Emerging Strategic Opportunities Surrounding the Evolution of Telemedicine

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Abstract

This paper presents a model and two scenarios that have been developed to assist decision makers in planning for the impact of telemedicine in both developed, and developing nations. A vision of ubiquitous access to health-monitoring and healthcare is explored and emerging approaches described, however there remain many formidable obstacles to the realization of telemedicine; some are technological, others relate to the development of international standards for medical record systems, and other challenges are related to human acceptance, as well as the development of appropriate and compelling business value chains.
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Introduction
Across the globe telemedicine is being adopted in response to escalating demand for healthcare services from a population that has passed the point of 7 billion. Telemedicine refers to the delivery of healthcare services via the Internet - a Radiologist located in California can provide a diagnosis for a patient living in Nepal. Telemedicine has been adopted by the armed services to deliver a diagnosis on the battlefield, and a course of psychological counseling sessions can be delivered using Skype. These services can be delivered via smart phones, medical devices, apps and cloud computing. The growth of telemedicine has implications for a range of industries and stakeholders. This paper presents a model and two scenarios that have been developed to assist decision makers in planning for the impact of telemedicine in developed, and developing nations, as well as to provoke further discussion.

Literature Review
The literature pertaining to this field has grown rapidly and reflects a number of important characteristics. Firstly, the field of telemedicine is broad and spans medical practice, telecommunications, operations strategy and marketing. Secondly, as the field has evolved, the terminology used to define it has become specialized and fragmented to encompass e-Health, m-Health, ihealth, digital health, and telemedicine. For example, e-Health is now more commonly used to refer to electronic health records, m-health – mobile health using smart phones and healthcare related “apps”. The American Telemedicine Association formally defines telemedicine as:

...the use of medical information exchanged from one site to another via electronic communications to improve a patient’s clinical health status. Telemedicine includes a growing variety of applications and services using two-way video, email, smart phones, wireless tools and other forms of telecommunications technology. (American Telemedicine Association, 2013)

Wilson (2008) provided a synthesis of the e-Health field and indicated a revolutionary change in the delivery of healthcare from a physician-centered approach to a patient-centered approach. Wilson observed that patients are increasingly empowered, as a consequence of a critical convergence of healthcare providers, technology and marketing. Increased collaboration between medical practitioners and technology providers is seen as a requirement to advance the m-Health pilots being trialed across the globe (Ascari and Bakshi, 2010; Sandhu, 2011). Falchuk, Falmolari, Fischer, Loeb and Panagos (2010) have provided a description of the technology required to deliver patient-centered mobile health. The pervasiveness of the Internet though the use of sensors has been described by Chui, Loffler, and Roberts (2010), in the Internet of things.

The common themes that emerge are the need for collaboration and the important shift to a patient-centric approach. The current paper builds on earlier work that explored the
relationship between technology and brand management in the evolving e-Landscape (Helman, de Chernatony & Addeo, 2010) and an examination of ubiquity and integration in m-Health and the implications for brand management (Helman, Addeo & Walters, 2011). Perspectives on the forces shaping the adoption of telemedicine and the development of a model to reflect this evolutionary process, were proposed by Santoso, Addeo, Helman and Santoso (2011). The purpose of the current paper is to explore the widespread adoption of cloud-based healthcare services and the implications for decision makers.

**Integrative Models**

The e-Landscape model (Helman *et al.* 2010), presented as Figure 1 integrates emerging technologies and focuses on the implications of the intersections of technology and brand management. *Market Pull (P1, P2, P3)* spans one or more application planes. For example, P1 depicts consumers of networked home appliances (e-Home), Intelligent Transportation Systems (ITS), and networked healthcare appliances (e-Health). P2 depicts consumers who have adopted e-Home and ITS applications, while P3 depicts consumers of only e-Home applications. Ubiquity and integration are critical characteristics and engines for growth in the e-Landscape. P1 may represent a diabetic patient who from his car is able to access information on insulin supply levels in his refrigerator at home and organize refills to be collected from his local chemist/pharmacy. The e-landscape model attempts to capture the critical relationships between an interactive consumer, digital devices and networks in the range of electronic landscapes that the consumer may navigate in the course of their everyday life. The brand manager should consider how the brand fits in these e-landscapes, particularly in relation to the need for collaboration to provide product-service combinations and in maintaining a coherent brand identity.

![Figure 1. Dimensions of Market Pull and Brand Management in the e-Landscape](image)

The emergence of increasingly sophisticated Internet-based technologies and services is driving the evolution of Internet-mediated delivery of medical services to an expanding patient-base of Internet citizens. Patient record and clinical administration systems, digital imaging and archiving systems, e-booking, e-practice and e-prescribing applications and services are being deployed to improve efficiency and lower costs for medical practitioners. Furthermore sensor, communication and intelligent decision-making technologies may offer substitutes for experts in many medical specialities such as general practice, radiology, and pathology. Concurrently, as mentioned above, a new era of market pull is emerging from an increasing population of interactive customers who are creating new demands for networked home appliances, advanced intelligent transportation systems, and networked health care appliances. Santoso et al. (2011) explores the various driving forces that are emerging in relation to telemedicine and argues that once resistances are overcome, a broad-scale evolution will take place. The model in Figure 2, develops the e-Landscape model, and offers a more detailed illustration of the e-Health layer and the forces shaping that layer. The various forces working in conjunction and against each other affecting the evolution of the healthcare system may reconfigure the landscape and a more sustainable state may emerge.

![Fig. 2. The Landscape of Healthcare Delivery and the Driving Forces. Source: Santos, N.I, Helman, D. Addeo., E.J., and Santoso, D.S. (2011)](image)

The driving forces considered in this model include cost-reduction, quality-improvement, physician resistance/readiness, patient resistance/readiness, enabling technologies and opportunities, regulation, law and politics (e.g. malpractice law, tort reform, etc.). The combined forces can be defined as a resultant (or composite) vector and will serve as the prime-mover in the evolution of the current healthcare system (within the boundaries of current regulations/law) towards a new equilibrium state. Several new equilibriums, as illustrated in Figure 2, may emerge as solutions. Each of them will offer different benefits, challenges and opportunities to the healthcare industry.

The model has been developed to explore adoption of telemedicine across the globe – currently technology problems relating to interoperability, security concerns, the regulatory environment and physician resistance (Ascari and Bakshi, 2010) have inhibited growth. The model suggests that in environments where there is less resistance telemedicine is likely to be more readily adopted – indeed in developing nations with high patient doctor ratios and cost constraints telemedicine solutions are evident.
Interesting scenarios may develop where advances in healthcare may originate in developing nations and migrate to developed nations – as the process of reverse innovation identified by Immelt, Govindarajan, & Trimble (2009) suggests. Developing nations with ubiquitous access to cloud computing may be able to leapfrog the aging infrastructures of the developed nations. On the other hand, the emergence of the iConsumer (Ludwig, 2011) may create a global healthcare consumer willing to access better value propositions wherever they are available. In the US, a partnership between Walgreens and Cisco is responding to these opportunities.

Physicians, may be willing to implement various aspects of telemedicine, however, at the same time, they are reluctant to change believing that online interactions may depersonalize the patient-physician relationship. Furthermore, the absence of information obtained during clinical evaluation will deprive the physician of some important decision-making inputs used in diagnostic process, thus reducing the quality. Patients looking forward to more cost efficient healthcare may have similar concerns about quality. Future research will be directed towards determining sets of estimated values based upon their importance and relative power, the model will offer a useful evolutionary scenario and planning tool for decision makers.

Additionally, a cogent and useful model which yields accuracy and integrity in predicting global penetration of telemedicine applications and services will need to incorporate the realistic “resistances” associated with the very slow adoption of security protocols for telemedicine.

The problem of secure communications in a telemedicine service environment is compounded by the very high complexity of these protocols which can by their inherent nature stimulate or cause security critical mistakes. The challenge then is to send secure messages in a platform-independent manner that allows visibility (opening of private networks to the Internet thereby greatly increasing visibility to other entities, potential service providers and patients) and reusability that enables the interchange of Web services - independent of computing environment, operating system, and programming language. In other words, these end-to-end security mechanisms will need to enable sending messages between applications in a platform-independent manner. This will allow systems written in different languages, running on different operation systems in different locations to interoperate with perimeter security and end-to-end message security. Hence, previously closed functions would become broadly available to be called anytime, anywhere, by anyone with valid access (authentication) credentials.

Access control techniques have been developed in a variety of ways in which the access control procedure may be carried out. However, these authentication mechanisms typically use a biometric authenticator (fingerprint or retina scan) in conjunction with a time-dependent PIN generated by a smart card. These mechanisms have high integrity, but are not particularly well matched to ease of usability of patients and service providers. Providing graceful access to telemedicine applications and services remains a significant challenge and this likely
is a “significant component of “resistance” in the near term. However, solutions will emerge. Two possible scenarios suggested by the model are presented here:

Scenario One:

| Enabling-technology are fully developed, patients’ and physicians’ resistances are minimal, and regulations are established to facilitate cost reduction, the healthcare system will most likely evolve towards to the minimum cost point. |
| All appropriate online resources are utilized. |

Sharing information may be established through ASTM’s continuity of care record (CCR) - a core data set of administrative, demographic, and clinical information facts about a patient's healthcare, covering healthcare encounters, could provide a means for one healthcare practitioner, system, or setting to aggregate all of the pertinent data about a patient and forward it to another practitioner, system, or setting to support the continuity of care. The CCR could provide a snapshot in time containing the pertinent clinical, demographic, and administrative data for a specific patient. In turn, global access to the CCR could be accessed through a “Cloud Computing” information-networked infrastructure. This approach could enable medical practitioners and patients to agilely access and update information from any end--user Internet appliance and even leverage off “Cloud–based” speech-to-speech language translation, with security and independent of location and time.

Concurrently, synergistic advances in all areas of technology from low power electronics and sensor technologies to the development of novel wired and wireless communication appliances and services are emerging. These advances have already led to the development of new small-sized wireless medical and environmental sensors that are capable of monitoring the human body as well at its environment in a more efficient way. These advances in sensing and communication technologies along with advances in software engineering make it possible to synthesize new solutions for wearable healthcare systems and enable the development of ubiquitous healthcare smart homes. With these systems, elderly people and those with pre-existing health conditions can remain in their own home, while healthcare providers can remotely monitor and advise them on how to improve their well being and provide them with quality healthcare – from anywhere in the world. Telemedicine can also be a proactive process. Indeed, medical practitioners have long recognized that modern society should change its dietary and exercise habits to reduce the rising incidence of diseases such as diabetes, heart attack, and stroke. As a result, gaming systems are emerging to motivate “healthy” adults and children to lead more healthy lives. The communications, storage, and application-aware biometric capabilities, of a powerful “Cloud Computing” information-networked infrastructure will likely be multiplied many times by the emergence of synergistic technologies including: Low power wireless sensor nodes that enable ubiquitous biomedical signal monitoring, wireless and wearable ECG sensors, and body-area nanonetworks with molecular communications in nanomedicine.
Information Networked Architecture for Telemedicine

Attributes:
• Interworking of Different End-User Appliances
• Native security, networking, and redundancy
• Virtual and/or physical server capacity on demand
• Integration of applications from mobile phone users
• Ubiquitous Access

Scenario 2:

Devices and networks are available but not ubiquitous and are not well integrated. Uncertainty exists in the marketplace for industry participants. Problems with technological literacy and willingness to change and collaborate remain. Problems managing information exist for doctors and patients.

Technologies are available, selective interest is indicated by patients and doctors - this translates into a varied pattern of adoption and non-adoption. Manufacturers remain cautious to make large investments in Telemedicine related NPD. Consumer electronics retailers increasing expansion in telemedicine related appliances for home use, further decisions are required in relation to future range dimension development. Telemedicine products are moving slowly through the regulatory pipeline. Insurance company mHealth services are being launched. Success for companies participating in radiology (Telemedicine Inc, Nighthawk). Competition from retail based healthcare providers increases (CVS Minute Clinic) providing less expensive healthcare options.

Widespread use of mobile devices for communication by patients with doctors (making appointments) and use of apps focused on wellness (workout regime).

Increase in use of telemedicine for monitoring top disease targets: diabetes, hypertension, congestive heart failure, obesity and “target” markets: 18-24 year old patients, geriatric patients, caregivers. Individual practitioners constrained by costs and lack of confidence in decision-making capabilities given rapid changes in technology and are cautious about commitment to new technologies and uneven experience of eHealth (HIT management systems). Doctors envisage problems with patient involvement and have concerns relating to increase in costs to manage each patient due to technology.
Implications for Strategic Decision Makers
The model presented here and the scenarios developed from it will provide insights for managers considering the impacts of changes in the healthcare sector across the globe.

Several important inferences should be apparent: The healthcare industry provides huge opportunities given changing consumer demographics and lifestyle, technology and medicine. However, this sector is immensely complicated by legal and regulatory constraints; value propositions become more complex and costs are likely to increase in the near term with the need for greater personalization; value chain complexity increases with the provision of globally accessible product-service combinations and reconfiguration to encompass new partners; the management of brand identity becomes more complex with product-service combinations; costs associated with technical support and customer service are likely to increase; the need for the management of stakeholder relationships will become more critical, and of course the relationships between doctors and their patients is fundamentally and rapidly changing.

Conclusions
While this vision of ubiquitous access to health-monitoring and healthcare is being enthusiastically pursued there remain many formidable obstacles to the realization of these solutions; some are technological, others include development of international standards for medical record systems, and yet other challenges are related to human acceptance in terms of comfort, as well as development of an appropriate and compelling business value chain. This paper presents scenarios generated from a model of the forces driving the evolution of the healthcare landscape. These scenarios are designed to provoke discussion and aid strategic decision makers and managers involved in policy formulation.
REFERENCES


