

In the increasingly wired world of healthcare, there are hundreds of technologies designed to improve patient care and ease the workload of healthcare providers. The proliferation of information and communications technologies over the past five years has been overwhelming. Yet the rate of adoption of some of these technologies has been slow.

The introduction of new technologies has always represented an uneasy shift. Welcomed by some, it has been rejected by others who see it as disrupting the accustomed way of doing things and creating new demands.

I am a firm believer that the past can offer many insights to those who are trying to introduce new ideas or concepts. Therefore, to better understand the factors influencing the uptake of new technologies it is helpful to look back in time. Looking at the printing press, the telegraph, the radio, the automobile, the telephone, the fax machine, the cell phone, the Internet, and the World Wide Web, we asked some key questions. What were the conditions that permitted the adoption of technology? What was the pace at which technologies were dispersed, and why? What role did the government play?

What is a disruptive technology?

Most new technology is self-sustaining and improves performance along dimensions that the mainstream customers in major markets have historically valued. By contrast, **disruptive technologies** typically have worse performance, at least in the near term. But:

- They have features that a few fringe and generally new customers value and which represent a key source of competitive value in the future;
- Products based on them are typically cheaper, simpler, smaller and frequently more convenient to use - often representing a new product architecture.
- They often bring a new and different value proposition.

(Adapted from The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail by Clayton Christensen)

Applying an analytical framework to the adoption of nine significant technologies from our past allows us to observe key elements and uncover lessons from history that may hold true for the adoption of healthcare technology today.

There's no question that these "disruptive" technologies have changed the way we work. But from the printing press to the telephone, the telegraph to the World Wide Web, this analysis



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LESSONS FROM THE PAST: How Other Disruptive Technologies Became Mainstream

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In *Diffusion of Innovation* (1995), Everett Rogers defines the five following attributes as being important variables in determining how fast a technology is adopted:

Relative Advantage: the degree to which an innovation is perceived as better than the idea it supersedes

Compatibility: the degree to which an innovation is perceived as consistent with existing values, past experiences, and needs of potential users

Complexity: the degree to which an innovation is perceived as relatively difficult to use and understand

Trialability: the degree to which an innovation may be experimented with on a limited basis

Observability: the degree to which the results of an innovation are visible to others

identifies the common attributes and conditions which determine how fast a technology is adopted, how quickly it is diffused, and how well it is received.

To begin, is the technology perceived as being better than the idea that preceded it, thereby having a *relative advantage*? Is it *compatible* with existing values, needs, and past experiences? What about *complexity* — how difficult is it to learn, understand and use? Can the idea be piloted, on a limited basis, to demonstrate its *trialability*? And finally, can the results be *observed* by those who may use it or be affected?

These are the attributes that determine how successful an innovation will be. But what about the conditions which can nudge a technology along and get the ball rolling? Several variables seem essential to the successful uptake of technology: *providing an infrastructure, finding a function, establishing the right price point, and becoming a necessity.*

Change takes time

In a world where we have become impatient with delays and accustomed to rapid change, the slow embrace of new technologies can be frustrating, but we shouldn't be surprised, or discouraged. It has always been that way, despite the pervasive belief that change is instantaneous.

Take the telephone. We are so dependent on this technology it is difficult to imagine that when it was first introduced in 1877, people had to be convinced that it was useful. Despite its simple design and seemingly obvious value, it took 75 years for the

telephone to reach 50 million users, and it wasn't until the 1960s that users saw a residential phone as a necessity.

Even the printing press, with its obvious advantage over laborious copying by hand, was not an instant success. Although the technology was seized on quickly by the Protestant Church, which encouraged literacy, it took centuries for the technology to be used for a mass publication newspaper — the New York Sun took to the streets on September 3, 1833, more than 300 years after Gutenberg invented the first printing press.

The printing press has important parallels to today's revolution in information technologies. Like the Internet, it suddenly made information available to many more people, and the increase in the spread of information led to confusion and mis-information. Different scientific and religious theories appeared simultaneously — which one was right? There was no peer review necessary to publish, no infrastructure in place to regulate the publishing industry.

The healthcare community and patients themselves face similar issues as medical information proliferates on the Net. Whose research is correct? Which is credible? How can people sort out the truth from the quackery? Many patients believe it would help if they received medical information online from their own doctors, someone they could trust.

The diffusion of the telegraph was somewhat faster than the printing press. Samuel Morse presented his prototype of the electric

Comparison: Rates of Diffusion

Although it's difficult to define exactly when a technology is fully “diffused”, it is interesting to compare how quickly technologies were adopted.

The printing press: 400 years following its invention it was finally used to reach a wide public audience with the publication of the first mass newspaper in 1833.

The automobile: 75 years from the introduction of the first internal combustion engine in 1885 to the point of market saturation in 1960

The telephone: 85 years from 1876 when Bell applied for his patent to full saturation in the 1960s

The fax machine: 144 years from its invention in 1843 to 1987, when enough people were using fax machines for it to make sense for everyone to get one

The Internet: 30 years, from 1968 to mid-2000 when an estimated 130 million Americans had access to the Internet

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telegraph to the US Congress in 1838, and by 1873 Western Union had carried more than twelve million messages. One of the reasons for the telegraph’s rapid success was the creation of the infrastructure which supported it — reliable connections, cheap and predictable rates, and a shared language. Common standards and a high degree of inter-operability made the telegraph a relatively easy sell.

But what about more recent technologies? It took five decades for the telephone to reach 10 per cent of U.S. households, but it took only five years for the Web to do the same. In fact, the Internet has reached 330 million users in only 30 years, arguably the fastest diffusion rate in history.

This is partly because the Internet *builds on an existing communications infrastructure*, and its speed and efficiency are easily observed. In the case of the Internet and the Web, users can develop their own functions, and generate their own content. These decentralized conditions allowed technology to spread quickly.

So what can we learn from these experiences, and how can we apply this knowledge to the health sector?

FROM STRUCTURE AND FUNCTION TO NECESSITY

One of the most important lessons is the importance of providing the critical underpinnings that will support a technology as it attempts to break new ground. This infrastructure varies, from the entire political and social structure, as with the printing press, to the regulatory environment in the case of the telegraph, the telephone and the radio.

For technologies to succeed, they must also find their function, sometimes creating a need where none existed before. With technologies that basically did the same thing, only faster, like the printing press or the fax machine, function wasn’t really an issue. But the social function of the residential telephone was largely ignored by industry for the first half of its history.

What we can deduce from this is that frequently the consumer determines the use of a technology, not the inventor, the vendor, or the marketer. This is especially true of technologies like the Internet and the Web.

Finding the right price is another important variable, although it would seem an obvious one.

And finally, while it may take decades to get there, any new technology must eventually be seen as a necessity. It must become part of the everyday way of doing things, as “invisible” and as vital. It’s hard to remember life before “What’s your e-mail address?”

Cheaper, faster ... better?

For many sectors, such as manufacturing and retail, the main contribution of information technologies has been to provide cheaper, faster handling of information. In other words, nothing particularly new, just a better way of doing it. A good example is the banking industry. For the cost of opening a branch to serve a single neighbourhood, a bank can set up a web site accessible to more than

15 million households. Cheaper, faster, an obvious function, and a ready-made infrastructure.

But most sectors share similar problems. Introducing a new technology can be a complex process, and it takes both time and effort to change the way people work.

There are also issues of security and privacy— a key issue in the transmission of sensitive information.

Ironically, many sectors have found out that word-of-mouth is one of the most effective ways of persuading people to try out a new technology. Opinion leaders who act as champions play a key role in getting it adopted and creating a demand.

Applying the old to the new

By applying the analytical framework and deriving the lessons of history and the experiences of other sectors, we can shed light on how we expect the medical community to adopt information technologies, and on the role the government can play in making it work.

The government has frequently regulated a new technology, or created the rules that allow commerce to take place fairly. But the government has also played a larger role by developing appropriate policies for technology’s use and distribution, by providing strategic funding, and by showcasing their own use of technology.

The government can also act as a catalyst. Apparently even the most skeptical critics of the telegraph were convinced of its advantages when the successful nominees at a United States’ Whig National Convention, transmitted by telegraph, were announced to the crowd 64 minutes before the list arrived by train. It was the U.S. Congress that paid for the first of Morse’s telegraph lines.

There’s no question that the computerization of health data and the emergence of information technologies has created unprecedented opportunities for providing better health care services. But, like any other sector, and as with any new technology, the medical community has to be convinced the new way is better than the old. Remember relative advantage?

The Brookings Task Force on the Internet concluded that the US healthcare system could significantly reduce their costs by using the Internet to handle information faster and cheaper. Nothing new, but better. Other studies of information technologies applied to healthcare have shown that the benefits could include improved management of patient-care delivery, improved access to information, reduced medical and medication errors, more timely care, and a better quality of life for chronically-ill patients.

Information technologies applied to healthcare also stand a better chance at succeeding if they are *compatible* with the medical culture. For example, more than 50 per cent of US physicians use wireless or handheld devices — a technology that fits comfortably into the working environment of hospitals. Government-funded sector councils can be pro-active in this area, making sure that the design, development and marketing of healthcare technologies takes the healthcare provider’s needs into account.

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For many in the health care system, the time crunch is a genuine barrier to the adoption of new technologies. So, the less complex the technology, the more likely it is to succeed. For health workers already struggling with the demands of paperwork, one more thing to learn can seem like too much.

Of course sometimes a technology is perceived to be complex, when it really isn't, and here is where extensive *trials and demonstrations* can be useful. Tips and lessons on how to use a technology can be spread throughout a healthcare organization by an on-site “e-vangelist”, someone within the organization who can also offer useful feedback to government.

The communication of the lessons learned from trial runs is a vital step in getting technology accepted. The government can use e-services directly to communicate with the health care sector, using technologies such as online conferencing. Outsourcing can also provide an excellent trial run for healthcare technologies — for example, one online platform service where patients log on and pay by credit card for prescription renewals, non-urgent medical advice, sick notes etc, has already been picked up by hundreds of physicians.

It's one thing to try a technology out, another to have it observed. Successful examples of information technologies being used in health care need to be promoted at all conferences, symposia and workshops, as well as models of the government's own success in using them. Marketing strategies can also make use of the mainstream and specialized press to get the message out, increasing public profile. Healthcare opinion leaders and champions must also speak up, widening the net of influence and acceptance.

Creating the right conditions

So far, the lessons on how certain attributes contribute to the adoption of technology apply as much to telemedicine as they did to the telephone or the automobile. But what about the essential conditions: *providing the infrastructure, finding a function, finding the right price and becoming a necessity?*

A significant legal and policy issue for the healthcare sector is privacy, and this is one of the most critical areas for government policy. Medical data is a sensitive area. Canadians will need to be reassured that the information technology used here is secure and reliable, before a corresponding infrastructure can be provided.

In addition, as with the telegraph, there also needs to be a common language, and standard definitions for data. The significance of this kind of infrastructure was borne out by the experience of the big three automakers in the US, who created the Automotive Industry Action Group to standardize processes. This group also started the Manufacturing Assembly Pilot Program, which ensured that everyone involved spoke the same language.

With earlier technologies, function was king. But with healthcare technologies today, who determines the function? The patient. According to the Toronto Star, most Canadians want online communications with their care providers, while most providers do not. For physicians and other health workers, it's probably a question of time. For patients, it's a matter of convenience. But it's

this interaction that will likely determine the ultimate function of e-mail in the healthcare setting.

The right price point is also a key condition for technology's success, and this applies as much today as it did a hundred years ago. Faced with tight budgets and a wide variety of competing innovations, the healthcare sector will certainly take price into consideration when considering the adoption of technology.

And finally, new technology must become a necessity. In the case of the Internet, the patient is determining what healthcare services will become essential. Some 84 per cent of Canadians who reported using the Internet in 2001 said they would like online access to their doctor to ask general health or education questions. In another survey, 62 per cent said they would also like to go online to make appointments or renew prescriptions.

The medical community is not averse to new technology, but they need to see and understand how it fits into the way they work, without disrupting the care of patients. Take the automobile, a technology that was quickly embraced by doctors who saw it as a better, faster way to reach the patients who needed them.

But if a laptop takes four minutes to boot up, and a doctor has only seven minutes with his first patient, the old hand-scribbled medical chart is going to seem like a more efficient way to enter patient information. Perhaps the key lies in integrating new technologies with established practices? For example, wired personal digital assistants can help doctors retrieve medical records quickly while they're consulting with their patients, and avoid mistakes in filling prescriptions that may be hard to read.

There are hundreds of examples, and the healthcare community needs to be selective in deciding which technologies work, and which don't. Their value must be clear, and where the function is patient care, there is a natural low tolerance for risk.

To sum up, if there is one vital lesson we have learned from the experiences of the past, it is this: change takes time. Solutions need to incubate, but we have discovered that as technologies are introduced, there are ways to influence the rate at which they are adopted. Governments, health care workers, patients themselves all have an active role to play in this process, especially in our increasingly inter-connected world. The rewards of this involvement will be an improved healthcare system, and better health for Canadians.

