Chapter 1

Descriptions of Telehealth and Telemedicine

The Origins of Telehealth and Telemedicine

Telemedicine—which can be thought of generally as the use of technology to enable remote health care—arose in the 1960s, driven in large part by the need of the U.S. aerospace and defense industry to innovate around space exploration and the use of space-based communications. Indeed, the National Aeronautics and Space Administration (NASA) faced a very significant problem—how to provide medical services to astronauts in space. Specifically:

medical personnel at the Mission Control Center at Johnson Space Center (JSC) in Houston needed to be able to monitor astronauts’ biomedical responses because they were in extreme and remote environments . . . during Space Shuttle missions . . . [necessitating] daily private medical conferences with the crew surgeon on Earth. Physiological parameters including heart rate, oxygen consumption, heat production and suit carbon dioxide levels, and environmental parameters [were also] monitored by the biomedical team at JSC via biotelemetry.¹

NASA continues to invest in telemedicine to advance the capability of delivering medical services in remote places (see Figure 1.1), but the focus has “expanded beyond the original mandate of . . . remote communication to encompass new ‘smart medical systems’ that are designed not simply to communicate and diagnose ill astronauts—but also to provide physicians on the ground with the ability to remotely provide limited treatment options.”

Figure 1.1: From JSC’s Experimental Planning and Operations Center, Dr. Michael DeBakey (right) talked with the crew and saw a demonstration of the remote telesurgery experiments in the Aquarius underwater lab off the coast of Florida.

As a result, “[t]elemedicine, in its modern form, started in the 1960s in large part driven by the military and space technology sectors, as well as a few individuals using readily available commercial equipment.”

Organizations such as the U.S. Department of Agriculture (USDA), the U.S. Department of Health and Human Services (DHHS) (specifically the National Library of Medicine [NLM]), NASA, the U.S. Army’s Telemedicine and Advanced Technology Research Center and the Veterans Administration are but a few of the agencies or departments that have been involved in the development and support of telehealth and telemedicine.5

Today, NASA still partners with academic institutions and the private sector to build smart medical systems and improve telemedicine. One important NASA strategic partnership is the National Space Biomedical Research Institute (NSBRI), a nonprofit scientific organization comprised of 12 public and private universities, “whose scientists and physicians are developing technologies to provide medical monitoring, diagnosis and treatment in the extreme environments that will be faced during exploration missions.”6 Some of the scientific research from NSBRI is commercialized for public use. For example, NSBRI contributed to the development of new portable ultrasound technologies in 2012, providing more accurate diagnosis and direct high-intensity focused ultrasound waves to stop internal bleeding without having to resort to invasive procedures.7 (See Figure 1.2.) This innovative ultrasound technology could be applied to astronauts in space to stop internal bleeding or to patients on Earth “where surgical access is limited and patients might otherwise die from traumatic injuries involving damage to internal organs or tissues.”8 NASA’s work with NSBRI and others to develop technologies that “meet the medical needs of astronauts has resulted in a tremendous flurry of innovations that have helped” beyond the confines of future human spaceflight.9

7. Id.
8. Id.
9. Id.
Figure 1.2: A portable ultrasound device is being developed that could one day be used to find and treat ailments using noninvasive surgical treatments. The device generates heat inside the body with pinpoint accuracy to stop bleeding or kill unwanted tissue such as tumors.*


The beneficiaries of NASA’s early investment in telemedicine run the gamut from sister government departments, such as the Department of Defense, the Department of Veterans Affairs, and the DHHS and the constituencies they serve, to nonprofit and for-profit hospitals and the patients they serve. After decades of telemedicine research and development both inside and outside of government, combined with the growth and availability of the Internet, a critical mass of users are now able to remotely communicate and exchange information with health care providers. For example, the advent of mobile technologies such as smartphones and tablets enables patients to conduct face-to-face consultations in real time with physicians or other providers, something that more than 40 years ago required NASA-level skills and investment.
Defining Telehealth, Telemedicine, and mHealth

What Is Telehealth?
Telehealth refers to a broad spectrum of capabilities typically thought to be related to the advancement of health and wellness generally using telecommunications tools. Telemedicine, a subcategory of telehealth, by comparison, is the provision of medical services using telecommunication tools.

The DHHS Health Resources and Services Administration (HRSA) describes telehealth as “the use of electronic information and telecommunications technologies to support long-distance clinical healthcare, patient and professional health-related education, public health, and health administration.” However, the term “telehealth” does not typically refer to services by a physician such as diagnosing, treating, or prescribing. This is the key distinction between the terms “telemedicine” and “telehealth.”

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<th>What Is Telehealth?</th>
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<td>Telehealth is defined as the use of technology to deliver healthcare, health information, or health education. “Telehealth” is an all-inclusive term for telemedicine and mHealth. Communication takes place synchronously—in “real time”—through videoconferencing, for example, or asynchronously—“store-and-forward”—through e-mail, for example. Store-and-forward technology enables “electronic transmission of medical information, such as digital images, documents, and pre-recorded videos through secure email transmission.”</td>
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As Figure 1.3 illustrates, the term “telehealth” is defined differently across federal government agencies. Nonetheless, most of the definitions share certain core characteristics such as (1) delivery of nonclinical care through the use of telecommunication technologies; (2) outreach to rural or remote individuals and communities; and (3) ability to monitor and/or manage patients with chronic diseases.

Figure 1.3: Definitions of Telehealth and Telemedicine from Federal Agencies/Departments

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<th>Agency/Office</th>
<th>Definition</th>
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<tr>
<td>1 USDA</td>
<td>Technologies, such as electronic information and telecommunications, that ensure the availability of quality healthcare service, education and healthcare information to rural America.</td>
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<td>2 DOC/NIST</td>
<td>Uses ATA’s definitions: Telemedicine and telehealth both describe the use of medical information exchanged from one site to another via electronic communications to improve patients’ health status. Telemedicine is sometimes associated with direct patient clinical services and telehealth sometimes associated with a broader definition of remote healthcare and is sometimes also perceived to be more focused on other health-related services.</td>
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<tr>
<td>3 DoD</td>
<td>T2: the use of electronic information and telecommunications technologies to support long-distance clinical healthcare, patient and professional health-related education, public health and health administration</td>
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<tr>
<td>4 FCC</td>
<td>Often used as a synonym for e-care, but includes nonclinical practices such as continuing medical education and nursing call centers. E-care is the electronic exchange of information - data, images and video – to aid in the practice of medicine and advanced analysis. Encompasses technologies that enable video consultation, remote monitoring and image transmission (“store and forward”) over fixed or mobile networks.</td>
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<tr>
<td>5 NASA</td>
<td>Telemedicine is the interactive transmission of medical images and data to provide better healthcare for people in remote or “medically underserved” locations.</td>
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<td>6 VA</td>
<td>“The wider application of care and case management principles to the delivery of healthcare services using health informatics, disease management, and telehealth technologies to facilitate access to care and improve the health of designated individuals and populations with the intent of providing the right care in the right place at the right time.”</td>
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What Is Telemedicine?

There is no single, commonly agreed-upon definition for “telemedicine.” Indeed, a World Health Organization (WHO) study found 104 peer-reviewed definitions of the word.\textsuperscript{13} WHO defines telemedicine as:

\begin{quote}
[t]he delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis,
\end{quote}

treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interest of advancing the health of individuals and their communities. Though there are many different definitions, telemedicine is generally characterized by the following:

- Geographic separation between two or more people or entities engaged in the practice of medicine;
- Use of telecommunications to gather, store, and disseminate clinical-related information; and
- Use of technologies to assess, diagnose, and treat medical conditions.

The American Telemedicine Association (ATA) simplifies the WHO definition and describes telemedicine as “the use of medical information exchanged from one site to another via electronic communications to improve a patient’s clinical health status.” Electronic communications include “two-way video, email, smart phones, wireless tools and other forms of telecommunications technology.” The ATA notes “telemedicine is closely allied with the term ‘health information technology’ (HIT); however, HIT more commonly refers to electronic medical records and related information systems while telemedicine refers to the actual delivery of remote health services using technology.” For example, a nurse practitioner from a CVS Minute Clinic utilizes HIT when using an iPad and a secure Internet website to upload and e-mail a patient’s influenza vaccination record to his general practitioner to include in the patient’s electronic health record (EHR).

14. Id. at 9.
17. Id.
What Is Telemedicine?

Telemedicine facilitates patient-to-provider communication and provider-to-provider communication. Synchronous telemedicine closely resembles a typical clinic visit except the patient and provider are not in the same location. This real-time experience is on the rise as more and more patients turn to mobile devices, such as iPads and smart phones, to connect with providers and receive healthcare services.


Similarly, the Institute of Medicine (IOM) defines telemedicine as “the use of electronic information and communications technologies to provide and support healthcare when distance separates participants.”19 The IOM goes on to describe telemedicine as “a large and very heterogeneous collection of clinical practices, technologies, and organizational arrangements” rather than a single technology.20 According to BCC Research, the global telemedicine market reached $13.8 billion in 2012 and an estimated $16.1 billion in 2013, and it is expected to reach $35.1 billion in 2018.21

Although the terms “telemedicine” and “telehealth” are often used interchangeably, there is a difference between them. Namely, the term “telehealth” “is sometimes used to refer to a broader definition of remote healthcare that does not always involve clinical services,” whereas the term “telemedicine” always involves clinical services.22 For example, using a workout app on a mobile device is an example of telehealth. The workout app allows the user to follow an exercise regime but does not offer clinical services.

20. Id.
What Is Mobile Health (mHealth)?

Mobile health (mHealth) is an established, growing application of telemedicine and telehealth using mobile devices. According to the Foundation for the National Institutes of Health, a public charity established by Congress in 1990, mHealth is “the delivery of healthcare services via mobile communication devices.”\(^{23}\) The U.S. Department of Veterans Affairs defines mHealth in terms of “providing technologies that . . . expand care beyond the traditional office visit” and include “secure applications (Apps) that . . . leverage the popularity of wireless technologies to support Veterans and VA care teams.”\(^{24}\) “MHealth” is a term that refers to the use of telecommunication devices to store and, if enabled, wirelessly transfer data to a third party, such as a mobile phone. Some mHealth devices are capable of transferring data to health care providers in regular, timely intervals. For example, some wirelessly enabled pacemakers provide data daily to a patient’s provider. This technology allows for more accurate patient monitoring and creates a rich data source for analysis.

On the other hand, some mobile devices are designed for consumers and do not have a provider or clinical application. They are primarily designed for health and wellness. Wireless fitness and activity monitoring devices, such as a Fitbit or Jawbone UP, fall within the scope of the mHealth subset of telehealth because they are mobile devices primarily used for patient education. The mHealth fitness and activity monitoring space—also called “wearable technology”—is rapidly growing. Wearable technology includes products such as:

- Smart glasses/goggles; ring/finger worn scanners; foot-wear such as [“smart”] athletic, fitness & sports shoes; wrist-wear such as advanced electronic watches and wrist-bands; and others (such as head-bands and neck-wear) along with the upcoming “smart textiles” and the yet to commercialize (expected in 2016) “e-textiles.”\(^{25}\)

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