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Chapter 6

Uses of Internet and Mobile Technology in Health Systems: Organizational and Social Issues in a Comparative Context

James Katz, Ronald E. Rice and Sophia Acord

Introduction

The Internet provides an opportunity to the public and healthcare professionals to access medical and health information, improve the efficiency and effective, timely healthcare. The rise of mobile systems and the widespread adoption of the cell phone mean that mobile applications are an exciting and rapidly expanding domain for such applications. Many new offerings are being developed through digital appliances, computer terminals and mobile devices. Yet important empirical questions remain to be answered at every level about how effective these systems are, how people in various socio-demographic sectors actually use these systems, what their different effects are on those sectors, and whether their expense justifies the efforts involved. Important too are issues of how quickly and in what format they should be created, who should bear the costs of development and dissemination, how to ensure their dependability and sustainability, and what their immediate and longer term social implications might be.

In earlier work, we have highlighted structural problems with Internet healthcare applications (Katz & Rice, 2001). More recently, we have observed that (1) there has been substantial resource commitment, resulting in the creation of many useful centralized services (some commercial, some governmental); (2) however, despite their utility, perceived and actual inadequacies of these services have stimulated disparate groups to organize their own compensatory, decentralized and local networks of health information resources. These include Internet listservs, "blogs" (that is, online interactive diaries or

"Weblogs") and local telephone circles. Often these para-institutional sources are designed to respond to patient needs as perceived by patients and care-givers, and response to the way they formulate and articulate their health concerns. But just as questions must be raised about the bias, flexibility and ease-of-use of the centralized systems, questions must also be raised about the bias, accuracy and accountability of the new flexible ones. (4) As new communication technologies are developed, they are also explored for novel e-health uses. Here a recent example is radio-frequency identification (RFID) tags that allow medical paraphernalia, prescription drugs to be traced, monitored and controlled. Indeed, RFID tags are already being used to track and treat patients in hospital settings. These technologies can not only deliver services cost-effectively but will inevitably save lives. They may even prevent the outbreak of epidemics. However, some of these new technologies raise not only serious questions for students of privacy and ethics, but fear of them may lead to avoidance behavior on the part of sick people. This in turn could lead to potentially catastrophic consequences for both the individual and the general population.

Clearly for both centralized and decentralized Internet health resources, there are still many issues to be resolved at the cultural, user interface, institutional and system levels. Of particular concern for those seeking to develop practices at the community level, attention needs to be given to issues of (4) how new systems reconfigure physician/patient relationships and how they re-distribute the respective benefits and drawbacks to both sides of the relationship (Rice & Katz, 2006), (5) to what degree they open channels of communication to help patients and physicians come to terms with new technologies in mutually-beneficial ways and help them communicate about how to best use new technologies for medical ends, and (6) how to create socially sensitive e-health services that are also socially equitable in terms of accessibility (Katz, Rice & Acord, 2004). And of course we are concerned about (7) what role cultural and social aspects impede the deployment of new, cost-effective healthcare and medical services.

In our analysis, we perceived a dialectical process: each of the above analytical themes stems from an original problem perceived by one or more stakeholders, which in turn gives rise to specific forms of Internet use. From these there arise new contradictions, which suggest potential, often novel, solutions. So advancement in effective Internet and mobile healthcare systems require not only empirical data on the specific reception of each system by its users, but also a larger framework that understands the logic of self-interest and cultural moorings that affect each system in a larger setting. For instance, analysts need to consider ways in which people try to use the Internet and mobile to serve their own needs, and how, when doing so, they become enmeshed in, or seek to subvert, the inherent logic and vested interests of health institutions and information systems.

Assessment of these problems involves issues that go beyond good intentions and laudable aims (or other motives) of providers. They should include consideration of the inherent bureaucratic logic of one-way information flow. This logic governs traditional relations of healthcare organizations with their clients, even as these operations are extended into digital domains and widespread access. Further, as this process unfolds, it often includes within it a market logic of packaging information for return on investment, and at the very least some concern about program efficiency. These inherent logics sometimes lead to confusion on the user's part since the user may not understand the deeper motivations and rationales. Yet organizations, if they are to have a continued existence and reap the rewards of sunk costs and prior efforts, must also attend to their vested interests.

Moreover, the specific area of health is further complicated by considerations of (and conflicts among stakeholders over) value orientations toward the rules governing individual and group privacy, commercial free speech, access to markets, legal and medical regulations, and effectively informing, protecting, and enabling patients as well as physicians and other healthcare workers. Increasingly, too, there are concerns of legal accountability and human rights. Thus, responses to identified problems that do not address these limitations are unlikely to be viable over a longer term. This is in contrast to the ways some new technologies are deployed, which might be described as "create a new technology, deploy it in a few sites, and then ask people how much they like it." Ultimately, then, it seems reasonable that further research on e-health applications needs to take into account (and be predicated upon) the *needs* of all stakeholders involved in the medical sphere (e.g., patients, physicians, hospitals, policy makers, regulators, and payers).

Before delving into the themes, we should mention our perspective, which we dub "Syntopian" (Katz & Rice, 2002). The Syntopian perspective rejects both dystopian and utopian perspectives on the social uses and consequences of information and communication technology. Rather, it emphasizes how people, groups, organizations and societies adopt, use and reinvent (Johnson & Rice, 1987; Rice & Gattiker, 2000) technologies to make meaning for themselves relative to others. Hence, while possibilities are limited by the nature of the given technological tools, systems and their uses are (potentially) surprisingly flexible. Thus technology becomes shaped by individual needs and social contexts. The perspective also highlights that the internal logic of both formal organizational systems and personal social systems are fully applicable to the Internet (Castells, 2000).

In this chapter, we focus on delineating some recent developments in the use of the Internet and related technologies for healthcare. The emphasis is on the situation in the US, though we draw on other countries as well for comparative and descriptive purposes. We try to highlight the macro social issues that could be of interest to policy-makers and suggest possibilities that could merit consideration by system designers or healthcare service professionals.

Internet Technology and E-health Resources

E-health resources have wide appeal in the US; quality, utility sometimes problematic

Clearly e-health is something that has great appeal to Internet users throughout the world, especially in North America. Numerous surveys have shown that in the US in particular there is heavy use among consumers and especially physicians (Katz, Rice & Acord, 2004). Many institutions have devoted vast resources to putting medical information online (Boston Consulting Group, 2003). In the US, this includes PubMed and Medline via the National Library of Medicine, which are generally accessible online from Internet-connected computers, regardless, generally speaking, of where around the globe they might be located. These resources are often free, which, though partly understandable, is also in many ways astonishing. (Portugal, incidentally, has committed to putting large amounts of information in

Portuguese on line and making it readily accessible to its citizens. As a case in point, to provide better access to governmental data, Portugal reportedly offers free public access in some parish churches—"eGovernment in Europe," 2004).

However, websites such as the NHS library or MDConsult.com, which aim to provide accurate and secure information to health-seekers, suffer from readability problems (Ebenezer, 2003) and are rarely designed for patients (Tench et al., 1998). Moreover, at least in the US and Canadian contexts, patients are generally unaware of these high-quality data sources (Sigouin & Jadad, 2002), so they are often not places to which consumers are likely to turn, at least in the first part of their attempts to seek information. Hence, health seekers tend to use general search engines, such as Google (Boston Consulting Group, 2001, 2003). However, the more centralized and commercial websites found in this manner generally lack customer interaction features. Instead they provide only unidirectional information (Cudmore & Bobrowski, 2003). For example, fewer than one out of three pharmaceutical company websites offer a way to respond online to consumer requests. Fewer than half of health-supply websites respond to online requests or questions (Pharmaceutical, 2003). Yet government health sites are even less interactive (Rice, Peterson & Christine, 2002). Further, these more general health sites may not provide the specific, contextual information appropriate to the user's needs, and may have both identifiable and hidden commercial and other biases.

Personal websites have role

Personal, rather than commercial, educational or government, health websites play a significant role in the construction of medical knowledge online, and represent the growth of interest in 'local' knowledge. In a search for rheumatoid arthritis, 34% of relevant sites were posted by an individual, more than those posted by a non-profit organization, and over 6 times more than those posted by an educational institution (Suarez-Almazor et al., 2001). Yet, very little research has been done on the ways in which health-seekers use this information source, as its existence is often overshadowed by online support groups. It is likely that "blogs," or web logs (which are essentially on-line diaries with an interactive component that encourages others to leave comments), will be playing a growing and complementary role in these processes.

Physician websites becoming an important resource

In the US, it appears that about one-third of physicians have a Web site, of whose development obstetrics/gynaecology and internal medicine specialists have been the most prevalent (AMA, 2002). Howitt et al. (2002) studied UK websites and found that, apart from e-mail sent to the practice, possibilities for electronic communication were low, as was the general quality of information. Sanchez (2002) notes that the vast majority of physician websites focus on practice enhancement tactics, rather than specific patient service. In contrast to the supply side of the healthcare equation, Norum et al. (2003) report that cancer patients want to see more information on hospital websites that is directly related to the delivery of healthcare. For example, these include waiting time before a physician is available, treatment services, and office location information (Pastore, 2001). Services like WebMD are providing physicians with an array of electronic support, including websites and secure email. Patients have reported that these sites are cumbersome, in part due to the concerns about liability and the assumption of responsibility.

Desire for useful online information from physicians is also typical of Spain, apparently, even though there is overall less Internet health-seeking and more traditional ties to local providers. This desire is reflected in a study of Catalonian patients. Panés et al. (2002) found that 84% of Internet health-seeking patients (which represented 44% of all patients) suffering from irritable bowel syndrome wanted a local website from their own clinic; 65% were willing to pay for this service. It seems that patient demand continues to exceed physician supply of useful information both in the US and Spain.

Health kiosks: Crossing a digital divide?

Health kiosks are uncommon in the US and tend to be situated in clinic waiting rooms (indeed the proportion seems to be declining for reasons of inutility and cost). For example, Sciamanna et al. (2004) experimented with a kiosk giving tailored advice on fitness and smoking. Although fewer than one/third of the participants had ever used the Internet to seek health information, over 80% found the kiosk easy to use. However, less than half of the doctors looked at the report provided by the kiosk or discussed it with the patient. Goldschmidt and

Goodrich (2004) placed bilingual kiosks in clinic waiting rooms and noted that 68% of people said they found all the information they were looking for, and that flu shots increased by 24% following the installation. In contrast to the US (which seems to use kiosks to reduce information demand on the physician), other countries are experimenting with health kiosks containing pre-sorted information, to reach communities which may not have Internet access or know-how. Jones et al. (2001) found that among an elderly Spanish population without Internet access, 25% were interested in the kiosk idea. While in terms of professional opinions about their utility, kiosks do not rate high, they may yet be a significant way to disseminate medical information to socially remote communities or in specific delivery locales.

Physician education resources

There is great potential for the Internet to help educate and update physicians. For instance, Casebeer et al. (2003) details the positive impact that a Web-based physician tutorial on preventative care (in these specific case, sexually transmitted diseases) had on the knowledge of the experiment group versus the control group.

Policy Concerns of Centralized Applications

Due to the decentralized, unregulated nature of the web, and even the contested nature of what constitutes valid and quality medical information, the accuracy and usability of online information are extremely pressing policy problems (Berland et al., 2001; Kunst et al., 2002; Rice, 2001; Zeng et al., 2004). As just one example, websites that offer so-called alternative medical treatments have been described as containing dangerously inadequate or misleading information (Ernst & Schmidt, 2002; Hainer et al., 2000; Molassiotis & Xu, 2004). Organizations such as HON (Health on the Net) have devised guidelines to rate the quality of e-health information, and some current websites carry the HON seal of approval (Wilson, 2002). However, it is not clear really to what degree health-seekers use general search engines because they are not familiar with approved medical resources, or because they are specifically looking for alternative treatment ideas. As there is no way to prevent the dissemination of hazardous information, the best use of resources seems to be to develop

sanctioned general web health portals and raise public awareness about ways to look for reliable health information, especially by the patients' physicians. The recent success of WebMD Health (after staggering losses in 2001) demonstrates the fruits of such policies.

In addition, it does seem as if health-seekers realize the dangers of bad health information online and want the development of local-medical sources such as physician websites. In responding to this need, the biggest factors are ensuring readability, privacy, and publicity in accurate medical sources, as well as informing patients of clinical studies for new treatments. As Seidman, Steinwachs and Rubin (2003) point out, there still needs to be developed a robust tool, accessible to health-seekers, to identify quality information on the Internet.

Yet these concerns should not blind us to the enormously important role online health information is already playing. For instance, Wagner et al. (2004) report that patients who suffer chronic diseases (in this case diabetes) find that the information gained through online channels help them manage their situation. Moreover, there is another way in which quality interacts with the Internet, and this is in terms of rating the quality of physicians and healthcare providers (especially hospitals and insurers). Indeed, this is one area in which we could predict a revolution that will benefit the public even at the cost of some individual or institutional reputations.

Apart from the quality or design of Internet health applications, there are still major differences in exposure and access. It is not always clear whether the fault or limitation inheres in the application or in the target population. But in the USA, at least, there are consistent "digital divides" in access to healthcare information. These include socioeconomic status, gender, race (Houston & Allison, 2002), health status, language (Berland et al., 2001, found Spanish-language sites suffered from even worse quality issues), age (Meischke et al., 2005)[1] and physical disabilities such as elderly immobility (Katz & Aspden, 2001) or visual impairment (Davis, 2002). Most importantly, much data support claims that higher education levels corresponds with Internet use (Giménéz-Perez et al., 2002; Licciardone et al., 2001;

[1] In fact, in a recent study in Washington State, only 7% of seniors who suffered heart attacks *and* had Internet access ever looked for information on their conditions online (Meischke et al., 2005).

Pandey et al., 2003). Kakai et al. (2003) found that people of higher education levels prefer to get their health information through seemingly objective, scientific, and updated forms, such as the Internet, while those of lower educational levels prefer to have their information come from mass media and other people because they say they like the human approach. Perhaps one way to increase delivery to the "have-nots" may be to develop health kiosks in ways that appeal to the elderly and non-native language speakers; of course attention to location and usability would be paramount, as well as situated teaching campaigns to train local populations in their use.

Cultural factors are also important in understanding the policy implications of various e-health applications (Yom, 1996). Kakai et al. (2003) found differences in preferred information sources along ethnic lines, as Caucasian patients preferred objective, scientific, and updated information obtained through medical journals, research institutions, and telephone and Internet sources, while Japanese patients preferred media and commercial sources such as TV, magazines, books, and other written sources. Non-Japanese Asians and Pacific Islanders tended to favor information sources marked by person-to-person communication, such as physicians, social groups, and other cancer patients. In the US, black women had a 60% lower likelihood of using computer-based resources than did white women (Nicholson et al., 2003), and non-white people are less likely to use the Internet to look up health information for breast cancer (Fogel et al., 2002). Social and cultural factors of populations and communities hence appear to be important considerations when developing targeted e-health applications (Morahan-Martin, 2004).

Thus, despite the widespread development of Internet e-health applications, these resources do not seem to be accessible to, or at least accessed by, large portions of US society. Nor do they often seem recognized as a source for medical knowledge in communities and cultures that are already much more familiar with face-to-face physician interaction. The challenge remains then to create health information systems accessible in ways that fit lifestyles and choices of underserved groups, motivate healthcare providers to provide personal encouragement for and information about using online resources, and encourage these groups to develop knowledge and routes of accessibility to e-health websites.

Internet Technology—Multidirectional

E-health applications also should not stop at merely providing unidirectional information, although this is important. Keeping in mind the way most non-students learn, it is important to develop on-line possibilities for multi-directional interaction between health-seekers and appropriately tailored information.

Physician webcams

Bamford et al. (2003) implemented a country-wide network of physician webcams in the UK through the implementation of double-headed microscopes in 35 histopathology departments across the UK. A year after installation, they found that 71% of the physicians had not even used the networking software. All of those physicians who had used it found it effective for diagnosis and exchanging opinions. Bamford et al. conclude that the project did not achieve its aims to due excessive workloads preventing physician training, IT staff reluctance to render assistance, but above all, user attitudes.

Email

Many physicians do not use email because they are not compensated for the time involved to check, assess, and respond (Anderson et al., 2003; Harris Interactive, 2001; Rice & Katz, 2006); and there are liability and confidentiality issues that preclude using email. In contrast, American healthcare consumers overwhelmingly say they would often like to be able to contact their physicians by email rather than through office visits (CyberAtlas, 2002; Norum et al., 2003). Patients would like to email for prescription refills, non-urgent consultations, and to receive test results (Couchman, Forjuoh & Rascoe, 2001). However, it is noteworthy that 75% of patient emails to physicians included requests for medication/treatment information or actions, or specific diseases/symptoms (Sittig, 2003). Hassol et al. (2004) found that most patients preferred email communication and face-to-face communication with their physicians (depending on the matter), while US physicians preferred telephone to email communication. Of those 20-30% of physicians who do use email or electronic communication, many see improved patient satisfaction and some note improved efficiency and care (Harris Interactive, 2001).

In this context, it is unsurprising that researchers have attempted to develop software that would identify terms in patients' emails that could be then linked to medical information to be emailed back to the patients without the need for a physician response (Brennan & Aronson, 2003). This system may be efficient, but it is also likely to raise some serious concerns in the minds of the patients; it may be that patients want email because they seek a *human* response, which may be paradoxically more difficult through traditional physician-patient channels.

Sometimes it is suggested that "out-sourcing" of medical information provisioning could help the developed countries as well as developing ones. This idea is already widespread in many technical and consumer support fields, most notably in computer user problem resolution. However, there appears to be scant interest on the part of healthcare consumers for such services at this point. For instance, Hassol et al. (2004) evaluated interest in various ways in which offshore physicians could be contacted by patients. They found mild interest in telephone contact methods among Americans, but no interest whatsoever in an email service.

Health information management systems

Mendelson and Salinsky (1997) note that the early failure of many Community Health Management Information Systems (CHMIS) (similar to CHINS, or community health information networks) was due to the lack of private sector support for integrated, state-wide systems. In addition, the general public distrust of state-sponsored health care systems combined with the proprietary interests of the players involved served to eliminate them in the majority of states (Eder & Wise, 2001; Katz & Aspden, 2001). However, in states where health databases exist, such as Wisconsin Health Information Networks, the direct access to clinical and administrative data saved up to $68,000 a year for private practices and up to $1 million for hospitals (Mendelson & Salinsky, 1997).

Using electronic medical records in hospital databases was demonstrated to help ensure consistent and correct coding by physicians, as well as context-sensitive treatment in Germany, by Muller et al. (2003). Patient-accessible health records have been found to be a valuable step forward, with satisfaction, rates in the 65-85% range (Hassol

et al., 2004; Joustra-Enquist & Eklund, 2004; Wang et al., 2004).[2] Yet there is both resistance to them by staff due to local cultural practices and larger concerns about privacy and security. Radio-frequency identification (RFID) systems are expected to blend database management and mobile tracking together in extremely fruitful ways, although problems of cost and integration remain to be solved before they can see widespread deployment.

Outside of the US, the EU has implemented a general e-health strategy for the years to come,[3] and Tachinardi (1998) describes an ongoing project in Brazil to build a network of e-health applications including a unified health record for the exchange of patient data, and a virtual hospital of health information and medical journals for physicians and lay patients..

Discussion groups

Online discussion groups respond to many of the needs unfulfilled by the centralized information providers. In some cases, these groups extract information from professional journals (Wikgren, 2001) and recreate it in a way to make it more applicable and understandable among the users. Many discussion groups include physicians (Katz & Aspden, 2001). Practically all conditions and situations have groups,

[2] Wang et al. (2004) developed a web-based personal health record for patients to collect and manage their health information (medical history, past surgeries, medications, and allergies), to request self-referrals, and to store a record of their consultations. The PHR also includes a messaging system that can be structured into the workflow of referral management as well as allowing more general communications. A preliminary study was conducted with 61 patients. Thirty-two patients completed a survey in which 85% of respondents were satisfied with the usability and 94% were satisfied with the overall online referral process. Joustra-Enquist and Eklund (2004) report on SUSTAINS, a web-based health care account in which the patient can login (with a login sent to their mobile phone) and review medical results and prescriptions and information, and exchange written information with physicians; participants reported that it is beneficial for both parties. According to Hassol et al. (2004), 65-85% of Americans in an experiment with electronic health records reported them easy to use, and that they understood all the information; a small minority reported confidentiality concerns.

[3] By the end of 2005, each member state should have a national roadmap for e-health, focusing on e-health symptoms and electronic records, and there will be an EU public health portal. By the end of 2006, member states should have a common approach to patient identifiers and identity-management, as well as interoperability standards for health data message and electronic health records. By 2008, health information networks should be commonplace (European Commission, 2004).

including those that deal with chronic conditions or embarrassing conditions (Millard & Fintak, 2002) and rare diseases (Patsos, 2001). Participants also report across-the-board benefits for themselves (Pew, 2000; Pew 2002) and for their loved ones (Till, 2003). They especially seem to like the fact that use offers empathy (Preece & Ghozati, 2001), personal empowerment (Sharf, 1997), and emotional support (Winzelberg et al., 2003). In fact, many report that symptoms seem reduced or alleviated by membership (Lorig et al., 2002; McKay et al., 2001; Winzelberg et al., 2003). This is not surprising in part because if people did not perceive benefits, they would not be using the systems. The social-psychological and emotional benefits are the qualities that are often lacking in treatments provided by physicians and institutions. Beyond the perception of psychological and emotional benefits, however, perceptions of actual health changes and improvements may be highly inaccurate and may even lead users to engage in treatment practices that are harmful.

E-commerce and online bidding

MedicineOnline.com offers an auction service in which patients can elicit physician bids for surgeries (Baur et al., 2001). It is unclear who uses this service, however, and what impact it has. At the same time, online "retail" e-commerce is likely to grow quickly, in part because of the desire to reduce costs and, in many societies including the US, to open channels of competition. This is likely to affect the cost of, and hence demand for, many elective procedures. Cosmetic surgery and whole-body magnetic resonance imaging (MRIs) are likely to be among those that are going to be competitively marketed online. Certainly there is already much promotion among dentists for both routine and cosmetic procedures through traditional distribution channels, and it is likely that the Internet will also become an important method of advertising for many common procedures and for attracting patients to under-utilized hospitals and treatment centers.

Web-Based interventions

The US has experimented with web-based health interventions, while other countries tend to focus on mobile phone text-based interventions (Curioso, 2006). For the US, one web-based diabetes care

management system saw an improvement in testing and check-up regularity among its users (Meigs et al., 2003). Overall, Wantland et al. (2004) found that web-based interventions were much more likely to achieve noticeable results than non web-based interventions in behavioral studies. These included areas of increased exercise time, knowledge of nutritional status and knowledge of treatments. However, in the UK, Eminovic et al. (2004) tested a web-based triage service with a nurse and found on average that it took twice as long to diagnose and treat complaints as with the NHS direct hotline. This study suggests the importance of interpersonal and cultural aspect in developing e-health applications.

Mobile Communication Technology: Bi-directional and Multidirectional

Telephone

The telephone can function as the basis for local support networks, often designed to harmonize with local culture. (Indeed it has been an important component in healthcare for more than a century!) In the US, this may be seen in the case of the Native American Cancer Survivors' Support Network (Burhansstipanov et al., 2001). This example is actually a cultural adaptation, based on dissatisfaction with tribal clinics. There was no use of local tribal authorities, in order to prevent the loss of confidentiality characteristic of small communities. Instead, survivors from other communities provided support via telephone. A similar project, the Aldre Vast Information Centre, took place in western Sweden (Hanson et al., 2002). In response to the requests of older people and their families, the project established telephone, videophone, and Internet support to older citizens and their families. The project had positive results in empowering these people to make better health care choices. As an alternative to face-to-face clinic-based behavioural counselling, Glasgow et al. (2004) describe how interactive voice-response telephone calls can generate comparable results.

The telephone is relied upon in Iberian countries in some ways like the Internet is in the US. A Spanish study of a call centre for oncology patients reports a decline in emergency hospital visits (42% to 24%), and an overall short call length (3-5 minutes) (Ferrer-Roca et al., 2002). This study demonstrates that telephone networks can be valuable for local patient support networks, as well as acting as effective paths to medical care. And, the short overall call time may indicate that such multidirectional networks will not take the toll on a physician's time that they fear. Likewise, a study of one Spanish telephone-intervention (Marquez Contreras et al., 2004a), found that telephone interventions increase treatment compliance as well as overall health.

Mobile phone

While Americans are relatively heavy seekers of Internet health information, there are relatively few mobile phone health applications in the US. The reverse is the situation in many other developed and developing countries (Curioso, 2006). Studies from Spain provide an illuminating contrast in usage patterns. Giménez-Pérez (2002) found that although only 36.5% of patients were regular Internet users, 76.6% of the patients owned a mobile phone, and 96% of those used it more than once a week. As a result, health applications involving mobile phones in Spain are more effective. Marquez Contreras et al. (2004b) conducted a controlled group study with hypertension patients; members of the intervention group were sent reminder text messages to their mobiles 2 days a week. Hypertension was significantly lower (51.5%) in the control group compared to the intervention group (64.7%). In another Spanish study, Vilella et al. (2004) found that text messages were an effective way to remind patients of immunization schedules prior to travelling abroad. Likewise, Bielli et al. (2004) report on an Italian study which analyzed the use of mobile phones for patients' health reporting. It was successful for 58% of patients; those who did not use it were older, less educated, and less familiar with new communications technology (mobile phone calls, mobile phone SMS, Internet, and email).

Similarly, trials in Asia report significant success with mobile phone health applications. Kubota et al. (2004) discuss a mobile application in which text messaging was used to send information about body weight reduction to study participants. Their study claims successful weight loss in 32% of the cases. Tang et al. (2004) report on a Hong Kong study that created a system for medical digital picture/scan information distribution and archiving using the physician's mobile

phone as the base. A central server handled the pre-sorting and processing of images. A Philippine study by Tolentino et al. (2004) describes a mobile phone based system for event reporting to develop an anaesthesia surveillance system.

Zhang et al. (2004) attribute much credit to mobile phone networks in the widespread success of public education during the SARS epidemic in China. Press reports at the time of the SARS epidemic described how public health workers in Hong Kong who were combating SARS would receive training and operational orders via SMS (short message service). The general public used SMS to alert others about which apartment buildings had infected residents (and hence should be avoided). At the same time, in the People's Republic of China, some people who were alerting others via SMS about SARS risks in their area were arrested by police and charged with spreading socially destructive rumors. The SARS example shows how mobile applications can be important in major health emergencies, but also shows how mobile communication can be a source of concern for officials seeking to control public behavior and movement of information.

Quite tellingly, research in Asia suggests strongly that there are substantial benefits available via mobile health applications for the elderly (once they have undergone the necessary training, of course). Ogawa et al. (2003) report on the success of using mobile phones with a pen-type entry sensor to provide and assess home care needs for elderly patients. Miyauchi et al. (2003) used mobile phones attached to sensors in order to inform medical services if elderly patients fall and are immobile, or are otherwise immobile, for set periods of time. Yoshiyama et al. (2004) also used mobile phones with digital photograph technology to effectively allow elder home care patients to communicate with their physicians.

Certainly there are some US applications employing mobile phone interventions. Several studies have been devoted to health improvement and self-management strategies as opposed to the management of specific chronic illness. For instance a study by Obermayer et al. (2004) used mobile phone text messages to deliver smoking-cessation intervention to college students, with a positive result. A similar study by Lazev et al. (2004) reports on the success in using mobile phone text to reach a low-income HIV-positive population in a smoking cessation program. The participants would not otherwise have land

phones or transportation to a clinic, so the mobile allowed them to get real-time counselling in life situations. Durso et al. (2004) also assessed how mobile phones could be used to communicate with older patients diagnosed with diabetes.

Morrissey (2004) blames concerns of electromagnetic interference with medical equipment for the poor availability of mobile phone networks in hospitals, claiming that alleviation of these concerns can lead the development of helpful physician and staff mobile communication. Klein and Djaiani (2003) note that this interference occurs only in close proximity to hospital equipment, and should not prevent the use of mobile phones in patient care areas and away from sensitive equipment, where access to and use of mobiles would encourage compliance with hospital policies.

Mobiles to fight AIDS and malaria in developing countries

It is worth including in our analysis a brief mention of the way mobile technology is being used to control malaria and AIDS. In the case of AIDS, free text messaging services are available in Kenya, where users can send text questions and receive free answers. As well, the free service sends out daily tips on how to prevent infection and deal with the disease's consequences. This service is provided by NGO One World (BBC, 2004). In Mali, local mobile company Ikatel sends free text messages with PSI-created health slogans twice a month to each of the company's 350,000 clients, and also prints AIDS and malaria prevention slogans on at least one million of the pre-paid phone cards most used by low-income customers. Sample messages include: "Protect your family against malaria—use an insecticide-treated mosquito net" (Plus News, 2004).

Certainly, given the mobile's success in social and business settings, there can be great expectations for the usefulness of the technology in fighting disease, especially in poor countries. These mobile health applications are interesting examples of how health information can be inserted directly into the daily lives of targeted populations, which contrasts with more traditional systems that are physically and psychologically remote from the active health-seeking population.

Mobiles healthcare databases highly useful in developing countries

In Rwanda, mobiles are used for connecting remote hospitals with centralized laboratories and supply houses. This saves enormous amounts of time and greatly increases efficiency. This initiative is based at the Earth Institute of Columbia University in New York City. Another mobile database operation may be seen in India. There, a rural healthcare project utilizing mobile phones won the UN's 2003 World Summit Award for e-Health. It triangulates mobile phones carried by field representatives to interconnect patient data, computers used by doctors in clinics, and a central database. Thus, distance-diagnosis is possible, saving on transportation costs, and other obstacles to health care (Simha, 2003).

Advanced mobile videophone and multi-media messaging

Chu and Ganz (2004) describe an ingenuous mobile medical application which uses commercial 3G wireless cellular data service to transmit a trauma patient's video, images, and electrocardiogram signals to a trauma specialist when the patient is in a remote location. Similarly, Weiner et al. (2003) used videoconferencing in nursing homes for unscheduled, night-time consultations. This study found that mobile multimedia applications were especially effective in dealing with mental health patients.

Mobile telemedicine

Telemedicine often is the use of satellite mobile communications technology to transfer information from patient to physician without the need for face-to-face interaction (Feliciani, 2003). Mobile telemedicine systems are used to convey images and information from location to location, such as from a remote clinic or an ambulance to a trauma centre (Heaton, 2006; Tahoka et al., 2003). Studies of systems include a German remote heart monitoring system, in which cardiac patients have their heart signal monitored and transferred to their mobile phone, and from there transmitted to their physician. Another one was a system in Brazil that allows remote physicians to confer via desktop computers with metropolitan cardiologists, and TelCardio Mobile, which allows important data and test results to be transferred

to physicians via mobile phones and PDAs. As a result, consultation and diagnosis can occur independently of a local infrastructure. There are many other telemedicine developments in India, the UK, and the EU, which allow the remote monitoring of patients by physicians in a hospital, via information transmitted over a mobile phone (Tahoka et al., 2003).

Important rationales for telemedicine are efficiency and effectiveness: physicians can do more with their time, and specialists can be remotely accessed by general clinics in low-income and sparsely-populated locations. Exemplifying the former, Holleran et al. (2003) describe the benefits of providing physicians with a wireless handheld device that is Web-enabled. The device can receive patient information anywhere, thus allowing physicians to respond in both a timely and an informed manner. A comparable approach has been developed by Chen et al. (2003). Although based in New York, their HealthNet system is used to provide better health care to Brazil's low-income northeast population. Examples of applications include fetal care and cardiology using telediagnosis and rendering second opinions about needed medical procedures (Barbosa et al., 2003).

Policy Implications of Internet and Mobile Health Technology

Ultimately, under most conditions it seems that healthcare applications have to resonate with a culture/society's dominant form of technology use. If either the provider or the patient side of the equation is resistant, difficulties will ensue. While the Internet has been characterized as an ideal way to disseminate information both locally and globally, for a variety of reasons discussed above, it has not succeeded in connecting up large portions of the population. Rather, telephone and mobile telephone health applications are relatively more popular in European and Asian countries; this is also reflected in the extraordinarily rapid spread of the mobile phone, which makes the heretofore seemingly rapid spread of the Internet seem slow by comparison.

Fahey (2003) warns that relying on cell phones to send text messages will lead to further inequality in health care along socioeconomic divides. However, other studies, such as Lavez et al. (2004), demonstrate the opposite. In fact, the very portability of mobile

phones and PDAs, enhanced by further device-to-device wireless technologies, actually make them versatile candidates to provide health care to remote areas, elderly individuals, transient workers, and individuals with disabilities (Curioso, 2006). (Sorri et al., 2003 developed a digital induction loop to improve the use of cell phones by the hearing impaired by means of reducing incompatibility with hearing aids.)

Concerning cross-cultural comparisons, it seems that most US telemedical developments are aimed at supporting physicians (such as mobile PDA-devices), while most non-US applications seem to be aimed at supporting patients (e.g., two-way health reporting through mobile phones).

To sum up, it seems that the original predictions about the problems of centralized systems continue to be borne out. Certainly unidirectional health applications continue to be developed, and succeed to some extent. But in trials and experiments, patients continue to ask for two-way communication and localized sensitivity. The abundance of mobile phone health applications in non-US countries, although their development came later than the original US health websites, seems to demonstrate the important role that the cultural-historical use of technology has on the acceptance of e-health devices. Above all, patients in remote areas or lower-income communities, as well as the elderly, generally find *interactional* e-health applications far more desirable than centralized sources. This differential is likely due to the cultural emphasis in these groups on non-mechanistic, face-to-face interaction. On the other hand, the active, independent, and non-confrontational health-seeking culture in the US lends itself well towards Web-based applications. In this regard, it will be interesting to track e-health developments as US mobile phone usage and EU Internet usage continue their respective rise. Yet, no matter the technology (Web or mobile phone), decentralized and interactional e-health applications seem to be taking an ever more prominent role in healthcare. Many programs that use them as their base also seem to be enjoying relative success. Presumably further development of these resources will add value to, and stand alongside of, the still-developing older formats of centralized, unidirectional healthcare information resources.

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