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Sustaining and Realizing the Promise of Telemedicine

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Background

It may be instructive to begin this summary report and analysis related to sustaining and realizing the promise of telemedicine with a brief mention of its evolution and a discussion of critical issues in its development.

The origin of telemedicine can be traced back to 1905 when the Dutch physician, Willem Einthoven, while interested in the telephone for its potential for measuring and recording heart sounds, demonstrated the feasibility of telephonic transmission of heart sounds over a distance of nearly 1 mile (1.5 km).[1] Five years later, in New York City, two American physicians successfully transmitted electrocardiograms of ventricular hypertrophy, atrial and ventricular ectopics, and atrial and ventricular fibrillation.[2] Over the next 100 plus years, the basic concept of remote medical care continued to evolve, although sporadically, through the use of the telephone and two-way radio. Landmark studies using two-way television communication occurred in the mid-1950s and early 1960s. This developmental trend accelerated over the last several decades, mostly as a result of vast improvements in the capabilities of the underlying information and communication technology (ICT), often accompanied by a decline in cost in some of its component equipment.

Today, the feasibility of this modality of care has been investigated in nearly all clinical specialties with the goal of ascertaining its effects on access, quality, and cost of care as well as its acceptance by both providers and patients, while clinicians, researchers, and product developers have expanded the scope of clinical applications for remote diagnosis and treatment of various health problems. Perhaps more important is that interest in telemedicine has been maintained and continues to grow mostly as a result of the promise of telemedicine in addressing intransigent problems in healthcare delivery, including limited access to care among segments of the population, uneven quality in the care that is generally available, and unabated cost inflation, which stand in striking contrast with the phenomenal progress of its underlying technology. Despite the unprecedented promise, a long history of experimentation and development, and the ever-increasing ubiquity of the underlying technology in all sectors of modern society, the basic issues and questions regarding the sustainability and future of telemedicine have not been fully resolved. Among others, these issues include the precise nature of its effects and its appropriate role in mainstream healthcare. Some continue to question whether this modality of care is financially viable or sustainable as currently constituted and financed. Hence, the search continues for effective business models to sustain telemedicine's use in the long run by mainstream health organizations. It has been suggested recently that a business plan for telemedicine in an academic health center "would not be successful if it were to rely on insurance billing alone…."[3] It would never generate sufficient revenue.

To date, it has not been determined whether telemedicine will fill only a unique niche in the health system, namely, to serve the needs of those who lack access by virtue of geography, isolation, or other constraints. Or, alternatively, whether telemedicine can be designed, implemented, accepted, and integrated as a necessary component of the mainstream healthcare armamentarium—that is, integrated to the extent that medical care for the general population as well as those isolated will be provided via a combination of in-person and virtual service. If the latter scenario holds true, both methods of care delivery would coexist to constitute essential components of the services provided by the health system. The immediate and relevant question then becomes the manner and means by which telemedicine can be fully integrated into mainstream medical care and healthcare. In this context, telemedicine will not be viewed solely as a means to extend the reach of providers to a larger and geographically dispersed client population but also as an essential component that enhances efficiency, assures equity in quality of care overall, and contributes to medical cost containment.

To achieve this end, it is vital that we determine how and where to merge certain applications such as telehome healthcare, triaging, and electronic medical records into the medical and healthcare process continuum. In brief, the questions must be addressed: "Is telemedicine to be viewed and incorporated merely as an adjunct or a core feature in modern healthcare delivery?" "What is the optimal role of telemedicine in medical and healthcare delivery systems?" "How does telemedicine's role fit into the multifocal care delivery continuum, ranging from prevention, diagnosis, treatment, monitoring, follow-up, and end of life care?" If telemedicine is to become part of mainstream medical care and healthcare, it must be adapted to and integrated into the panoply of care locations (e.g., from private residence to assisted living facilities, from acute and subacute care

centers to skilled nursing centers and outpatient rehabilitation centers, from physicians' offices to clinics [both urgent and nonurgent] and community, regional, and major academic hospitals).

From the perspective of function, telemedicine's role must extend to the wide variety of clinical functions within the health system, including clinical decision support systems, physician order entry protocols, health information exchanges, and patient and provider education and research. Today, these issues and questions are especially germane in the United States and in many other countries. For example, we have yet to resolve fundamental issues regarding appropriate and equitable compensation when providers deliver care to patients via telemedicine or in-person. Questions remain as to whether telemedicine should be restricted to a select or a specified set of diagnostic and/or clinical services that ordinarily do not require personal contact between patient and provider. Furthermore, if this is the case, the appropriate and optimal diagnostic and clinical applications must be determined. This, in turn, leads to questions pertaining to optimal technological, organizational, financial, and human resource configurations for deploying telemedicine systems.

Telemedicine constitutes a system of care embedded in and supported by a complex information technology, which is in a constant state of flux. As such, it also continues to evolve, undergoing significant changes and transformations related to the enabling technology and the spectrum of clinical, educational, and research applications. In turn, these changes have varying but significant impact on access, quality, and cost, as well as the interaction between them. One interaction in particular is the typically positive relationship between quality and cost. However, this relationship has not been consistently demonstrated in telemedicine. Indeed, the capabilities and quality (or clinical effectiveness) of the underlying technology continue to advance at an accelerating pace without a commensurate increase in price. Consequently, we may never be able to ascertain definitively the cost-effectiveness of this electronic information technology–based care or get a stationary assessment of its economic and clinical merit or its ultimate contribution to society.[4]

After almost half a century of telemedicine proliferation, considerable evidence has been accumulated pointing to its considerable benefits, especially those accruing to persons living in isolated areas or institutions or those homebound and relying on biometric monitoring of physiological functioning for health maintenance. A majority of the relatively substantial amount of empirical and experiential-based evidence pertaining to the value of telemedicine is positive, although not necessarily definitive. This is due largely to the fact that well-designed large-scale multi-institutional clinical trials that could provide the definitive answers to the pertinent clinical and economic questions have been and will likely continue to be elusive in the foreseeable future. Alternative methodological strategies for reaching closure on the outstanding questions have been suggested and may be necessary, and possibly optimal.[5–8]

Nevertheless, there is uncontestable evidence of telemedicine's feasibility as a clinically effective substitute for in-person care across an ever-increasingly wide spectrum of applications and settings. With respect to diagnostic accuracy, for example, there is clear evidence of the equivalence of virtual and in-person medical visits. There also exists evidence for the added value of telemedicine providing readily available information for clinical decision making, disease management, and provider and patient education. Much of this evidence, however, has come in small increments, often based on imperfect methodology.[5] Nonetheless, the applications continue to expand and proliferate, the imperfect nature of the available evidence notwithstanding.

Indeed, all things considered, it is time to identify or construct effective business models for sustaining the current telemedicine systems and to serve as a basis for expanding telemedicine to the next logical level (i.e., as part of mainstream medical care and healthcare). Ideally, these models will be based on actual experience in managing programs successfully or, alternatively, on evidence-based links between telemedicine interventions and specified outcomes. At a minimum, there must be clear and explicitly identified plausible expectations of beneficial outcomes resulting from telemedicine. Moreover, the view of the future must be tempered by the evolving technology within the broader context of a continual search for enhanced access to care quality, safety assurance, and, finally, cost containment.

At least for the foreseeable future, telemedicine in the United States can only sustain itself on the basis of long-term business models that rely on recurring revenue and diverse sources of financing. Yet, in the current environment, business models that are limited to direct fee-for-service reimbursement may not be sufficient to sustain telemedicine in the long term because they are severely constrained, and we may be approaching the end of the fee-for-service method of reimbursement. Absent a reliable recurring revenue source, business models for telemedicine will require demonstrable evidence of benefits to patients, providers, and/or society at large to warrant an institutional and/or governmental investment in both the infrastructure and the human resources necessary to operate the program.

With this background, it has become increasingly apparent that we need to chart a prudent course of action regarding deployment of and support for telemedicine systems in various states, regions, and health systems. This needs to be viewed as part of the broader agenda of improving access to care, enhancing quality of care, and containing cost. Case studies of several state-based and provincial-based telemedicine programs presented in this volume describe active networks to serve the health needs of the resident population in their respective "telemedicine" regions. Some are provided in conjunction with leading academic health centers; others provide service to special populations such as American Indians and U.S. Army personnel and families.

It is interesting that, prior to the ICT era, the Regional Medical Program in the United States had an auspicious beginning. However, because of lack of continued federal support and, perhaps, lack of a basis of integrative communication technology, it did not survive.[9] Perhaps today's tools of telemedicine could be used to revise this idea that was ahead of its time. Given the solution of interstate licensing of health practitioners and interinstitutional cooperation, telemedicine

can serve as a basis for feasible and rational regionalization highly desirable from the standpoints of access, quality, and economics. To date, with limited exceptions, private sector interstate, regional, and, indeed, nationally integrated health systems (i.e., those linked with academic medical centers or centers of excellence as construed by the original Regional Medical Program concept) remain in their infancy. One notable exception is teleradiology, which has now developed into not only active interstate but also international networks of providers and users. The situation vis-à-vis interstate and national regionalization is quite different in public sector direct service programs, for example, the U.S. Army, Veterans Administration (VA), and the Indian Health Service (IHS). These agencies have fully embraced telemedicine as an essential component of their immense healthcare systems to serve constituents who are geographically dispersed throughout the country (and worldwide in the case of the military).

Therefore, this is both an opportune and a critical time to consider effective strategies for sustaining and realizing the promise of telemedicine in academic health centers and other provider settings in the private sector and for integrating its tools into the mainstream medical care and healthcare. This was the background and the rationale for organizing this symposium-workshop on the campus of the University of Michigan. Its explicit purpose was to address the issues pertinent to sustainability and realizing the promise of telemedicine.

As explained earlier, the symposium focused on two basic issues of current interest. The first pertains to sustainability of telemedicine in the current environment and the business models that have been used to date. The second issue was the future prospect for this field, more specifically, how to realize the promise of telemedicine more fully than achieved thus far. Sustainability and realizing the promise of telemedicine are logically and realistically interrelated because they branch from the same roots, namely, the continuing problems of limited access for variously disadvantaged segments of the population, uneven quality of care, and unabated cost inflation. To date, these problems have defied all attempts to resolve them, while telemedicine continues to offer the lure of addressing all three problems simultaneously.[10]

Based on the available evidence and using the traditional definition of this field,[11] the actual use of telemedicine in the United States today has been considerably below expectation and resource capacity. There are, however, sectors where case volume is quite high. For example, in the VA, considering both store-and-forward and real-time services (but not including teleradiology), about 385,000 patients were served in 2011. The VA's electronic health record database (My HealthVet) serves more than 1 million users or 14.5% of VA patients. During the same period, the U.S. Army reported an estimated 60,000 individuals served via telemedicine. Additionally, client cell phone-based medical services were also available, with about 400,000 people currently getting medical services (e.g., telemental and behavioral health) using their cell phones. Remote telemental health consultations, primarily involving private practitioners, provided a total of about 300,000 consultations last year. In the federal prison system, there were about 225,000 telemedicine visits. Finally, personal emergency response systems (which some may not consider telemedicine but rather a remote service) have about 1.6 million people presently subscribed—certainly not an insignificant number. With these notable exceptions (and even among them), the potential volume of telemedicine use remains far below expectation and capacity.

Several explanations have been suggested for the slow adoption of telemedicine. These include insurance coverage, reimbursement, and the convenience and availability of the technology.[12] Limited or lack of reimbursement has been identified as telemedicine's "Gordian knot" and one of the major reasons for the slow diffusion of telemedicine, hence the recent efforts regarding payment parity legislation in many states. *Table 1* highlights the 12 states, covering over 106 million Americans, that have mandated telemedicine-provided services. *Table 2* highlights the six states that in 2011 had pending legislative proposals. Similar legislation was enacted in Michigan in 2012 (House Bill 5408).

However, it should be noted that telemedicine use has been limited even in those funded programs in which patients/clients are not required to pay for services received and providers are compensated through project funds. In other words, it is not clear why the use of telemedicine has fallen below expected use even in situations where reimbursement is not a factor. Of course, when any population is presented with an innovation that requires a radical change in behavior, there is usually a learning curve associated with adoption/rejection of the innovation. In many instances funded projects are ended before they reach "maturity," and the acceptance–adoption

Table 1. States That Have Adopted Mandates for Telemedicine-Provided Covered Services

STATE	YEAR OF ENACTMENT
California	1996
Colorado	2001
Georgia	2006
Hawaii	1999
Kentucky	2000
Louisiana	1995
Maine	2009
New Hampshire	2009
Oklahoma	1997
Oregon	2009
Texas	1997
Virginia	2010
Michigan	2012

Table 2. States with Pending Legislation

STATE	LEGISLATIVE STATUS
Florida	S.B. 1842, H.B. 60
Maryland	S.B. 298, S.B. 744, H.B. 14
New Mexico	H.B. 591
Ohio	S.B. 280
Pennsylvania	H.B. 273
Vermont	H.B. 37

Source: www.americantelemed.org/files/public/Meetings/PolicySummit2011/StateMandate.pdf

H.B., House Bill, S.B., Senate Bill.

process by the target population, including physicians, cannot be completed.

Teleradiology programs are one exception. Among telemedicine applications to date, they have demonstrably experienced the greatest degree of acceptance and proliferation. Some of the key reasons behind this level of success include (1) the fact that the majority of radiologic services (excluding interventional) rarely include face-to-face interaction between the radiologist and the patient, (2) the early creation of a communications standard the Digital Imaging and Communications in Medicine (DICOM) standard (http://medical.nema.org/)) that facilitated system interoperability across vendors and institutions, (3) ready reimbursement approval by the Health Care Financing Administration in large part due to the previous two factors, and (4) the fact that the majority of technology used in digital radiology and thus teleradiology were Food and Drug Administration–approved devices.

A broader question pertains to the disjuncture between capacity and volume of use. The capacity for telemedicine technology far exceeds actual use. When properly designed and implemented, the vast majority of extant programs have the potential to serve much larger patient populations. As well, again, if properly designed and implemented, the enabling technology can arguably enhance productivity and capacity well beyond current levels. Nevertheless, some evidence suggests that, in some instances, telemedicine encounters are more time consuming than in-person consults. In these instances, this adversely affects provider productivity and therefore makes it difficult to assess accurately total resource capacity. It is also difficult to measure the precise impact on productivity because of the complex combination of human resources (doctors, nurses, etc.), equipment, and connectivity in play. Be this as it may, once the supporting technology is in place, a much larger and widely distributed patient population can be served by telemedicine than in the traditional in-person consult. Moreover, in addition to forward movement along the learning curve by providers, there are operational processes to increase efficiency and productivity, such as scheduling blocks of clinic time rather than offering the service on "as requested" basis. *Ceteris paribus*, we can expect a substantial lag between the capabilities of telemedicine technologies and our ability to exploit these capabilities. Although we may never match use with capacity, there is considerable impetus to improve the ratio. This is especially true at this time when the United States and countries around the world are struggling with budget deficits in which spending on healthcare comprises a significant drain on the federal revenues.

Sustainability of Telemedicine

Certainly, sustainability in healthcare, as for any self-supporting enterprise or service delivery system, depends primarily on recurring revenue. However, return on investment can be thought of broadly or narrowly. It can take different forms and can be direct or indirect, immediate or delayed, tangible or intangible. Regardless of the form recurring revenue takes, it must occur and must be of sufficient size or accrued value if the enterprise is to remain solvent over the long term. Indeed, should recurring revenue be inadequate, the enterprise must make structural adjustments. These include reducing the size and/or scope of service or improving its mode of production. When revenues or derived value in the form of an indirect return on investment cannot be sustained, the organization must find ways to reduce expenditures in order to maintain its financial integrity or otherwise cease to exist in its present form.

To date, the majority of private sector telemedicine programs in the United States have relied heavily on non-recurring extramural funding or other provisions or appropriations from state and/or federal sources. Grants have come in different forms, including line items (set-aside funds) in state or federal budgets or as successful bids in competitive solicitations. Regardless of form, these agency funds have been instrumental in establishing telemedicine programs during the "maturation period" of telemedicine and beyond, particularly in the initial stages of development and in some instances sustaining them beyond the initial funding period. Moreover, the use of these funds enabled some programs to demonstrate the benefits of telemedicine to policymakers and third-party payers. Furthermore, they have also served as fertile grounds for gathering useful information about the feasibility, effects, and acceptance of telemedicine. Nonetheless, agency grants and funding offer only temporary support, and they can never serve as effective substitutes for recurring revenue.

This is not meant to belittle the impact of granting agency funding, for this funding of telemedicine over the last two decades has been substantial and vital. It served to create a critical mass of programs across the United States, which in turn have supported development of telemedicine applications and practitioners across almost the entire spectrum of clinical care. Additionally, the funding generated a generation of system development specialists and a proliferation of telemedicine vendors. This critical mass of gatekeepers now advocate actively for the wider adoption of favorable policies to advance the practice of telemedicine at local, state, and national levels. Their advocacy has proven effective in reducing barriers to reimbursement for telemedicine consultations and interstate licensure and practice. The growth in telemedicine is reflected in the growth of the

American Telemedicine Association (ATA). The ATA was established in 1993 as a nonprofit organization headquartered in Washington, DC. Although originally organized as an "American" association, the ATA now has two international regional chapters (Pacific Islands and Latin-American & Caribbean Chapters) and a membership distributed across 45 countries. The ATA has also signed membership-based agreements with eight other countries.

Sustainability Perspectives

Analysis of the sustainability of telemedicine as a system or modality of care can be considered from several perspectives. Each represents an informed viewpoint developed to ascertain or establish a basis for operational continuity in a specific health system, whether private or public. A health system may adopt one or more of these perspectives, as befitting its institutional mission, goals and objectives, and strategic plans. This is especially the case for those with relationships to the larger community of patients and other providers in their respective spheres. These perspectives include telemedicine as a mainstream service, gateway to the institution, and intra- or inter-community or state/federal resource.

TELEMEDICINE AS A MAINSTREAM SERVICE

As stated earlier, the telemedicine proponents' view of telemedicine is one of a mainstream service fully integrated into the institutional portfolio of services provided by the health system. Ideally, under this scenario, telemedicine services would be reimbursed under the prevailing payment system utilizing service charge codes similar to those for in-person care. The indirect cost involving the purchase and maintenance of the infrastructure would be absorbed by the institution. Recurring revenue would occur in one or a combination of several forms, including reimbursement per unit of service or contractual agreements/partnerships with global budgeting for blocks of service. Even in such an "ideal world," telemedicine would be viewed as a mainstream service only when it is supported by a payment system that does not impose severe constraints on the direct reimbursement for care when rendered "virtually" via ICT.

TELEMEDICINE AS A GATEWAY TO THE INSTITUTION

Absent direct recurring revenue, the provision of telemedicine services may be viewed as a gateway to the institution that has a potential for delayed or latent sources of income. In this case, sustainability can derive from downstream revenue through increased appropriate referrals, that is, patients requiring more specialized, high-intensity services. Additionally, patients with more favorable health insurance coverage, including self-insured patients, can be attracted from a much wider geographic area. From a management standpoint, this perspective requires detailed documentation to provide evidence of deferred revenue that can be attributed to telemedicine interventions. The documentation would also include off-site triage of patients for efficient referral to specialty or emergency services.

TELEMEDICINE AS AN INTRASTATE COMMUNITY OR INTERSTATE REGIONAL RESOURCE

When neither direct nor delayed recurring reimbursement is possible, it becomes difficult to sustain a telemedicine program for an appreciable period of time absent dedicated extramural funding. Hence, a third perspective would consist of considering and developing telemedicine services as an intrastate community or interstate regional resource network to support remote providers. From this perspective, the investment in the infrastructure can be considered an essential utility in the broader health system of the state, the region, or the nation. Sustainability would be achieved by a broad-based governmental or health system constituency and increased efficiency, effectiveness, and system integration.

The Promise of Telemedicine

The promise of telemedicine rests on the three pillars of care, namely, improved access, enhanced quality, and cost containment. This daunting promise contains an imposing challenge that will be difficult to meet. Nonetheless, this is the task at hand. We cannot nor should we hesitate in proceeding. To do this, as a first step, we must identify and define the specific telemedicine modalities both necessary and appropriate to meet these challenges and thus fulfill each of these promises. Subsequently we must determine the processes to implement and sustain them.

ACCESS

In assessing the effects of telemedicine on access to care, we need to develop the following:

- An explicit understanding, in realistic and feasible terms, of the manner in which telemedicine contributes to the full spectrum of access, including avoiding unnecessary travel, spatial–temporal, and economic aspects, and opportunity cost.
- A clear definition of the manner in which telemedicine improves the linkages between use of service and need for service. This entails an empirical analysis of the location of need, the location of resources to satisfy that need, and how telemedicine provides the linkages between them.

QUALITY

When considering quality, we need:

- Professional performance standards based upon the research findings pertaining to the practice of evidence-based medicine from tertiary-care centers to individual practitioners. At the same time, it must be acknowledged that today much if not most medical care is not evidence-based, and therefore performance standards developed for telemedicine may, in fact, be disseminated to and therefore improve medical care in general.
- A clear definition of the specific role and contributions of telemedicine to the practice of evidence-based medicine across the continuum of patient-centered care.

- An explicit understanding of the specific mechanisms by which telemedicine contributes to optimal quality of care not only for the individual but also for population groups and communities. In the latter instance, we need to demonstrate the potential contributions of telemedicine to achieving optimal health status in the community. This implies an inclusive focus on a continuum of care management focused on patients rather than diseases, ranging from preventative services to therapeutic and rehabilitative services to humane and dignified end-of-life support strategies.
- Beyond these, it would also entail a realistic analysis of how telemedicine can encourage *appropriate* use of services and discourage *inappropriate* use of services. To be sure, this is made somewhat more difficult because of the lack of clear and universally accepted definitions of what is acceptable for each application. The optimal applications of telemedicine would support and enable the provision of appropriate level and intensity of care at the point of need by appropriate providers in an appropriate site or setting.

COST CONTAINMENT

And, finally, when considering cost containment, we need:

- A comprehensive definition of cost containment in real terms over and beyond reductions in opportunity cost for patients and/or providers. This definition must not be limited to obviating or reducing the need for travel for patients and/or providers.
- A clear understanding of the specific processes by which telemedicine would reduce redundancy and waste of resources and reduce intensity of care while minimizing adverse events. Perhaps, most importantly, we need to learn how to create effective substitutions, whereby less costly interventions will produce similar health outcomes (i.e., lower-cost substitutes without infringing on quality).
- Explicit triage algorithms at the remote sites (or those requesting service or information) would establish protocols for second opinion, referral, or transfer as indicated by clinical need and the availability of appropriate resources at the local or regional level. This would require uniform personal health records accessible at all sites of care.

Concluding Remarks

Attempts to address the seemingly intransigent problems pertaining to inequitable access to healthcare and differential quality in available care can be traced back to the mid-19th century in the United States and even earlier in Europe. To this must be added the more recent problem of the unabated inflation in the cost of medical care that has continued since the mid-20th century. It is against this backdrop and within this context that telemedicine has emerged, and proponents have argued that it holds the promise of improving access to healthcare, while enhancing quality of care and restraining cost inflation. Despite these promises, basic questions persist as to how to sustain telemedicine and how to realize its promise.

A careful review of articles presented in this issue of the *Journal* reveals a set of creative business strategies and, in some cases, the serendipitous circumstances that led to the initial start-up of now well-established telemedicine academic medical center programs. These strategies include (1) securing start-up as well as competitive grants and "set-aside" line items in federal and state agency budgets, (2) state advocacy (and some at the national level) to enact laws aimed at removing reimbursement barriers for telemedicine services, (3) direct state sponsorship of programs, (4) institutional funding, (5) membership fees from participating sites, and (6) private donations. Indeed, the most successful programs have relied on a combination of all the above.

This scenario contrasts sharply with those described in articles pertaining to telemedicine programs in direct delivery systems, such as the VA, the U.S. Army, and the IHS. In these instances, financial support for telemedicine is provided in measured response to a perceived and real need to deliver quality care for large and geographically dispersed target populations. The users (both patients and providers) and the specific applications are clearly identified. Hence, the benefits to the health system (or return on investment) are usually demonstrable in some form, such as saved lives, cost efficiencies, etc. These telemedicine programs are implemented on a regional, national, and/or global basis. Even given the vagaries of funding cycles from one Congress to another, funding for these telemedicine programs seems to be secure. However, complications can arise. In the case of the IHS, for example, federal laws pertaining to Tribal control of federal funding for healthcare as well as cultural differences in terms of "appropriate" forms of medical care have created obstacles to ubiquitous implementation of telemedicine for the American Indian and Alaskan Native populations.

The Canadian example, represented here by the Ontario Telemedicine Network, is singular in that it describes a setting where governments at the federal and provincial levels recognize the merit of telemedicine in expanding access to quality healthcare in the private sector in an efficient manner. In this instance, the government is a single payer for a federally tax-supported, inclusive healthcare system.

In the future, sustaining telemedicine and, importantly, seeing it become an integral component of mainstream healthcare will come to fruition through the combination of developing and adopting business plans assuring stable recurring revenues, regardless of form or source. The latter include one or a combination of funds, derived from telemedicine, as a gateway to the institution, intra- and inter-community, or federal resources. To the extent that previous experience informs, it appears that a single-payer, federally funded public healthcare system provides an optimal scenario for telemedicine becoming both sustainable and an integral component of mainstream healthcare.

In the absence of this, however, the promise of telemedicine relies on understanding telemedicine's contribution to the full spectrum of care and the manner in which it enables an appropriate balance

between the need for and use of care. The degree to which telemedicine favorably influences quality of care through the provision of evidence-based care must be assessed and demonstrated. Finally, telemedicine's economic implications must be evaluated comprehensively, that is, beyond reduction of opportunity costs for patients and providers. The economic analysis must be expanded to include telemedicine's effects on reducing, if not eliminating, redundancy and waste of resources, improving provider productivity, and enhancing on-site triage for patients as well as the application of appropriate protocols and intensity of care at the appropriate site. It is to these ends that the symposium "Sustaining and Realizing the Promise of Telemedicine" was convened and that this special issue of the *Telemedicine and e-Health Journal* is presented.

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