

From The Printing Press to Telemedicine: Communication Technology and Its Impact on Health

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Abstract

Innovations in communication technologies have had a profound impact on health. Over the decades, new communication tools have sometimes prompted fears that they will produce sociological and psychological distress, and have a negative impact on various aspects of health. Critics claim that innovation may disrupt the social order and degrade the health of communities due to anxiety. On the other hand, advocates of new technologies have pointed out that innovation supports progress in society, saves time and money, and improves health. This paper reviews responses to new communication technologies over the centuries, and how resistance to them, or cultural lag, has sometimes delayed their impact on health. As evidence accumulates that the benefits of a new technology outweigh the harms, innovations in health communication become part of standard practice. To ensure that emerging communication technologies provide the most benefit to the most people we recommend that purveyors of health information on any channel or platform be held accountable to standards that are ethical, scientific, and evidence-based.

Keywords: communication technology, innovation, health, telemedicine, history, computer-mediated communication

Most reasonable people believe that advancing communication technologies benefit society, economize on material, time, and human resources, and improve public health. However, some critics purport that innovation disrupts the social order and degrades public health by producing anxiety among the population. Early sociologist William Ogburn suggested that maladjustments occur in societies in which technological innovations outpace people's capacity to understand and integrate them into daily life. He termed this concept "cultural lag" (Ogburn, 1922). Ogburn argued that an innovation in one part of society creates the need for adjustment in another part of society. This paper examines communication technologies' role in cultural lag and in turn, its net effect on society's health over time, and the dynamics leading to their acceptance.

Movable Type Printing Press

In 1452 Gutenberg's innovation of the printing press made The Bible available to the masses. It was later used to mass-produce papal indulgence certificates which were sold to believers to reduce the amount of time their souls might spend in purgatory after death (Karolides, Bald & Sova, 1999). In part, the sale of printed indulgences triggered Martin Luther to initiate the Protestant Reformation of 1517 (Eisenstein, 1979). In the process of publishing the pamphlet, *Disputation on the Power and Efficacy of Indulgences* in the common German vernacular, Luther became the first best-selling author (Dittmar, 2011). Some of Luther's other publications recommended the use of apothecaries, barbers, physicians, and nurses to cure physical ailments, and influenced how the public viewed physicians by emphasizing that most diseases could be traced to natural explanations and were not always caused by black magic and Satan (Elmer, 2004).

By 1500 an estimated 13 million books were in circulation among the European population of 100 million people (Briggs & Burke, 2010). Medical texts were used by European healers to treat a variety of illnesses, from gastric problems to syphilis. Social critics of that time were concerned that mass-produced books printed in the common vernacular allowed ordinary folk access to knowledge previously held by clergy and the ruling class, in turn disrupting the social order (Zaret, 2000).

In 1641 Samuel Hartlib, an Eastern European exile in Britain, warned, “the art of printing will so spread knowledge that the common people, knowing their own rights and liberties, will not be governed by way of oppression” (Briggs & Burke, 2011, p. 15).

Postman suggested that the movable printing press led to the separation of young people into a distinct class (1992). Before widespread literacy, young people grew up learning through the spoken word and by observing adults. After the printing press, young people were schooled to read—often in groups of ages 7 to 13. Social class schooling became a way to educate youth. Postman argued that, “With the establishment of schools, it was inevitable that the young would come to be viewed as a special class of people whose mind and character were qualitatively different from adults” (Postman, 1992, p. 153). By the end of the 17th century, mass-produced and economically printed books had profoundly altered the European social order and the health of literate people.

Photography

By the mid-nineteenth century, photography added a new diagnostic dimension to medical praxis and knowledge. O’Connor (1995) asserted, “As both diagnostic aid and documentary device, the photograph was seen as depicting pure data; it seemed to perfect medicine’s emphasis on seeing, and so represented the ultimate form of scientific knowledge” (p. 546). Early proponents suggested that photography was not being deployed fast enough for the medical or health professions, as in this quote from the British medical journal, *Lancet*, in 1859: “We were, therefore, surprised, in passing through the rooms of the Photographic Society lately, to find so few photographs which had any bearing of what kind soever upon surgery, medicine, and the allied sciences. It is much to be regretted that the great resources of the photographic art — seen here in a hundred beautiful forms — have not yet been fully applied to the purposes of our art” (as cited in O’Connor, 1999).

Röntgen’s innovation of X-ray photography in 1895 became an instantaneous tool for the medical and health professions. “Every interested person who had access to the apparatus could and in fact did work with the X-rays in the early days, and no explicit rules were developed for the making and interpreting of the images” (Pasveer, 1989, p. 364). Photographers who were used to working with plates and chemicals, electricians who worked with electricity, and medical professionals who had knowledge of the body, partnered to advance the science of radiology. By 1910, various medical societies had begun to call for regulation and professionalization of the field as the ill effects of X-ray photography were exposed by iatrogenic illnesses and deaths. As early as 1898 Röntgen noted the ill effects of X-ray photography, yet it would be decades before medical practitioners would protect themselves and the public from X-ray photography (Pasveer, 1989).

Moving Pictures

At about the same time as the innovation of X-rays, Thomas Edison patented his apparatus for moving pictures. One of the first films seen by the public was ‘The Kiss.’ One critic said, “The spectacle of the prolonged pasturing on each other’s lips was beastly enough in life size on the stage, but magnified to gargantuan proportions and repeated three times over it is absolutely disgusting” (Grahame-Smith, 2005, p. 15). Alarmists said that children would so desire to see the movies that they would steal the price of admission, and watch scenes of criminality and debauchery, and then imitate what they saw in the films (Butters, 2007). This foretelling of sexually explicit materials into the next century would be balanced by the use of ‘moving pictures’ as educational tools, particularly regarding health and medicine (Haefner & Kirscht, 1970). Commercial films depicted struggles with diseases from syphilis in “Dr. Ehrlich’s Magic Bullet,” to poliomyelitis in “Sister Kenny,” to amyotrophic lateral sclerosis in “The Theory of Everything,” to epidemics in “The Seventh Seal.” Educational films promoting health have been used at all levels of public education, as well as in training health professionals (e.g. Bálint, Nagy and Csabai, 2014; Chi, Pickrell and Riedy, 2014). Educators, policy makers, marketers, entertainers, dictators and subversives have used films to entertain, educate, incite, and exploit—with health, health behavior, and health knowledge as key components. Commercial movies have provoked emotional responses to health issues, and in some cases, searches for more health information (Bonah & Laukötter, 2009).

20th Century Innovations

With the advent of the phonograph, the telephone, the radio, and television, some commentators condemned the technology because it was altering the way that people related to one another (Wartella & Jennings, 2000). One critic was the musical luminary John Philip Sousa who argued that the phonograph would diminish the vital capacity that people developed by singing. “With the phonograph vocal exercises will be out of vogue! Then what of the national throat? Will it not weaken? What of the national chest? Will it not shrink?” (McLuhan, 1964, p.

304). Sousa's fears were obviously unfounded. Critics of the telephone opined that it would break up home-life and the practice of visiting friends, and, that it "... penetrates and thus profanes all places; hence there are none in churches...institutional boundaries are incompatible with the universality, the irreverence, and the pugnacity of the telephone" (Fischer, 1994, p. 1). In contrast, the telephone was functioning as a lifeline to health with physicians telephoning patients' heart sounds to colleagues for consultation in the early 20th century, to dialing 911 today (Bashshur, Shannon, Krupinski, & Grigsby, 2013).

Radio was deemed harmful because of programs that depicted crime and violence, particularly in children's programs. Critics claimed it contributed to juvenile delinquency, providing youngsters with the techniques and motivation for criminal acts (Davis, 1976). More recently, Korea and Italy have pointed to increased cases of leukemia among people who live near AM radio transmitters, and among amateur radio operators (Milham, 1988; Park, Ha & Im, 2004).

Regarding the potential health benefits of radio, a study from the 1930s reported that, among teenage and adult radio listeners, food, toothpaste, and medicine were recalled as being promoted on the radio for their health benefits. However, Turner, Drenckhahn and Bates (1935) issued the caution, "The general lack of discrimination as to the reliability or unreliability of broadcast health advice shows the need for controlling health broadcasting and for instruction concerning pernicious advertising" (p. 594). Despite the warnings and broadcast misinformation, radio became an integral part of public health campaigns around the world for numerous of health issues, including nutrition, HPV vaccinations, drug abuse, blood donation, and HIV/AIDS prevention (e.g., Cates, Diehl, Crandell & Coyne-Beasley, 2014; Schroeder, 2016; Wakefield, Loken, & Hornik, 2010).

Critics had the same misgivings about television just a few decades after the introduction of broadcast radio. Detractors charged that there was too much crime and violence in television programming, and that TV-viewing children would turn to juvenile delinquency (Spigel, 1992). Some suggested that television would destroy childhood by the end of the 20th century (Postman, 1988). Despite the warnings and misgivings, television became an integral part of public health campaigns around the world for a variety of health topics. Television news and entertainment programs routinely air shows on health issues, from the factual to the fantastical. However, television contributes to viewers' sedentary lifestyle, which leads to obesity and its related health problems. Studies also suggest an association between watching television and body weight because the advertising for processed foods leads to an increased consumption of those foods (Boulos, Vikre, Oppenheimer, Chang, & Kanarek, 2012; Inoue, et al., 2012).

Another potentially detrimental effect of television on health is the steady stream of pharmaceutical advertising. In 2016, pharmaceutical companies spent over \$6.4 billion to advertise directly to U.S. consumers, using practices that could easily mislead the consumer about the efficacy of their medications and their side effects, or prompt consumers to request medication that is unnecessary. In 2015, the American Medical Association voted to support a ban on direct-to-consumer advertising (Mackey, 2016). The original intent of the FDA's guidelines that allow direct-to-consumer pharmaceutical advertising was to encourage consumers to seek additional information online and elsewhere (Chesnes & Jin, 2016; Horovitz & Appleby, 2017).

Critics warned that the radio was going to corrupt our youth, that the phonograph prompted immoral dancing, that the telephone encouraged too much familiarity, and that television meant that couples and families would no longer converse in the evening. To the extent that any of those things occurred, the alarmists' worst fears were confirmed, and anxieties about the negative impact of technology have continued.

The Internet and Digital Communication

Since the 1990s, the Internet has profoundly altered communication and people's access to health information. It is estimated that a third of the world's population is online, some two billion Internet users (Curran, Fenton, & Freedman, 2016). Observers have expressed concern that computerized communication is simply bad for us (Beninger, 1987; Crystal, 2008; Stoll, 1995). The World Wide Web is accessible to anyone who wants to self-publish any content they choose, including health advice (Lenhart, 2009). Like the printing press, it affords access, and can be threatening to those who want to preserve values, conserve social institutions, guard against differing views, and maintain existing hierarchies (Curran, Fenton, & Freedman, 2016; Schellekens & Prins, 2006). This near-universal ability to create and use online content has a significant impact on health.

It is possible to find sites that diagnose an illness based on self-perceived symptoms—and instantaneously direct the user to an on-line business selling dietary supplements, health devices, herbal remedies, non-regulated (and sometimes, regulated) medications, and licensed and non-licensed practitioners (Boulos, Brewer, Karimkhani, Buller & Dellavalle, 2014; Kellermann & Jones, 2013; Morlacchi, Szasz, Wade, Frew, & Smith, 2014; Van Deursen, 2012). Today 93% of young people under the age of 24 in the United States use the Internet (Lenhart, 2009). They seek and share information, opinions/advice about everything from relationships to sexually transmitted infections and celebrities, and publish content – from blogs to ‘YouTube’ videos, social networking profiles, fan fiction, and health advice (Lenhart, Arafeh, Smith, & Macgill, 2008). The Internet is used to connect with people in chatrooms, newsgroups, bulletin boards, social networking sites, online dating sites, ‘hook-up’ apps, and multi-player games on (Bonebrake, 2002; Cornwell & Lundgren, 2001; Elford, Bolding & Sherr, 2001).

As with the printing press, radio, and television, critics warn of the social ills that consumers have experienced and those that may yet come from the use of online communication. ‘Internet addiction’, mental illness, compulsive behavior, identity deception, child exploitation, infidelity, sexual assault and sexually transmitted infections are just some of the issues critics have posited within the ‘dark net’ of online and wireless communication (Cooper, Putnam, Planchon & Boies, 1999; Delmonico & Carnes, 1999; Finkelhor, Mitchell & Wolak, 2000; Griffiths, 1995; Klausner, Wolf, Fischer-Ponce, Ogilvie, 2001; Millner, 2008; Parsons, Severino, Grov, Bimbi, & Morgenstern, 2007). Critics suggest that today’s young people are less informed, less literate, more depressed, socially inept, and self-absorbed than previous generations because of their focus on their screens. Some scholars have argued that the more we interact through machines rather than directly with human beings, the more alienated and unfulfilled we become (Postman, 1992; Turkle, 2011; Zuboff, 1988).

Young people increasingly turn to the Internet for health, sex, and relationship information—while parents, policy makers, and child education and welfare professionals often seek to monitor and regulate the online content, particularly sexual content, that is available to youth (Heim, 1993; Stern & Handel, 2001). Critics warn that young people may develop a shallow or unhealthy understanding of sexuality and intimate relationships (Kraut, et al., 1998). However, there is research that suggests that the Internet is simply another tool for maintaining intimate relationships, and may in fact support healthy connections between partners (McGee, 2014). In generations past, most people met their mates in the neighborhood in which they were living, while today’s digital world is full of possibilities of finding a mate from anywhere in cyberspace. This new reality again prompts grim anxieties from some and optimistic excitement for others.

Seeking Health Information Online

Since the innovation of search engines in the 1990s, Internet users have increasingly used them to access information. Innumerable online searches are conducted each day by people seeking health information, advice, and diagnoses. While some of these searches yield accurate information, some are linked to a marketing source or to spurious health information, drugs/supplements, and other health products. As Julianne Filion posted on the Gebauer Company website in an article called, “4 Things You Should Know Before Googling Health Symptoms”: “Wikipedia is the sixth most popular website for medical information—and that’s a terrifying fact. Anyone can write and edit Wikipedia articles with wild abandon if they so choose. And even though Wikipedia has policies and guidelines in place to improve the publication, it does not require contributors to adhere to them. It doesn’t even require contributors to provide their real name, which means there is zero accountability for what gets modified or published” (Filion, 2016).

Some professionals have labeled a condition “cyberchondria,” identifying those whose fear of the unknown worsens as they seek answers about their symptoms on the internet. Many of these people wind up never seeing their health care provider because of their anxiety (Innes, 2013). Researchers have reported that the value of health information on the Internet is highly variable, and consumers seeking health information should view these resources with caution (Heffernan, 2014; Lin, Zhang, Song, & Omori, 2015; Miller & Bell, 2012; Weaver, Thompson, Weaver, & Hopkins, 2009).

The New York Times reported that some health websites provide the visitor with more flash than reliable substance. For instance, “With the site’s (admitted) connections to pharmaceutical and other companies, WebMD has become permeated with pseudo medicine and subtle misinformation” (Heffernan, 2014). There are over 70,000 health websites on the World Wide Web, and 50 million U.S. consumers seek health information online, with 59 percent of adults in the United States seeking information in a given year, so this is a potentially significant problem (Cline & Haynes, 2001; Fox & Duggan, 2013).

In the U.S., among adults who have diagnosed themselves by using an online search, only 41 percent of their diagnoses were confirmed by a health care professional (Fox & Duggan, 2013).

Among college students there are a variety of reasons to seek health information online. For many of them, living on campus is the first time they are separated from their primary care provider, often their family physician. College students frequently first turn to online health information rather than college health services or their primary care provider for health information and diagnosis. A major factor in their decision to go on-line for health concerns is the nature of the concern, with sexually transmitted infections, alcohol and drug use/abuse, and unplanned pregnancies being the most common (Percheski & Hargittai, 2011).

In a study of 743 undergraduate students, 74 percent of them reported having received health information online, and more than 40 percent reported that they frequently searched the Internet for health information (e.g., Escoffery, et al., 2005, Fox & Duggan, 2013; Tong, Raynor, & Aslani, 2014). Internet access can also challenge individuals who have poor health literacy or with cognitive disabilities. They may not possess the skills to effectively navigate the Internet for health and medical information or referral (Sharma & Kaur, 2016). Non-compliant patients who refuse or discontinue treatment or medical advice from healthcare professionals spend more time researching diseases, illnesses, and treatments on the Internet. They may place greater significance on health information obtained from the mass media or social media than on their providers (Weaver, Thompson, Weaver, & Hopkins, 2009). Misleading or poorly targeted online information may result in deficient treatment choices or undiagnosed illnesses. Additionally, a surplus of inaccurate or ineffective information may lead to avoidable anxiety or preventable morbidity and mortality for patients (Baker, Wagner, Singer & Bundorf, 2003; Wald, Dube & Anthony, 2007).

On the positive side, health consumers who use the Internet tend to explore health topics with greater rigor and from more varied sources (Risk & Petersen, 2002). Based on the information found online, patients tend to ask their providers more informed questions when they see them (Murray, et al., 2003). Health websites can also assist providers to connect information-seeking users to the services they need through online ads and Internet links (Sharma & Kaur, 2016). Access to online health information supports practitioner-patient communication and relationships by increasing patients' health literacy. Further, some research suggests that consumers who seek health information online report that they learn through the process and are more likely to visit a health professional (Suziedelyte, 2012; Wald, Dube & Anthony, 2007).

Some analysts contend that the Internet has caused a shift in the experience of illness from private to public, as patients go online to seek other patients with the same diagnosis, and share treatments, resources, and support (Conrad, Bandini & Vasquez, 2016). Their experience of their illness or condition becomes part of a public forum shared in online support groups, chat rooms and in social media. While this activity can be of great value to consumers, it can also lead to highly subjective advice that may circumvent effective treatments. A 2016 study of nearly 15,000 adults looked at the relationship between sources of health information and perceived health status. The results showed that, "Health information from the Internet and pharmaceutical companies was significantly associated with better health status, whereas information from social media, health care apps, news outlets, and health care companies was not" (Bounsanga Voss, Crum & Hung, 2016). It appears that seeking health information leads to mixed outcomes, depending on the sources of the information.

It is clear that given the volume of health information on the Internet, there is a need to attend to the quality and legitimacy of the information, products, and practitioners being promoted. Currently there is no system or agency directly responsible for vetting the health and medical information accessible on the Internet (Cline & Haynes, 2011). Given the democracy of the World Wide Web, and the ardent advocates for more or less oversight, this debate is likely to continue. There are consumer friendly websites that have adopted explicit quality control guidelines that apply to the information they publish. These guidelines vet sponsorships of health information for accuracy. Nevertheless, the best advice to visitors to these sites is, 'buyer beware' (LaValley, Kiviniemi, & Gage-Bouchard, 2016).

The impact of the repeal of the "net neutrality" policy is yet to be seen. The neutrality policy was intended to prevent corporate Internet providers from speeding up, slowing down or blocking any content, applications or websites, based on fees paid to the providers. There has been concern that some people may face barriers to accessing health information, that telehealth providers may lack bandwidth to provide effective services, and that the new technologies with fitness and health trackers may be limited in their ability to communicate with some health care providers (Spitzer, 2017).

Some suggest that only the larger medical companies would be able to afford taking advantage of broader bandwidth, while low-income Americans with chronic illnesses like diabetes may actually have fewer options for health care services or be forced to rely on more expensive companies that offer telehealth services (Mukherjee, 2017).

Telemedicine/tele health

The use of technology to remotely diagnose, treat, and monitor patients is commonly known as telemedicine or telehealth. It has been around in one form or another for decades. While the societal response to telemedicine was initially curious and cautious, it has become increasingly positive (Bashshur, Shannon, Krupinski, & Grigsby, 2013; Gumpert, 2015). Each of the communication innovations has contributed to telemedicine—from the printed word disseminating health and medical information, to X-ray photographs identifying closed wound bone fractures, to the telephone transmitting heart sounds and electrocardiograms. It is now commonplace for medical practitioners to care for their patients over vast distances via video calls, closed circuit television, texts, smart phone applications, email, and wireless apparatus (Ramos, 2010). Television, moving pictures, and the Internet are all part of telemedical practice today, as are smart phone cameras, digital stethoscopes, ophthalmoscopes, otoscopes, vital sign monitoring devices (e.g., blood pressure cuff, pulse oximeter, and weight scale, all with wireless routers), and wearable biosensors (Lyuboslavsky, 2015). Today health care consumers routinely use advanced communications technologies. These can positively influence consumers' health by allowing them to efficiently communicate and interact with medical professionals and in turn gain knowledge about their health concerns. Patients routinely use these communication technologies to schedule/cancel offices appointments, obtain test results, or to confer and learn about their conditions.

As with previous communication innovations, there are advocates and critics of telemedicine. The chief concern about telemedicine is the loss of the personal touch and face-to-face contact between health care provider and patient (Lyuboslavsky, 2015). Web companies that offer telemedicine services to patients recognize that some people may not want to receive care from a random doctor that they will never meet face-to-face. Nevertheless, companies like Teladoc, Doctor on Demand, and American Well conducted 1.2 million virtual doctor visits in 2016, an increase of 20 percent over the previous year (Beck, 2016). The assumption is that the use of technology for telemedicine will continue to increase, as three quarters of large employers offered virtual doctor visits in 2016, as compared to 48 percent in 2015 (Beck, 2016).

Nonetheless, there is a concern that health conditions cannot be effectively evaluated by a clinician who is in another location, and is unable to feel for swollen glands, listen to the heart, or palpate the abdomen. What happens when a misdiagnosis occurs? A study published in *JAMA Dermatology* showed that physicians could get it wrong in virtual visits (Resneck, et al., 2016). They regularly failed to ask simple relevant questions and diagnostic performance was poor. Major diagnoses were repeatedly missed, including secondary syphilis, eczema herpeticum, gram-negative folliculitis, and polycystic ovarian syndrome. Regardless of the diagnoses given, treatments prescribed were sometimes at odds with existing guidelines (p. 1774).

The authors of the study did recognize the limitation that there was no control to determine if the telemedicine clinicians would have performed any better in person. However, while medical histories are standard procedure for in-person clinician office visits; this was not the case for virtual visits in this study population. Telemedicine continues to be of concern of consumers, medical practitioners, and third-party insurers in that telemedicine may be less trustworthy, less effective, and more expensive than conventional health care.

One example of telemedicine's promise in action is Mercy Health System's Virtual Care System, located in St. Louis, that provides remote care for intensive care units, emergency departments, and other programs in 38 smaller hospitals around the country. In 2015 the ICUs they monitored saw a 35 percent decrease in the average length of a patient's stay, and 30 percent fewer deaths than expected (Beck, 2016). Various other studies have examined the effects of telemedicine in veterans' administration medical centers in the treatment of PTSD, genetic services for rural populations, and collaborative care in the treatment of depression. In each of these, the outcomes have been better with telemedicine than with control groups who did not use the remote technology (Fortney, et al., 2013; Fortney, et al., 2015; Hilgart, Hayward, Coles, & Iredale, 2012). There is growing evidence that telemedicine improves health, patient satisfaction, access to care, and reduces costs.

Conclusions

Every innovation in communication technology over the last 700 years has had an impact on the health and well-being of society. Integrating technology into our lives requires mastering the caution that challenges innovation for the social good against the accommodation for social adjustment. What has changed is that communication innovations of the past often afforded society decades to adjust, while the innovations of the present, like the Internet, afford us scant time to adapt. In 2017, chief operating officers from 100 technology companies met to discuss the future of digital information. They realized the challenge was not creating new technology, but rather creating a society that can adapt to change. IBM's Jon Iwata was quoted as saying, "Culture is the number one impediment...Culture moves in a linear way; technology moves exponentially" (Murray, 2017).

The management of information, particularly health information, has shifted from centuries past when only the privileged few could read and write, to the majority of literate people today who have access to the Internet. In turn, society's adjustment to advancing communication technologies is not only a matter of the channel or platform. Society's responsibility is to work toward integrity of the health information made available by advancing communication innovations.

To this end, we are hopeful that purveyors of health information and practice who publish on any new or existing communications platform will be held accountable to standards that are ethical, scientific, and evidence-based. In this way, the health consumer will be able to judge the quality of the information based on facts and best practice, and make informed decisions about their care.

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