment in which they live have direct impacts on their health and ultimately the cost of their care. An ever-expanding body of evidence points to limited or inconsistent public attention to healthy diets, physical activity, smoking avoidance, and moderate drinking. For example, obesity rates among adults in the United States doubled between 1980 and 2004. Obesity is associated with increased risk for a number of conditions, including diabetes mellitus, cardiovascular disease, hypertension and certain cancers, and with increased risk of disability and a mod-

estly elevated risk of all-cause mortality. In 2006, about 34% of Americans (over 72 million) over 19 years of age were obese.¹⁷

About 21% of adults and about 13% of children (age 10–17) smoke. The percentage for white children increases to 15%. The teen birth rate is 40 per 1,000, and 13% of these births are pre-term. Eight percent of all births are low weight; among blacks it is 14%. Finally, only about one-half of adults participate in some form of moderate or vigorous physical activity.^{18,19}

3. *Structural problems in health manpower.* The greater emphasis on acute care and medical specialization, along with institution-based care, took precedence over the country's need for primary care and preventive medicine. We have deviated from the prescribed norm of roughly equal numbers of specialist and generalist physicians. "One of the more entrenched physician workforce concerns in the United States has been the limited number of physicians in rural communities."²⁰ The limited number and wide geographic variation of pediatric endocrinologists was discussed earlier. A similar situation exists for many, if not all, clinical specialties. For example, great variation exists in the geographic distribution of cardiologists and in numbers of cardiac services provided across the United States.²¹ The importance of this distribution is illustrated by a leading health economist, Uwe Reinhardt, who notes that "no one knows what differences in the quality of patients' lives are associated with the stunning geographic variations in practice style".¹⁵ Wennberg and colleagues suggested that the strongest predictor of per capita consumption of cardiac services is the per capita distribution of cardiologists. People with heart problems who live in medically underserved areas simply cannot get the care they need.

Another specialty with marked geographic maldistribution is dermatology. Despite worries in the 1990s about an oversupply of dermatologists, a 2002 survey on medical practice reported a relative shortage of these specialists, leading to long delay times in first appointments ranging from 20 to 90 days.²² In 2004, conclusions based on survey data on waiting times and other related issues also reported an inadequate supply of dermatologists to meet the demand for their services (Resneck and Kimball 2004). The average waiting time for the first appointment ranged from 18 days in Mississippi to 66 days in Pennsylvania. Early diagnosis and treatment of skin cancer is closely linked to successful outcomes.

Finally, for large segments of the U.S. population, mental healthcare is frequently unavailable, or accessible with substantial difficulty. A survey of nonfederal psychiatrists in the United States reported a 50-fold variation in the availability of psychiatrists by state, measured as the ratio of psychiatrist to

100,000 individuals in the population. The lowest ratios were in Alaska and Wyoming at 0.6 and 0.8, respectively, while the highest were in Massachusetts and New York at 31.1 and 28.2, respectively.²³ Moreover, a recent study reported that the shortage of psychiatrists for children and adolescents remains, adversely affecting those living in rural areas or in poverty.²⁴

In short, we have failed to address the need for reaching parity between primary care and specialists in the United States, and the greater lure of specialization in medicine remains strong.

4. *Demographics and population health.* The aging of the population and the attendant increase in chronic illness have expanded the demand for care, while the adoption of unhealthy lifestyles has exacerbated the problem. Approximately 75% of health costs are attributable to chronic disease, a large percentage of which is preventable but only when action is taken long before the onset of the disease.

5. *Wasteful spending in medical care.* Despite disagreement about the exact magnitude of the extent of wasteful spending in medical care, there is a general consensus that we are not getting the greatest value for the amount spent. Recently, the president and chief executive of the Mayo Clinic explained, "We are not getting what we pay for. It's just that simple."²⁵ Several decades of research by Wennberg and colleagues have demonstrated wide geographic discrepancies in the care that patients receive, and factors other than need are important drivers of the system. For example, according to Wennberg (2005), "It was immediately apparent that suppliers were more important in driving demand [for care] than previously realized."²⁶ An analysis of multiple medical interventions suggests that due to asymmetries in the accumulation of benefits, risks, and costs, clinical trials may overestimate the benefits and underestimate the risks and costs for an individual submitting to multiple interventions. On the other hand, Cutler et al. (2006) concluded that "Even taking wasted care into account, the U.S. system as a whole is probably worth the cost. The paradox of U.S. medical care is that a high total value of care is combined with a significant amount of waste."²⁷

6. *The dilemma of the technological imperative.* Whereas advances in medical technology and medical science have contributed to saving lives and improving quality of life through sophisticated diagnostic tools, improved surgical techniques, and a vast array of therapeutic drugs, they have played a major role in raising the cost of care. In many instances their development and utilization have been guided largely by special interest groups and institutions. Moreover, their benefits have not been distributed on the basis of need. Increasingly, technological advances are beyond

the reach of many middle and lower income people because of their high cost, as well as the high prevalence of un-insurance and underinsurance in these populations.

7. *The uninsured.* Both the number and percentage of the uninsured and underinsured in the United States population have been increasing, a problem rapidly and significantly exacerbated by the current economic downturn. Unlike most developed and developing countries, health insurance in the United States has been linked to employment, especially after labor unions gained this benefit through collective bargaining. Insurance status is a significant determinant of use of service and ultimately health status, since the uninsured tend to postpone or forego needed care. When needed care is delayed, health problems may be exacerbated and more expensive care may become necessary with fewer health benefits for the individual concerned. While this is a serious structural problem that must be addressed, it falls beyond the scope of telemedicine, except insofar as telemedicine may reduce certain costs. Some of the cost savings that may be accrued from the use of telemedicine could be used to extend coverage to the uninsured and underinsured.

Conclusions

While not a panacea, *telemedicine offers significant opportunities to address the issues of inequities in access to care, cost containment, and quality enhancement.* Telemedicine not only provides the potential to address structural issues of the health system, but it also promotes transparency and evaluation to drive further improvement. Telemedicine connections between primary care providers and specialists would lend greater economic benefits and social prestige to primary care. Patients would be less likely to get “lost” in the complexities of fragmented and unconnected medical providers and health systems. Instead, their care would be facilitated through an integrated and electronically connected medical care landscape across the entire country.

Disclosure Statement

Ronald S. Weinstein, MD, discloses that he is a Co-founder, Board member, and has equity in DMetrix, Inc. and is President, Chairman of the Board, and has equity in UltraClinics, Inc. Jay H. Sanders, MD, discloses the following entities that represent either existing consulting clients and/or entities in which he has been provided stock or stock options in which a conflict of interest either exists or might be perceived: (1) AFrame Digital; (2) Kinetic Muscles, Inc.; (3) Rivulet; (4) BiObex; (5) Compressus; (6) MedApps; (7) Emaginos; (8) InTouch Health; (9) RMD Networks; (10) ATI; (11) iCons; (12) Vesalius Ventures; (13) Flexible Medical Systems; (14) PhiloMetron; (15) Sensitron;

(16) InforMedix; (17) Emergency Medical Technologies, and (18) TeleVital. Robert J. Waters, JD, discloses serving as Counsel to the Center for Telehealth and E-Health Law and as Director of the Home Care Technology Association of America. For all other authors no competing financial interests exist.

REFERENCES

- Hsiang-Ching K, Hovert D, Jiaqun X, Murphy S. Deaths: Final data for 2005. *National Vital and Statistics Report*. Available at: <http://www.cdc.gov/nchs/data/nvsr/nvsr5610.pdf>. 2008. (Last accessed June 4, 2009).
- ADA. Economic costs of diabetes in the United States, 2007. *Diabetes Care* 2008;31:596–615.
- Lee J, Davis M, Menon R, Freed G. Geographic distribution of childhood diabetes and obesity relative to the supply of pediatric endocrinologists in the United States. *J Pediatr* 2008;152:333–336.
- Silverstein J, Klingessmith G, Copeland K, Plotnick L, Kaufman F, Laffel L, Deeb L, Grey M, Anderson B, Holzmeister LA, Clark N, American Diabetes Association. Care of children and adolescents with type I diabetes: A statement of the American Diabetic Association. *Diabetes Care* 2005;28:186–212.
- Jackson J, Doescher M, Hart G, Jerant A. A national study of obesity prevalence and trends by type of rural county. *J Rural Health* 2005;21:140–48.
- Shea S, Weinstock R, Starren J, Teresi J, Palmas W, Field L, Morin P, Goland R, Izquierdo R, Wolff T, Asraf M, Hilman C, Silver S, Meyer S, Holms D, Petkova E, Capps L, Lantigua R. A randomized trial comparing telemedicine case management with usual care in older, ethnically diverse, medically underserved patients with diabetes mellitus. *J Am Med Inform Ass* 2006;13:40–51.
- Izquierdo R, Knudson P, Meyer S, Kearns J, Ploutz-Snyder R, Weinstock R. A comparison of diabetes education administered through telemedicine versus in person. *Diabetes Care* 2003;26:1002–1007.
- Balamurugan A, Hall-Barrow J, Blevins M, Brech D, Phillips M, Holley E, Bittle K. A pilot study of diabetes education via telemedicine in a rural underserved community—Opportunities and challenges. *Diabetes Educator* 2009;35:147–154.
- Keehan S, Sisko A, Truffer C, Smith S, Cown C, Poisal JA, Clemens MK. Health spending projections through 2017. *Health Affairs* 2008;27:w145–w155.
- Reinhardt U, Hussey P, Anderson G. U.S. health care spending in an international context. *Health Affairs* 2004;23:10–25.
- Anderson G. In search of value: An international comparison of cost, access, and outcomes. *Health Affairs* 1997;16:163–171.
- Peterson C, Burton R. U.S. health care spending: Comparison with other OECD countries. In: *CRS Report for Congress: Congressional Research Service*. Available at: http://digitalcommons.ilr.cornell.edu/cji?article=1316&context=key_workplace. 2007. (Last accessed June 4, 2009).
- Holly L, Howe J, Katterhagen G, Yates J, Lehnerr M. Urban-rural differences in the management of breast cancer. *Cancer Causes Control* 1992;3:533–539.
- Davis K, Schoen C, Schoenbaum S, Doty M, Holmgren A, Kriss J, Shea K. Mirror, mirror on the wall: An update on the quality of American health care through the patient’s lens. In: *The Commonwealth Fund Publication*. Available at: http://www.commonwealthfund.org/usr_doc/1027_Davis_mirror_mirror_international_update_final.pdf?section=4039. 2007. (Last accessed June 4, 2009).
- Reinhardt U. Analyzing cause and effect in the U.S. physician workforce. *Health Affairs* 2002;21:165–166.

16. Bodenheimer T, Grumbach K. The reconfiguration of US medicine. *JAMA* 1995;274:85–90.
17. CDC. Obesity among adults in the United States. National Center for Health Statistics Data Brief. Available at: <http://www.cdc.gov/nchs/data/databriefs/db01.pdf>. 2007. (Last accessed June 4, 2009).
18. CDC. Racial/ethnic differences among youths in cigarette smoking and susceptibility to start smoking—United States, 2002–2004. *Morbidity and Mortality Weekly Report* 2006;55:1275–1277.
19. Schoenbron C, Adams P. Sleep duration as a correlate of smoking, alcohol use, leisure-time physical inactivity, and obesity among adults: United States, 2004–2006. Centers for Disease Control Health e-Stats. Available at: <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/sleep04-06/sleep04-06.pdf>. 2008. (Last accessed June 4, 2009).
20. Salsberg E, Forte G. Trends in the physician workforce. *Health Affairs* 2002;21:165–173.
21. Wennberg D, Birkmeyer J. *The Dartmouth Atlas of Cardiovascular Health Care*. Chicago, IL: AHA Press, 1999.
22. Jancin B. Survey: Shortage of dermatologists spurs long waits: It's time to enlarge residency programs and start training more dermatologists. In: *Health Care Industry: Skin and Allergy News*. Available at: http://findarticles.com/pl/articles/mi_hb4393/is_4_34/ai_n28997246/pg_2?tag=content:col1. 2003. (Last accessed June 4, 2009).
23. Scully J, Wilk J. Selected characteristics and data of psychiatrists in the United States, 2001–2002. *Acad Psychiatry* 2003;27:247–251.
24. Thomas C, Holzer C. The continuing shortage of child and adolescent psychiatrists. *J Am Acad Child Adolesc Psychiatry* 2006;45:1023–1031.
25. Cortes D, Korsmo J. Health care reform: Why we cannot afford to fail. *Health Affairs* 2009;28:w173–w176.
26. Wennberg J. *Variation in the use of Medicare services among regions and selected medical centers: Is more better?* New York: Commonwealth Fund, 2005.
27. Cutler D, Rosen A, Vijan S. The value of medical spending in the United States, 1960–2000. *N Engl J Med* 2006;355:920–927.

Address correspondence to:
Rashid L. Bashshur, Ph.D.
Telemedicine Resource Center
300 N Ingalls, 8 B 07, SPC 5402
Ann Arbor, MI 48109-5402

E-mail: bashshur@med.umich.edu

Received: May 26, 2009
Accepted: May 26, 2009

SIGNATORIES

Rashid L. Bashshur, Ph.D.
 Professor Emeritus of
 Health Management and Policy
 University of Michigan
 Ann Arbor, MI

Gary W. Shannon, Ph.D.
 Professor of Geography
 University of Kentucky
 Lexington, KY

Elizabeth A. Krupinski, Ph.D.
 Research Professor of Radiology
 University of Arizona
 Tucson, AZ

Jim Grigsby, Ph.D.
 Professor of Psychology and Medicine
 University of Colorado Denver
 Denver, CO

Joseph C. Kvedar, M.D.
 Director, Center for Connected Health
 and Associate Professor
 of Dermatology
 Harvard Medical School
 Boston, MA

Ronald S. Weinstein, M.D.
 Director
 Arizona Telemedicine Program
 University of Arizona
 Tucson, AZ

Jay H. Sanders, M.D.
 CEO, The Global Telemedicine Group
 and Professor of Medicine (adjunct)
 Johns Hopkins School of Medicine
 McLean, VA

Karen S. Rheuban, M.D.
 Senior Associate Dean
 University of Virginia Health System
 Charlottesville, VA

Thomas S. Nesbitt, M.D.
 Executive Associate Dean
 UC Davis Health System
 Sacramento, CA

Dale C. Alverson, M.D.
 Professor of Pediatrics and
 Regents Professor
 University of New Mexico
 Albuquerque, NM

Ronald C. Merrell, M.D.
 Professor of Surgery
 Virginia Commonwealth University
 Richmond, VA

Jonathan D. Linkous
 CEO, American Telemedicine
 Association
 Washington, DC

A. Stewart Ferguson, Ph.D.
 Director of Telehealth
 Alaska Native Tribal Health
 Consortium
 Fairbanks, AK

Robert J. Waters, J.D.
 Center for Telehealth and
 E-health Law
 Washington, DC

Max E. Stachura, M.D.
 Director, Center for Telehealth and
 Professor of Medicine and
 Physiology
 Medical College of Georgia
 Augusta, GA

David G. Ellis, M.D.
 Associate Professor of
 Emergency Medicine
 State University of New York
 at Buffalo
 Buffalo, NY

Nina M. Antoniotti, Ph.D.
 Director, Marshfield Clinic Telehealth
 Marshfield, WI

Barbara Johnston, M.S.N.
 Executive Director,
 Medical Board of California
 Sacramento, CA

Charles R. Doarn, M.B.A.
 Associate Professor of Surgery and
 Biomedical Engineering
 University of Cincinnati
 Cincinnati, OH

Peter Yellowlees, M.D.
 Professor of Psychiatry
 UC Davis Health System
 Sacramento, CA

Steven Normandin
 President, AMD Global Telemedicine
 Boston, MA

Joseph Tracy
 Vice President, Telehealth Services
 Lehigh Valley Health Network
 Allentown, PA