Clinical Examination Component of Telemedicine, Telehealth, mHealth, and Connected Health Medical Practices

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KEYWORDS

- Telemedicine • Telehealth • mHealth • eHealth • Connected health
- Direct-to-consumer telehealth care

KEY POINTS

- Telemedicine and telehealth involves performing several clinical tests on patients at a distance.
- Video conferencing is often used for telemedicine clinical examinations.
- Many clinical tests are performed at a distance using special medical devices referred to as telemedicine peripherals (eg, electronic stethoscopes, tele-ophthalmoscopes, video-otoscopes, and so forth).
- Telemedicine peripherals can expand and enhance some clinical examinations and, in the future, may even become the standard of care for in-person clinical encounters.
- Some conventional clinical examination tests, such as palpation of the liver, are not currently amenable to telemedicine.

INTRODUCTION

A century ago, the great academic physicians of the day achieved fame based on their remarkable bedside diagnostic skills.[1] These observation-based clinical examination

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tests (or signs) often bore the names of their creators[2(P650)] and became standard components of in-person clinical examinations. In the twenty-first century, many of these tests can be performed at a distance through telemedicine.[3–7]

Traditional in-person clinical examination tests and their telemedicine counterparts have similar performance characteristics.[3–10] In some clinical settings, the conventional examination's performance might even be improved by integrating a telemedicine peripheral, such as an electronic stethoscope, to aid in data acquisition and interpretation.

Evolution of Telemedicine, Telehealth, eHealth, and Direct-to-Consumer Telehealth Clinical Practices

Teleradiology and tele-psychiatry were among the earliest telemedicine applications. Although the roots of telemedicine date quite far back, the modern era of telemedicine[11] started in 1968, when the Massachusetts General Hospital (MGH) bundled these and other services together into the first hospital-based multispecialty telemedicine practice that offered remote clinical examinations to travelers and airport workers at Logan International Airport. An assortment of ill airline passengers in transit and largely healthy airport workers needing annual physical examinations entered the MGH telemedicine system near gate 23 at the airport. The MGH tele-physicians were stationed 2.7 miles away near the MGH side of the Callahan Tunnel that linked the airport to downtown Boston.[12] Over the next decade, more than 1000 patients received telemedicine clinical examinations through the MGH service. This effort was a high-profile endeavor that had visibility in popular US magazines (**Fig. 1**) and inspired dozens of telemedicine programs around the world.[12]

For unclear reasons, most of these programs disappeared by 1980, leading to a decade hiatus in telemedicine activities. The telemedicine industry was jump-started again in the early 1990s and has undergone continuous growth and refinement in terms of implementation and practice as well as development of a taxonomy framework for research.[12,13] The reasons for this rebound are multidimensional; but some of the key factors include the development and rapid expansion of the Internet, increase in digital communication technologies (especially the smartphone), and, more recently, the reduction in the cost of technologies that drive telemedicine innovations.

Millions of patients around the world have received telemedicine and telehealth services from thousands of providers. In recent years, investments in start-up telemedicine service companies have skyrocketed. Thousands of hospitals are outsourcing selected gap services (eg, nighttime and weekend coverage by teleradiology) and urgent services (eg, tele-stroke services).[4] Direct-to-consumer telemedicine and telehealth services are a more recent entrant into the marketplace. The direct-to-consumer market includes in-store telehealth-enabled primary care services, typically delivered at pharmacies or big box stores; walk-in clinics; as well as services delivered directly to patients through the Internet or mobile devices. Typically, these patient-targeted services deliver a defined set of primary care services directly to patients, at the venue of their choice, and at low, fixed prices. Some evidence suggests that direct-to-consumer telehealth may increase utilization and health care spending by increasing access and convenience. A recent review[14] analyzed commercial claims data from more than 300,000 patients over a 3-year period on direct-to-consumer utilization and spending for acute respiratory illnesses. Ironically, the actual per-episode cost of a telehealth visit was lower than a comparable in-person visit; but the overall convenience resulted in greater use of care, thus, overall making telemedicine potentially more costly. It is important to note that this study did not examine the long-term impact of telemedicine, which might, for example, reduce more expensive health care

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