New Strategies for Digital Health

Françoise Simon*, PhD and François M. Meurgey**

Abstract:
Healthcare information technology (IT) applications have grown rapidly, driven by technical innovation, provider interest and consumer demand. eHealth (broadly defined as the application of IT to improve care quality and access) is reshaping the medical landscape, from electronic medical records to telemedicine via mobile devices.
This paper first examines provider-to-provider dynamics, then reviews consumer-centered applications, and finally covers innovations from biopharmaceutical and medical device companies. While eHealth is increasingly adopted by many players, remaining barriers range from the lack of system interoperability, to patient privacy concerns, and reimbursement and liability issues for providers.

* Columbia University, New York
** CEO, Oukelos Consulting, Brussels

Healthcare information technology (IT) applications have grown substantially in the last decade, driven by technical innovations. This paper results from extensive direct research (over 30 interviews with top executives in biopharma firms, agencies and consultancies), as well as a literature review of business and medical journals.

E-health is broadly defined as the application of IT to improve care quality and patient access, with tools from electronic medical records (EMRs) to telemedicine, health information systems, mobile devices, online or e-learning tools, and decision support systems. E-health is increasingly seen by national and international public health authorities such as WHO as an effective way to improve health systems, use resources efficiently, and make progress towards a goal of universal health coverage (1).

The World Health Organization (WHO) defines eHealth as "the transfer of health resources and healthcare by electronic means", encompassing three main areas:
- the management and delivery of health information, for health professionals and health consumers, through the Internet and telecommunications.
- using the power of IT and e-commerce to improve public health services, e.g. through the education and training of health workers.
- the use of e-commerce and e-business practices in health systems management.

mHealth is defined as a subset of "electronic health (eHealth) and it is the provision of health services and information through mobile technologies such as mobile phones and PDAs (personal digital assistants)".

WHO has embraced eHealth: starting with Resolution WHA58.28 of the 58th Assembly on 25 May 2005, the organization "recognized the potential of eHealth to strengthen health systems and to improve quality, safety and access to care, and encouraged Member States to take action to incorporate eHealth in health systems and services" (2). WHO maintains a Global Observatory for eHealth which provides regularly eHealth country profiles, results of global surveys as well as guidelines and toolkits for eHealth development in its member states (3, 4).

Governments in countries as diverse as the US (with the 2009 Health Information Technology for Economic and Clinical Health or HITECH Act), China (as part of its 2009-2011 massive 850 billion renminbi or $125 billion overhaul of its healthcare system), the EU (with a first eHealth Action Plan in 2004 and an expanded eHealth Action Plan for the period 2012-2020) or Saudi Arabia (which commissioned it first eHealth strategy in 2011) have identified broader application of IT to healthcare as an opportunity to improve care and control costs (5).

In the US, the Office of the National Coordinator for Health IT (ONC) has developed a Consumer eHealth Program based on a "3As" strategy:
- Increase access to health information through incentive programs from Medicare & Medicaid in order to encourage "meaningful use" of electronic health records (EHRs)
- Enable consumers to take action by supporting e-health tool developers (open collaboration with 68 organizations including Microsoft, GE and Kinergy, to set up common standards)

- Shift attitudes to encourage consumers to act as eHealth partners: ONC has launched the HealthIT.gov website to serve as a "one-stop shop" for patients to learn about e-health tools, sponsored crowdsourced video contests about use of eHealth, and partnered with Sharecare.com, an interactive health and wellness social media platform, to inform patients about eHealth.

Table 1 gives examples of mobile health initiatives from multiple stakeholders, from employers to insurers and retail distributors.

Table 1. Examples of mobile health efforts from multiple stakeholders

Stakeholder	Health Issue	Who	Mobile health solution
Employer	Rising healthcare costs of self-insured employers	Safeway	Competition to promote healthy lifestyles and incentives for employees
Provider	Efficiency in coordinating care/physician work flow	Good Shepherd Health System	Developed own iPhone app to help physicians access patient records and coordinate with care team
	Physician to physician consultation to enhance patient care	Physicians from Duke & Harvard	Virtual physician network for video mobile consults
Health Insurer	Finding physicians in network or checking claims	Aetna	Mobilizing "doc" finder and claims check
Pharma Manufacturer	Patient compliance in diabetes monitoring	Bayer	Digital glucose monitor (DIDGET) that integrates with Nintendo game console
Retail Pharmacy	Cost information and prescription management	CVS Caremark	iPhone app for drug information and member management of refills and retail location finder
Telecom	Bandwith and capacity constraints on hospital networks	Verizon	4G and more robust Wi-Fi networks to increase capacity for image and data transfer
Retail Distributor	Access to remote monitoring devices	Best Buy	Partnership with Meridian Health to explore consumer access to monitoring devices through retail stores

Source: Françoise Simon and François Meurgey, partly adapted from PricewaterhouseCoopers Health Research Institute (6)

Estimates of the size and nature of the eHealth market vary widely: at the 2008 Bellagio conference organized by the Rockefeller Foundation, the Boston Consulting Group presented initial estimates of $96 billion for the global eHealth products and services market, with 95% in industrialized countries, and nearly half of the emerging markets (estimated at $4 billion) located in just four countries, the now famous BRIC (Brazil, Russia, India and China). Research and

Markets released in July 2013 a report estimating the global healthcare IT market at $40.4 billion in 2012, growing to $56.7 billion in 2017 (7). A March 2012 report by BCC Research cited by the European Commission estimated the global telemedicine market at $9.8 billion in 2010, growing to $11.6 billion in 2011 and to $27.3 billion in 2016 (8). Other - somewhat more specific - estimates are less impressive: IHS/InMedica forecasted the global telehealth market would reach about $1 billion by 2015 and could grow to $6 billion in 2020 (9).

Regardless of the speed of progress in different parts of the world and the real size of the commercial opportunity, it is clear that secular trends such as an ageing population, the increasing burden of chronic diseases, consumerism, the broad diffusion of mobile technology and the need for healthcare cost containment will drive the unstoppable rise of eHealth applications.

Few other trends have such potential for solving the three challenges of healthcare systems around the world: improving outcomes, broadening access and managing cost. IT is rapidly redefining the medical workplace and the consumer marketplace by enabling access to care in remote areas and offering the opportunity to improve health outcomes through e-learning and e-monitoring.

However, significant challenges remain, from the fragmented nature of electronic medical systems to issues of data privacy and confidentiality, varying e-health literacy among consumers, and the critical issue of exactly who will pay for what products and services.

I. PROVIDER-TO-PROVIDER DYNAMICS
The transformation of healthcare delivery is driven by IT leaders and large provider networks such as Kaiser Permanente in the US. Kaiser Permanente is the largest nonprofit health plan in the US, serving over 9 million members through 37 hospitals, 650 medical offices staffed by over 17,000 physicians and 48,000 nurses. All its hospitals and most medical clinics or imaging labs built with telehealth capabilities, and use of EHRs is fully generalized. In 2011, Kaiser Permanente implemented over 50 telehealth projects that provided over 250,000 visits.

At the end of 2011, Orange, together with GE Healthcare, was awarded a contract to integrate the imaging needs of the Paris/Ile-de-France region (the most populous in France), connecting over 90 hospitals and over 500 radiologists, covering over 12 million patients. AT&T similarly won important contracts for the Indiana health information exchange as well as for Baylor Healthcare network, a large private healthcare network (10).

An IHS/InMedica January 2013 report found that over 300,000 patients worldwide were already monitored remotely for conditions such as congestive heart failure, diabetes, hypertension and mental illness, and that number was expected to rise to 1.8 million in the next four years (11).

There are currently about 200 telemedicine networks, with 3,500 service sites in the U.S. Nearly 1 million Americans are currently using remote cardiac monitors and in 2011, the Veterans Health Administration delivered more than 300,000 remote consultations using telemedicine. More than half of all U.S. hospitals now use some form of telemedicine (12).

There have been relatively few controlled experiments comparing telehealth vs. conventional care, with mixed results (13). At the Geisinger Clinic, decision support systems improve diagnosis, prevention and treatment, especially in transitions from inpatient to outpatient care (13). A Veterans Administration (VA) study compared standard vs. web-based care for diabetes patients. The latter led to substantially improved outcomes (14).

One of the largest - and most positive - randomized control trial of telehealth to date was the Whole System Demonstrator (WSD) programme, launched in May 2008, and involving 6,191 patients and 238 GP practices across three sites in the UK. The interim findings demonstrated a 15% reduction in A&E visits, a 20% reduction in emergency admissions, a 14% reduction in elective admissions, a 14% reduction in bed days, an 8% reduction in tariff costs, and most strikingly, a 45% reduction in mortality rates (15). On the basis of the WSD programme, the Department of Health has launched the "3millionlives" programme to leverage the benefits of telehealth and telecare for the 3 million people with long term conditions and/or social care needs. (16)

A Commonwealth Fund 2012 survey reported that nearly all primary care physicians in the UK and the Netherlands use EMRs, but only two-thirds of US and French physicians do. The most common uses were lab test order entry, e-prescribing, and drug interaction alerts (17).

The last few years have seen a remarkable growth of physician social networks in the US (such as Doximity with 200,000 verified physician members or Sermo with 125,000), in Europe (Doctors.net.uk with 200,000 UK physicians, Coliquio or DocCheck in Germany, MedCenter in Spain/Portugal, Egora in France, doktorsitesi.com in Turkey, etc.) and in Asia such as dxy.cn or Haoyisheng.com (Good Doctor) in China, which claims about 1.9 million members or 40% of all healthcare professionals!

Cegedim estimates that 78% of Japanese physicians use online medical communities, vs. 55% of Chinese, 54% of Indian, 52% of Russian, 47% of American, 40% of British and 39% of German but only 15% of Italian and 9% of French physicians (18). These physician-only social networks allow physicians to interact with colleagues, exchange information and seek support, as well as learn from experts and peers, discuss clinical issues and practice management challenges.

II. CONSUMER-CENTERED APPLICATIONS

The Internet has revolutionized access to information in every walk of human activity, but perhaps nowhere has it been felt as deeply as in healthcare, where availability of medical information has transformed the power relationship between patient and healthcare provider. Up to 80% of adult Internet users now search for health information online. Looking for health information is the third most common activity admitted by Internet users after using a search engine and e-mail (19).

There is now broad adoption of digital communication between providers and patients such as e-mail, text messages, or simple online services like electronic appointment booking: this last option typically results in higher patient satisfaction and better customer retention, but one

surprising outcome for Aurora Health Care, a 15-hospital network in Wisconsin, was that the number of no-shows decreased significantly, from 10% to 2% (20).

A study by the National Partnership for Women and Families found key potential benefits to patient-centered implementation of eHealth:
- "whole person" care, i.e. an integrated team instead of a disease-centered approach.
- online self-management tools, with linkages to community services.
- ready access to health information for those with limited mobility (21).

According to a public opinion survey conducted at Brown University, barriers to these online interactions include privacy concerns for patients, and issues regarding reimbursement and staff costs for providers (22).

Table 2 summarizes the convergences, as well as variances, between physician and consumer acceptance of eHealth.

Table 2. Where physicians and consumers meet

How Consumers Feel	Summary	How Physicians Feel
56% like the idea of remote care and **41%** would prefer to have more of their care via mobile	**Nontraditional appointments** Doctors and consumers are open to nontraditional appointments (e.g.: phone conversations, online visits, and communication through secure online portals)	**45%** said Internet visits would expand access to patients
27% said medication reminders via text messages would be helpful	**Using text messages (SMS)** There may be opportunities to incorporate text messaging for simple communications between the provider and consumer	**31%** said they use or would like to use text messaging for routine administrative communications
23% prefer providers communicate by email for appointment reminders/ simple communications	**Administrative communications** Doctors and consumers are interested in using email to communicate about administrative tasks (e.g.: appointment reminders, but doctors appear to be more eager)	**66%** said they use or would like to use email for administrative communications
40% said they would pay for remote monitoring device with a monthly service fee	**Paying for mobile health** There is a consumer market for remote monitoring devices that send data to the healthcare professional	**57%** said they want to monitor patients outside the hospital

Source: Françoise Simon and François Meurgey, partly adapted from PricewaterhouseCoopers Health Research Institute (6)

The August 2013 update of the Ericsson Mobility Report indicates that there were 6.5 billion mobile subscriptions in the world at the end of the 2nd quarter 2013, a penetration rate of 91% of the world population. About 1.8 billion of these subscriptions are mobile broadband, supporting

the use of smartphones: it is estimated that there are now more than 1 billion smartphones in the world, and smartphone sales now exceed the sales of older feature phones since early 2013.

Given this pent-up demand, there has naturally been a proliferation of mobile phone applications dedicated to health and wellness, from custom fitness programs to diet and menu planners to weight management, to apps targeted at chronic patients (helping with management of a wide range of diseases, from multiple sclerosis to diabetes to bipolar disorder) or healthcare professionals (such as Medscape, ePocrates, iRadiology, etc.). According to imedicalapps.com (12 July 2013), there were about 20,000 smartphone medical apps in the iTunes store (i.e. using iOS) vs. "only" 8,000 medical apps in the Google Play store, the 2nd largest app store. It is worth noting that as of March 2013, the FDA had approved only about 100 medical apps, so the quality of these other 28,000+ apps is untested.

According to Research2Guidance, 500 million smartphone users worldwide will be using a health care application by 2015 (23). A November 2011 report by Juniper Research predicted that 44 million health-related apps would be downloaded in 2012, and this number is expected to grow to 142 million by 2016 (24).

Another very important trend is the emergence of the Quantified Self movement as well as the rise of patient social networks such as www.patientslikeme.com (220,000 members), Carenity, rareconnect.org (available in 5 languages), diabeticconnect.com, rareshare.org, HealthUnlocked, Inspire, SmartPatients, etc. which allow patients to share personal histories of symptoms and treatments, exchange information on physicians, hospitals and drugs, and simply communicate with people who have similar life experiences and challenges.

III. MANUFACTURER INNOVATIONS (25)
Responding to this pent-up demand, IT and device leaders are launching new tools and technologies that leverage compatibility with this rapidly rising number of mobile devices:
- GE Healthcare's iPad-supported Centricity Practice Solution allows physicians to view and respond in real time to patient information, choose the right ICD-10 diagnosis code, check instantly formulary status and patient eligibility for ePrescribing, as well as track and measure care quality outcomes.
- Innovative diabetes management tools (ultimately targeting 285 million patients worldwide) includes initiatives by Cellnovo (whose system combines an insulin pump, an app-based touch-screen handset and a web-based clinical management tool, all linked by a wireless connection), and Sanofi/AgaMatrix, who developed the iBGStar, the first blood glucose monitor compatible with the iPhone and iPod, and STARsystem, a glucose e-monitoring system for patients and care teams.
- Another important trend is gamification: Bayer's DIDGET™ is the first and only blood glucose meter that rewards kids for consistent testing with points they can use on Nintendo™ gaming systems. Boehringer Ingelheim launched the online social game Syrum in September 2012 which challenges players to discover new cures for diseases, create stable drug treatments and set up clinical trials to facilitate the launch of the drug and cure the disease. Combining elements of the card-trading game Pokemon and

functionality of Facebook, this social game entices players to use the social network's mobile 'check-ins' to earn in-game rewards and connect with their Facebook friends to collaborate on molecule development.
- Withings is developing a range of "smart products" that are wirelessly connected to mobile devices: scales measuring weight and body composition but also heart rate and air quality, a blood pressure cuff, a baby monitor, activity tracking devices, etc.
- in July 2012, FDA approved the first ingestible sensor developed by Proteus Digital Health: digestion of the pill activates transmission of a coded signal to a patch worn by the patient (the patch can collect other data such as heart rate, body temperature, patient position and activity level), which in turn relays this information to a Bluetooth-enabled device such as a cell phone. Investors in Proteus include Medtronic, Kaiser Permanente, Oracle, Novartis and Otsuka: both pharmaceutical companies are now exploring how to incorporate this compliance monitoring technology into some of their chronic treatments, e.g. for MS, post-transplant organ rejection or schizophrenia (25).

IV OBSTACLES TO eHEALTH GROWTH

There are a number of issues that have so far limited the adoption of Internet-based and wireless solutions:
- Lack of common standards and software platforms are limiting the so-called "interoperability" of medical systems
- Concerns about data protection and confidentiality remain a core issue among consumers: many are reluctant to store data online (cf. the difficult history of Personal Health Records portals such as Google Health – discontinued in 2012 – or Microsoft HealthVault) or send them electronically to a doctor.
- The business case for eHealth is still weakened by limited evidence of cost-effectiveness, high start-up costs and lack of clear business models: see PWC report demonstrating that mobile health tends to reduce healthcare resource utilization (need for hospital admissions, physician office or home health visits, etc.), thereby decreasing provider revenues! New payment models based on outcomes, not on volume, are needed to encourage seamless care and innovative solutions.
- Low rate of equipment and health/IT literacy of certain populations (e.g. the elderly) constrains the ability to reach some of the neediest groups.

CONCLUSIONS

The essential building blocks of an ideal healthcare system are:
- quality and timing of information (e.g. diagnosis, treatment outcome, continuous monitoring) at the individual and population levels, allowing optimal decision-making
- coordination among providers and caregivers
- easy access to care and patient-provider communication, facilitating engagement of all stakeholders.
- and of course all this at a sustainable level of cost to the community…

eHealth clearly has the potential to deliver on all these facets through technology, widespread adoption of mobile devices and social networking, the processing power of cloud computing and

big data analytics… But this will require a concerted effort by all parties to harmonize protocols and systems, provide a robust legal framework to ensure data protection, confidentiality and resolve liability issues, and offer a sound business model with clear incentives for patients, healthcare providers, manufacturers and service providers. In particular, the traditional fee-for-service model is likely to give way to some form of fee-for-outcome, driving significant attitudinal and behavioral changes for all parties involved.

Telehealth is already transforming workplace and marketplace dynamics for all healthcare players. As governments encourage and fund eHealth adoption, there remain areas to be further researched, including the cost/benefit of health IT, the interoperability of electronic medical systems, the legitimate concerns about data ownership and protection, and disparities in consumer health literacy levels.

REFERENCES
1.   Tricia Gerber, Veronica Olazabal, Karl Brown and Ariel Pablos-Mendez, "An Agenda For Action on Global E-Health", Health Affairs, 2010;29(2):233-236
2.   WHO website on eHealth http://www.who.int/ehealth/about/en/index.htm accessed 1-Sep-2013
3.   http://www.who.int/goe/en/ accessed on 1-Sep-2013
4.   WHO/ITU National eHealth Strategy Toolkit (March 2012) http://www.itu.int/ITU-D/cyb/events/2012/e-health/Nat_eH_Dev/Session%201/ITU-WHO%20National%20eHealth%20Strategy%20toolkit%20March%202012.pdf accessed on 1-Sep-2012
5.   Simon Kennedy and Benjamin Berk, "Enabling e-Health, a Revolution for Informatics in Health Care" IT Advantage, the Boston Consulting Group, 4 March 2011.
6.   "Healthcare Unwired, New business models delivering care anywhere" PricewaterhouseCoopers Health Research Institute, September 2010
7.   press release 24 July 2013 - accessed 1 September 2013 http://www.businesswire.com/news/home/20130724006384/en/Research-Markets-Global-Healthcare-Market-Report
8.   European Commission eHealth Action Plan 2012-2020 page 4 footnote 14 and BCC Research website http://www.bccresearch.com/market-research/healthcare/telemedicine-technologies-global-markets-hlc014e.html accessed on 1-Sep-2013
9.   IHS/InMedica press releases 15 September 2011 http://in-medica.com/press-release/Global_Telehealth_Market_Set_to_Exceed_1_Billion_by_2016 and 28 November 2011 http://in-medica.com/press-release/Competition_in_the_Telehealth_Market_Set_to_Intensify access on 1-Sep-2013
10.   Kai-Lik Foh "Integrating Healthcare: The Role and Value of Mobile Operators in eHealth" GSMA mHealth Programme (May-2012)
11.   IHS/InMedica press release 21 January 2013, http://in-medica.com/press-release/Telehealth_to_Reach_1.8_Million_Patients_by_2017 accessed on 1-Sep-2013
12.   "Technology Transforming Business: Health Care" Supplement to the San Diego Business Journal (20-May-13)

13.   Caroline Lubick Goldzweig, Ali Towfigh, Margaret Maglione and Paul G. Shekelle, "Costs and Benefits of Health IT: New Trends From the Literature", Health Affairs Web Exclusive, 27 Jan. 2009, w282-w293.

14.   Graham T. McMahon, Helen E. Gomes, Sara Hickson Hohne et al "Web-Based Care Management in Patients with Poorly Controlled Diabetes" Diabetes Care July 2005;28(7):1624-1629

15.   Department of Health, Whole System Demonstrator programme - Headline Findings, December 2011

16.   http://3millionlives.co.uk/about-3ml#background accessed 1 September 2013

17.   Cathy Schoen, Robin Osborn, David Squires et al "A Survey Of Primary Care Doctors In Ten Countries Shows Progress In Use Of Health Information Technology, Less In Other Areas" Health Affairs 2012;31(12):2805-2816

18.   "Physicians in emerging markets more open to using social networking sites compared to their European counterparts" Cegedim Strategic Data press release 16 June 2012

19.   David McDaid and A-La Park, "Online Health: Untangling the Web" BUPA Health Pulse 2010, 4 January 2011

20.   Chris Murphy, "Digital Business Requires Dose of Humility" Information Week, 17 June 2013

21.   Christine Bechtel and Debra Ness, "If You Build It, Will They Come? Designing Truly Patient-Centered Healthcare", Health Affairs, May 2010;29(5):914-919.

22.   Edward Alan Miller and Darrell West, "Where's the Revolution? Digital Technology and Health care in the Internet Age", Journal of Health Politics, Policy and Law, 34:2, April 2009, 261-284.

23.   Malay Ghandi and Deborah Pascoe. "FDA 101: A guide to the FDA for digital health entrepreneurs by @Rock_Health." A Rock Report by Rock Health

24.   press release, 29-Nov-2011 - accessed 1 September 2013 http://www.juniperresearch.com/viewpressrelease.php?pr=275

25.   Examples in Section III are derived from personal communication to authors from company representatives (May to September 2013) and internal company documents.