Telemedicine: Its Past, Present and Future

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Abstract

The concept of Telemedicine is nearly 100 years old as demonstrated in an early US magazine depiction of the "Radio Doctor" in 1924. Later in the 1960s, innovative physicians leveraged available emerging telecommunications technology and adapted clinical protocols to pilot medical applications that addressed real-world challenges in patient access for remote populations. Health Plan investments and advancements in mobile and network technology enabled limited scale telehealth services direct to consumers in the early twenty-first century. Prior to 2020, adoption was low and targeted. It was restricted by payer payment policy, state and federal medical/health privacy regulations and provider limited acceptance. That all changed with the global emergency declarations resulting from COVID19 pandemic starting in early 2020 when health safety concerns by consumers, first responders and healthcare workers created transformational telehealth adoption. Restrictive regulations and payment barriers were waived, and telehealth demand exploded. Now that patient, provider and payer telehealth benefits have been exposed and partially realized, multispecialty, scalable telehealth services have reached the tipping point for increased enterprise investment, innovation and broadscale adoption going forward.

Looking beyond 2021 there will be greater emphasis on optimized consumer health, wellness and seamless, local and remote, patient-centered *integrated* care for the sick and injured. Telemedicine, telehealth, digital health analytics, standards-based medical sensors and system automation technology advancements will enable improved, timely, scalable patient self-care and augmented, specialist to remote primary care and/or care giver *capabilities* and *capacity*.

Keywords

Telehealth · Telemedicine · Virtual care Virtual visit · Digital health · Machine learning · Autonomous systems and COVID19

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Learning objective:

- Differentiate telemedicine use before and after the pandemic.
- List some common successful specialties for telemedicine.
- Analyze the clinical practice guidelines for telemedicine from the American Telemedicine Association.

9.1 Introduction

9.1.1 Brief History of Telemedicine

The concept of Telemedicine may have originated in the April 1924 issue of **Radio News**, Fig. 9.1 which depicted a REMOTE doctor interactively evaluating a child's throat with family members looking on from a **video "radio"** screen with a large speaker, multiple adjustment dials and a paper recorder. This was decades ahead of its time and before the enabling network and technology was feasible.

Early audio/video point-to-point telecommunication links became possible in the 1960s. NASA, as well other early telemedicine pioneers from academic medical centers demonstrated early clinical pilots with their "advanced" telecommunications technology and adapted clinical protocols as depicted in Figs. 9.2 and 9.3.

In Fig. 9.3, innovative physicians led early proof-of-concept demonstrations using available off-the-shelf television camera technology to address their current medical challenges in projecting their medical expertise and clinical assessment over time and distance. This original MGH telemedicine project avoided lost travel time in traffic for hospital physicians evaluating and treating patients from the Boston Logan Airport medical clinic.

As desktop computing, telecommunication networks and compact digital audio/video camera technology matured, clinical champions developed more advanced telemedicine pilots. In the mid-1990s this first wave of practical, provider-to-provider telemedicine services supported **remote, underserved patient populations on a limited scale** (*high value, but low volume*). This exploration was expanded by significant investments by the federal government (VA, DoD, and HHS with HRSA grants) over the next two decades.

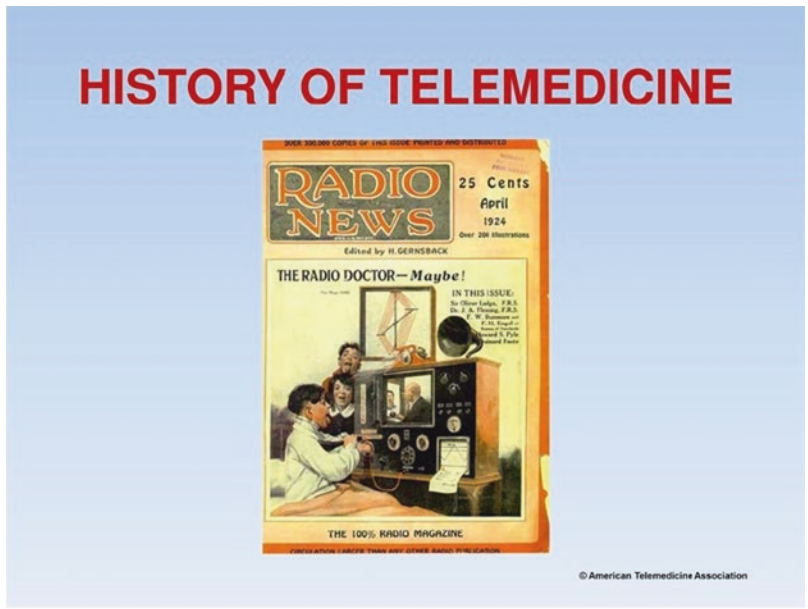


Fig. 9.1 Radio news cover

Courtesy of Jonathan D. Linkous, CEO American Telemedicine Association

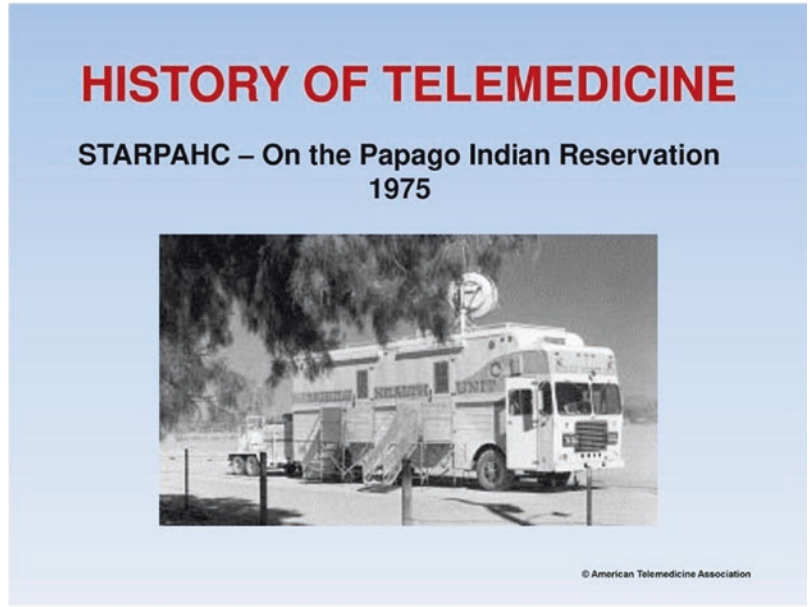


Fig. 9.2 NASA mobile health unit circa 1960s

Courtesy of Jonathan D. Linkous, CEO American Telemedicine Association

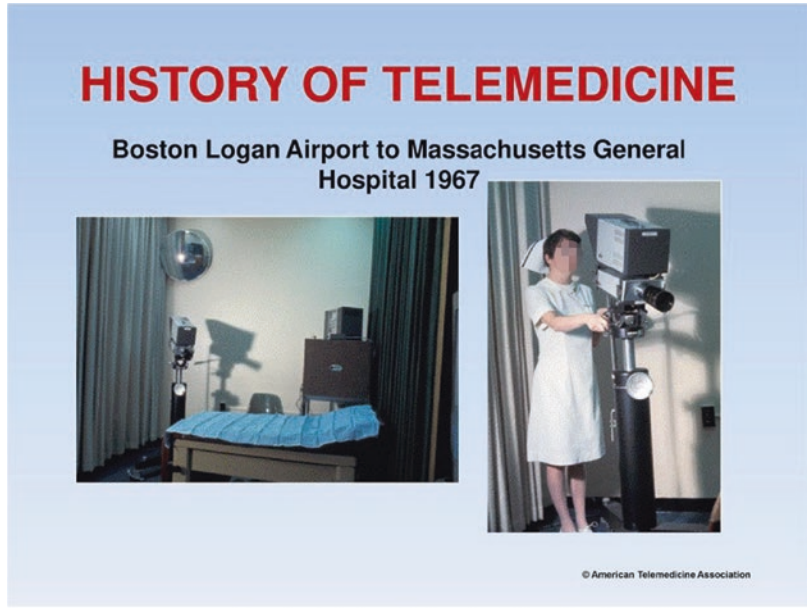


Fig. 9.3 Telemedicine in 1967 at Boston Logan Airport

Courtesy of Jonathan D. Linkous, CEO American Telemedicine Association

As the more affordable Internet, mobile devices and more advanced compact digital imaging tools emerged, direct-to-consumer telehealth services emerged, supported by funding from healthcare payers for selected patients with defined minor acute and chronic medical conditions. This second wave of telehealth innovation was motivated by **reducing managed care costs and improving patient access to timely primary care and specialty healthcare services** thereby avoiding more costly acute emergency department, urgent care, or inpatient healthcare alternative expenses.

Prior to February 2020, telemedicine and telehealth services slowly, but incrementally increased by single digit adoption based increasingly on consumer awareness, demand and trust; a small number of targeted grant-funded **projects** which were clinical champion led with limited support staffing or institutional financial investment; poorly aligned payer financial incentives; and significant state and federal regulatory barriers that impeded mainstream expansion of these proven telemedicine and telehealth delivery models.

During this 25-year exploratory period (1995–2020) of the first and second wave of telemedicine and telehealth there were important foundational lessons learned which will fuel the rapid growth and advancement in 2021 and beyond.

1. **Telemedicine and Telehealth works**—many pilots have shown that with adequate advanced planning, training, communication, multi-disciplinary support and thoughtful execution—patients, providers, and payers all benefit from improved timely access, quality and affordable healthcare.
2. **There must be a medical need identified**—successful projects require a pre-existing health or medical benefit identified up front which is supported by a documented clinical, operational, and sustainable financial business case in advance of execution
3. **Enterprise Governance is key**—telemedicine and telehealth **PROGRAMS** require central, top down strategic leadership, defined measures of effectiveness, programmatic ongoing reporting and oversight, and adequate staff and financial resources
4. **Projects require Program tactical support to scale—**consistent, central multi-disciplinary staffing support and standardization across service lines enable sustainable growth
5. **Measurement and reporting are critical to quality assurance**—each project business case must include pre-defined goals, objectives, and key performance indicators
6. **Standardization leads to increase productivity, efficiency, and lower cost**—clinical protocols, training, technical support, regulatory compliance, communication/marketing, technology/network infrastructure, data sharing and seamless workflows should be centrally coordinated
7. **Innovation originates from the operators**—advancements in new use cases, projects and improved workflows come from providers and patients near the point of service
8. **Patient trust and provider professional bonding drive adoption**—transparency for accountability for patient privacy and evidence of professional credibility are important for program growth
9. **Clinical and operational documentation is foundational**—accurate, timely and structured medical documentation and coding are critical for optimal reimbursement and accountability
10. **Alignment of incentives leads to sustainable growth**—financial, operational, and professional alignment of incentives enhances adoption and program expansion (new service lines)

9.2 Telemedicine and Telehealth Before the 2020 COVID-19 Pandemic

9.2.1 Provider-to-Provider Telemedicine Services

Hub (remote limited number of medical specialists) and **spoke** (many local primary care practitioners/first responders) networks, provider-to-provider telemedicine clinical services have incrementally developed over the past two decades improving access to specialty care for undeserved patient populations from distant, remote locations (e.g. ships at sea, space, south pole), in remote rural communities from critical access hospitals/clinics and in dense urban centers with limited and time-sensitive requirements for augmented sub-specialty care.

The rate of adoption has been hampered by dated state and federal regulatory barriers, payer reimbursement policy mis-aligned for positive telehealth incentives, overworked providers with current in-person care (limited capacity for telehealth), variable provider trust/quality concerns, inefficient workflows and resistance to change from existing provider-centered convenient delivery models.

Some of the most common successful specialties for telemedicine services prior to 2020:

- Tele-radiology—one of the first specialties in telemedicine, starting in 1960s.
- Tele-stroke (neurology)—expedited treatment for patients with acute stroke
- Tele-critical care—from the ICU, NICU and Emergency Department
- Tele-behavioral health—psychiatry, psychology, and social services
- Tele-dermatology—at home and remote inpatient consultation
- Tele-ophthalmology and optometry—screening patients with possible diabetic retinopathy
- Tele-orthopedics—at home follow-up and remote inpatient consultation
- Tele-burn—remote assessment and treatment follow-up
- Tele-ENT—clinic or inpatient remote endoscopy
- Tele-nephrology—remote monitoring patients with renal failure and on dialysis
- Tele-obstetrics—at home and remote inpatient consultation
- Tele-oncology—at home follow-up, remote inpatient consultation, tumor boards, 2nd opinions
- Tele-pathology—remote interpretation of the digital slide or remote microscopy
- Tele-rehabilitation—post-op or medical follow up treatment at home and remote consultation

The **American Telemedicine Association** has published clinical practice guidelines available from their website for many of these adopted telemedicine and telehealth medical applications (https://www.americantelemed.org/resource_categories/practice-guidelines/).

In addition to these medical specialties or clinical condition-based applications, there are examples of proven educational and clinical support use cases such as:

- Tele-medical grand rounds
- Tele-tumor boards
- Tele-second opinion clinical conferences
- Tele-morbidity and mortality conferences
- Tele-mentoring/supervision for surgical subspecialists in the OR for cost-effective training

Finally, there have been innovative telemedicine special case delivery models which have enhanced timely patient access

- **Reverse Telemedicine** where a circuit rider specialist travels to a remote location to perform clinical procedures and continues to follow his primary site patient's remotely online when his/her schedule permits.
- **Spoke (distributed Primary Care) and Hub (Online Specialists) network** of community-based health system hospitals and clinics that contract for online clinical services only (without their technology—hardware and software) from professional service organizations (PSO's). The spoke network leverages their modular platform primary care telemedicine infrastructure to contract for multi-specialty clinical services with the incremental and duplicative cost of additional single service line technology. This more efficient upfront technology investment strategy by the spoke network reduces cost of training, maintenance, health information technology system interfaces and support over time. It also incentivizes the spoke sites to incrementally employ specialists to support their distributed network at a lower cost and transition from contracted PSO clinical contracted services to workload balanced services internally.
- **Infectious Disease isolation room telemedicine**—increase local health provider safety,

improve timely access to remote specialists and reduce need for costly PPE.
- **Strategic value of Tele-education** application such as Grand Rounds as a tool to increase provider adoption and build relationships and trust by enhancing professional bonding of local and remote medical professionals. It also improves and maintains user familiarity with the technology during pre-go live or periods of low utilization.

9.2.2 Direct-to-Consumer Telehealth Services

Recent technology advancements of mobile devices, smart phones and tablets; with their respective applications stores; affordable network bandwidth; increasing targeted reimbursement by payers to avoid more costly in-person care and growing consumer trust has spurred the growth of consumer telehealth over the past decade. Despite the increasing body of evidence supporting the value and safety of this virtual delivery model the incremental adoption has only represented single digit percent volume of ambulatory patient visits during this near term pre-2020 period.

According to 2000 primary care physicians surveyed before the 2020 COVID-19 pandemic the top ten applications for direct to consumer telemedicine services included a range of bundle concierge online services for fee paying patients for convenient access, patients with acute minor conditions, others with chronic conditions requiring follow up or medication renewals, enhanced pediatric after-hours access and post-acute follow up for medical and surgical patients. This category also includes standalone remote patient monitoring nursing services supported by federal, state, and private payers to avoid emergency room and inpatient readmissions after an acute exacerbation for patients with chronic conditions or a new medical diagnosis.

This national survey further concluded that 57% of physicians were willing to conduct video visits with their patients. Just 12% of physicians were unwilling to see a patient over video, while 31% remained uncertain.

The top 10 uses physicians indicated telemedicine can provide. Respondents could choose more than one response.

1. **Concierge services for fee paying patients**: 91%
2. **Medication management/prescription renewal**: 86%
3. **Minor urgent care (i.e. pink eye, fevers)**: 85%
4. **Birth control counseling**: 83%
5. **Home health care**: 82%
6. **Chronic condition management**: 80%
7. **Pediatric after-hours needs**: 79%
8. **Behavioral health**: 77%
9. **Post-hospital discharge**: 73%
10. **Post-surgical follow-up**: 59%

This was a 2016 survey conducted in collaboration with QuantiaMD. Source: Becker's Health IT: https://www.beckershospitalreview.com/healthcare-information-technology/10-top-uses-for-telemedicine-according-to-physicians.html

9.3 Telemedicine and Telehealth During the 2020 COVID-19 Pandemic

9.3.1 The Challenge to Adopt and Scale Telehealth During "Fog of War"

The 2020 COVID-19 pandemic was transformational for many hospitals and healthcare systems. The scale and scope of temporary regulatory and reimbursement waivers made under the national and state Emergency Declarations were unprecedented. Elective medical procedures were cancelled or delayed. Medical staff were furloughed due to lost reimbursement of elective procedures. Online telehealth visits replaced clinic and emergency room visits when possible. But the sudden transition from 11% virtual visits to over 60% in less than a month was challenging for the entire healthcare leadership and workforce. This sud-

den and unexpected medical crisis exposed a lack of enterprise governance, planning, training, and infrastructure to accommodate this rapid change in delivery models.

Prior to March 2020, most telemedicine and telehealth initiatives were project based, led by a departmental champion, funded by grants, or limited targeted payer reimbursement requiring special clinical coding modifiers and supporting EHR documentation to limit overuse of telehealth services. Workflows and clinical data were often siloed and not integrated in the daily clinician workflows. State medical licensure, local definitions of telemedicine services, federal dated regulations and reimbursement policy had been a barrier to innovation and growth of widespread telehealth services in the United States.

Announcements of federal and state regulatory and payer reimbursement copay waivers created initial confusion and poor alignment of policy needed to incentivize early adoption of telehealth services directly to consumers. This crisis exposed the lack of contingency readiness to implement the necessary changes. However, legitimate concerns for patient timely access to critical health services, the viral infection transmission risk for patients, first responders and health workers from COVID-19 and the limited access to the required personal protective equipment by first responders and health workers was a major driver for rapid adoption of telehealth delivery models over the following months. Consumers were forced to socially distance and transition to online video services for work when possible, education and entertainment as the US economy was shut down. The telecommunication providers had to scramble to rapidly expand capacity orders of magnitude to accommodate this sudden transition to online commerce and communication. Healthcare was competing for bandwidth, infrastructure, and technology to scale these mission critical services. The lack of enterprise program governance in hospitals and health systems made this transition to online healthcare difficult, costly and in some cases limited in quality. Many providers had to resort to telephone online services because of their lack of readiness with video technology and user training at the scale needed, adding thousands of users from a baseline of less than 20 in some cases.

A few advanced health systems were able to successfully scale their pre-pandemic telemedicine and telehealth services having a pre-existing enterprise program office with dedicated multidisciplinary stakeholders for planning, training, and executing these remote clinical services. Organizational governance; standardized and integrated technology and reporting metrics; dedicated support staff; well-defined clinical protocols; and a scalable, sustainable business case were all critical success factors in making this unplanned transformation over a few weeks rather than several months.

9.4 Telehealth After the 2020 COVID-19 Pandemic

9.4.1 Emergence of Telehealth Programs: Convergence of Telehealth Projects

As providers, clinics, hospitals, health systems, payers and patients recover from the financial and operational disruptions created by the pandemic healthcare crisis over the next year or two, telehealth providers and administrators will now have a seat at the table with a new mission critical role in planning for the future new normal. Based on lessons learned, prior pre-pandemic projects will converge into enterprise programs with the clinical oversight, administrative support and business discipline required for sustainable growth and quality assurance. These institutional cross-departmental healthcare services could benefit from organizational models adopted by other healthcare ancillary services (such as medical imaging, laboratory, or pharmacy).

As illustrated in the KPMG, LLP diagram below in Fig. 9.4 there are proven critical success factors than enable hospitals and health systems to incremental scale, extend and sustain telemedicine and telehealth service lines leveraging common governance, staff, technology, and infrastructure. This enterprise programmatic approach to leverage shared resources and stan-

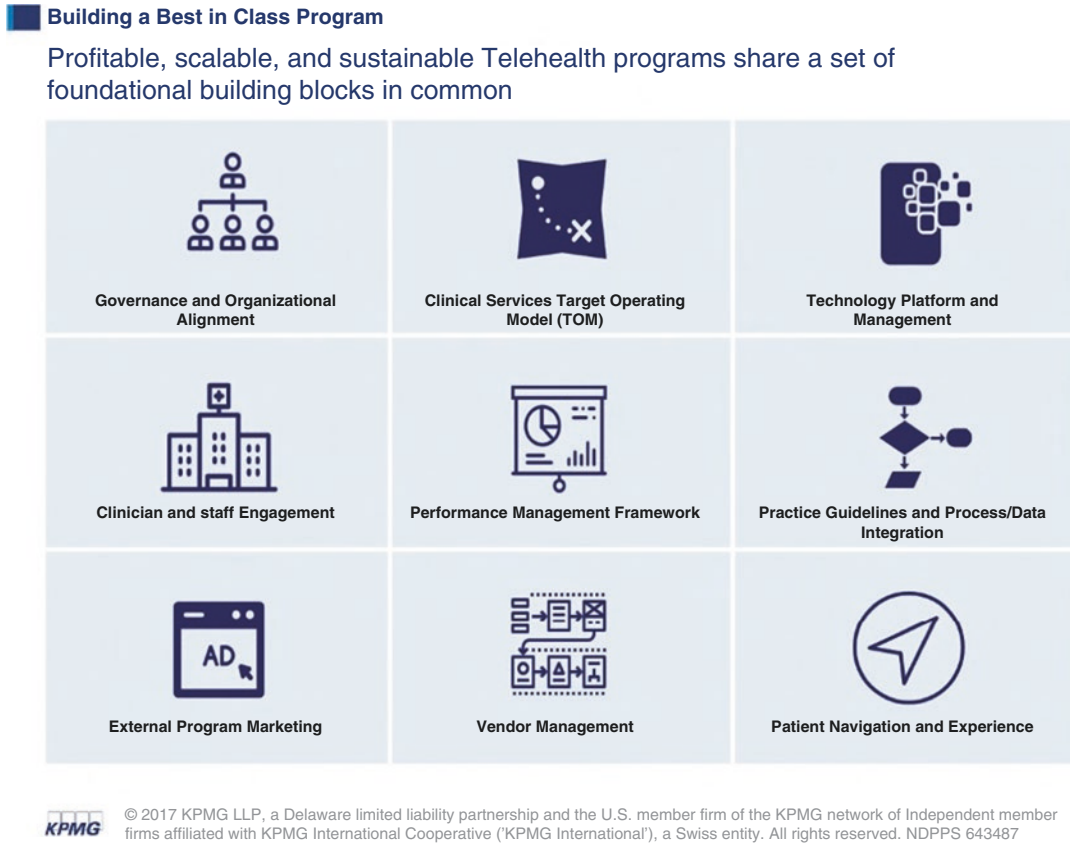


Fig. 9.4 Telemedicine program critical success factors

dardize operational and clinical protocols, share data, interoperable technology and reliable and timely support is key to affordable and scalable growth of virtual care services.

Of the nine critical success factors, the top three most important are the enterprise governance and organizational strategic alignment; clinical protocols and workflows; and integrated technology platform management. The ViTel Net telehealth modular platform design shown in Fig. 9.5 is an example of how existing investments in health information technology (HIT) can be incorporated into an integrated telehealth service delivery model with share data and workflows. Maturity of these three foundational components represent the key difference between temporary and siloed telehealth projects and a sustainable and extensible telehealth innovation program. To achieve the full potential of scalable, broad adoption of telemedicine and telehealth services going forward healthcare providers and payers will make investments in governance (see Fig. 9.6), clinical leadership, and shared and integrated modular platform technology. In Fig. 9.7, there is an example of workflow standardization based on service line clinical guidelines.

9.4.2 Critical Components in Telehealth Program Design

The KPMG information contained above in Figs. 9.4, 9.6 and 9.7 is of a general nature and is not intended to address the specific circumstances of any particular individual or entity. For additional news and information, please visit KPMG at https://home.kpmg/us/en/home.html.

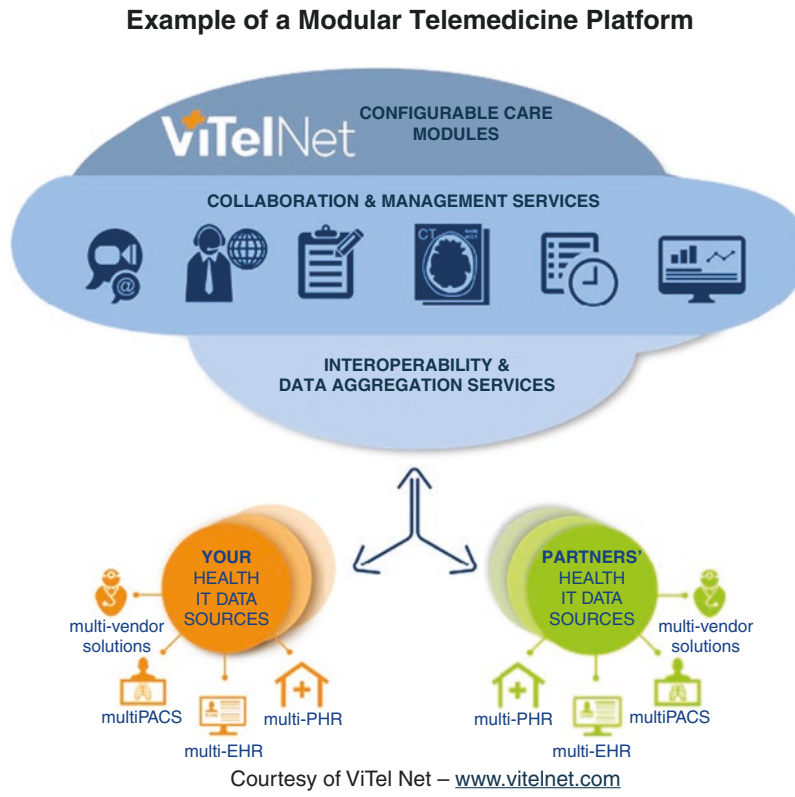


Fig. 9.5 Example of a telemedicine platform design

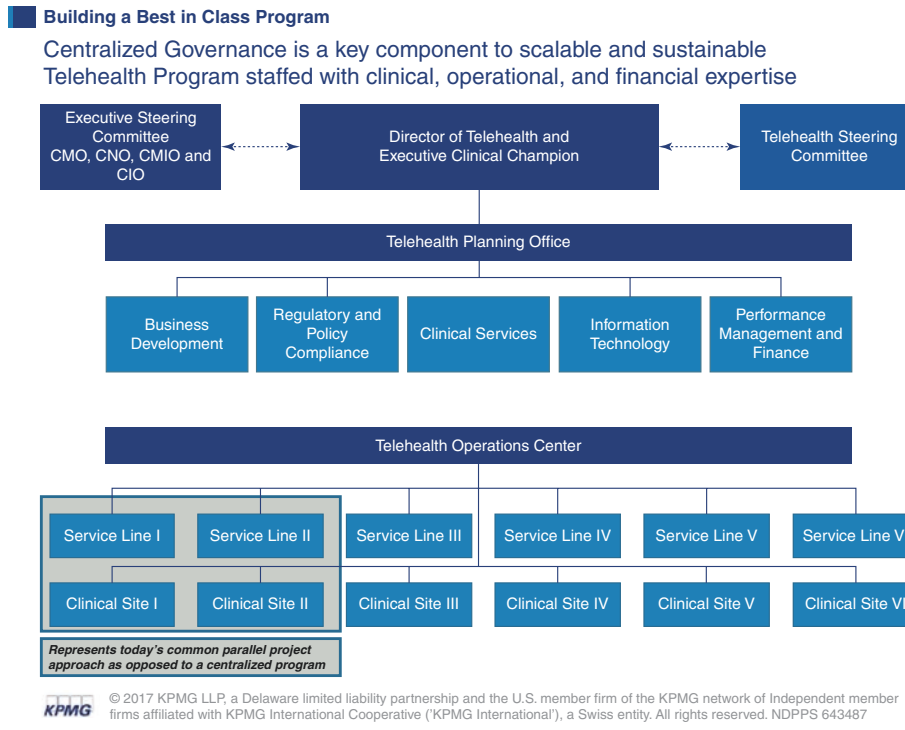


Fig. 9.6 Example of a telemedicine program governance structure

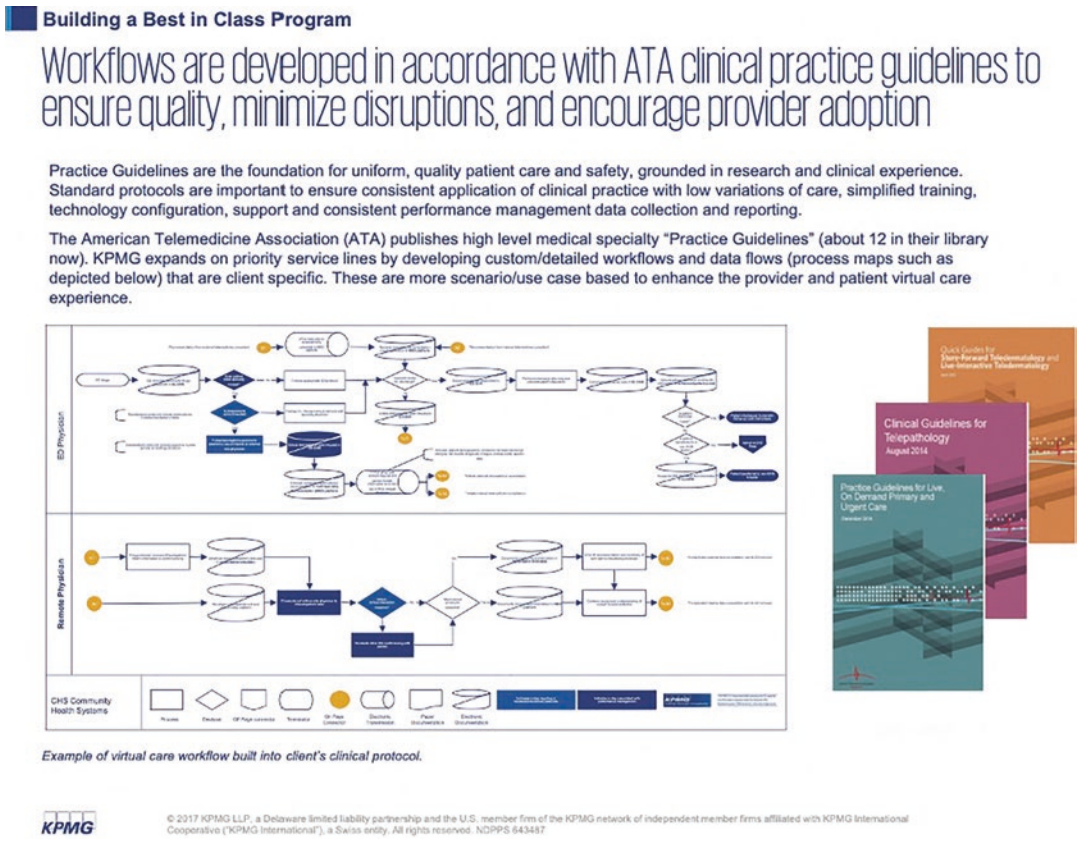
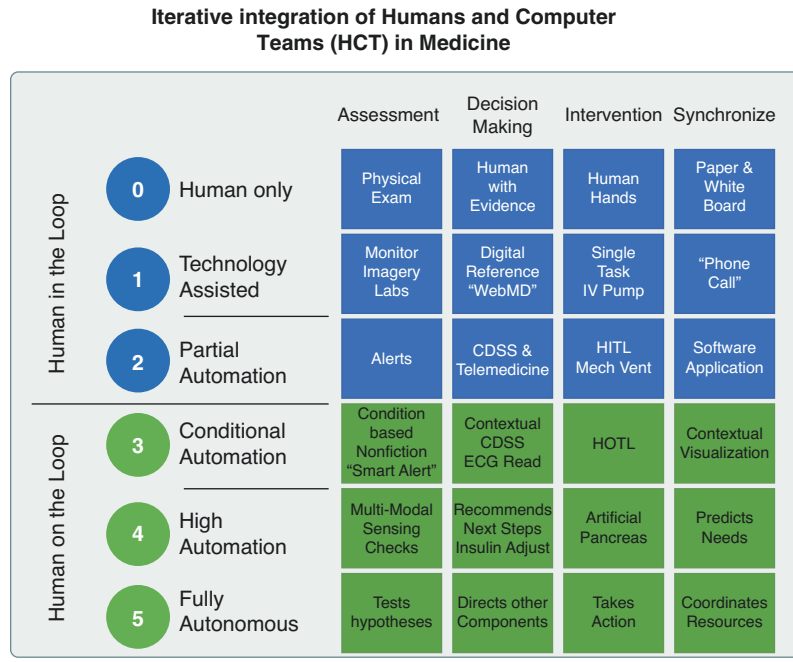


Fig. 9.7 Example of a Telemedicine Process Map and Guidelines

Fig. 9.9 Example of envisioned medical automation levels



Courtesy of COL Jermy C. Pamplin, US Army, Director, TATRC, (http://www.tatrc.org)

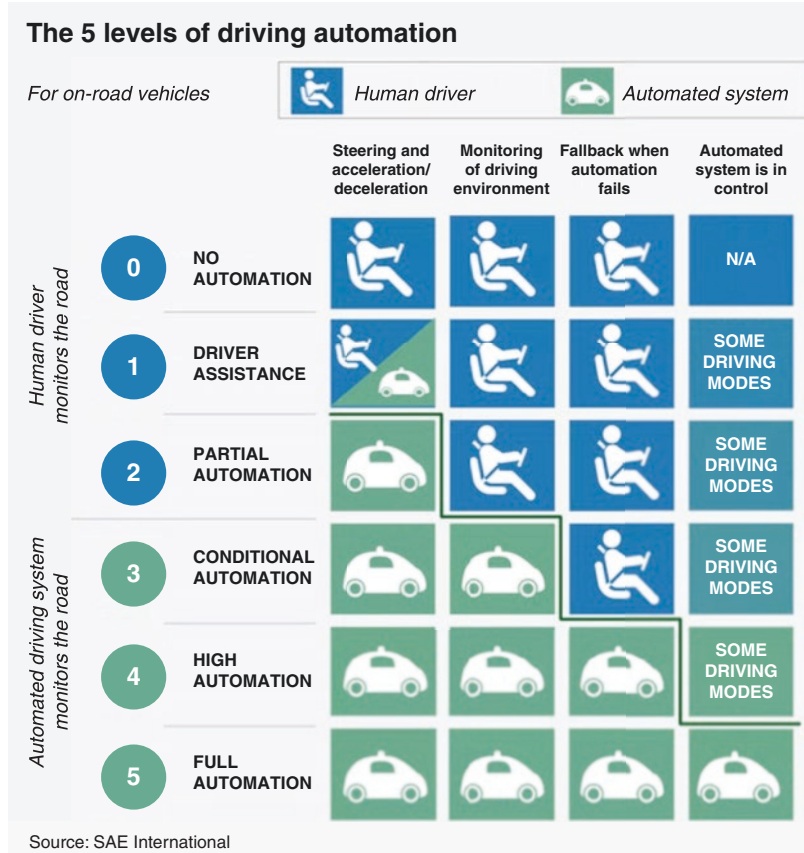


Fig. 9.8 Automotive industry levels of automation

9.5 Future Directions and Innovation in Telehealth in the Future

As healthcare providers invest, standardize, and leverage existing advanced HIT and digital technology in telehealth, governments and industry are investing in the next generation of telehealth and telemedicine capabilities for the future. This next wave of virtual care innovation will focus on interoperability of medical devices and sensors; automation and autonomous systems; and artificial intelligence, machine learning and predictive analytics. As shown in Fig. 9.8, the automotive model for incremental automation to advance from manual, human drivers to autonomous computer system driven cars can be a guide for future healthcare or medical incremental transformation toward autonomous closed loop clinical systems as shown in Fig. 9.9. The US Army Telemedicine and Advanced Technology Research Center (TATRC, https://www.tatrc.org/www/about/) has sponsored this advanced research in making this aspirational vision a reality.

In summary prior to 2020 Telemedicine project objectives were focused on improving patient clinical access, projecting medical specialist expertise to providers of remote underserved populations, reducing healthcare avoidable costs just as unnecessary early readmissions or emergency room visits and treating patients where they are, thereby enhancing timely patient access, clinical quality and payer value.

Looking forward to 2021 and beyond there will be greater emphasis on consumer health optimization and seamless, local and remote, patient-centered *integrated* care for the sick and injured. Telemedicine, telehealth and digital health information automation technology advancements in the future will enable enhanced patient self-care and augmented remote care giver ***capabilities*** **and** ***capacity*** using existing

medical devices and sensors with software adapters and increased adoption of existing interoperability software standards such as **ICE** (*integrated clinical environment*, http://www.mdpnp.org/mdice.html) and the complementary **MDIRA** (*medical device interoperability reference architecture*, https://secwww.jhuapl.edu/mdira).

Future telemedicine scenarios will drive investment in new medical devices and sensors which will be compliant "out of the box" with these interoperability standards leading to efficient, affordable, contextual and incremental deployment of advanced closed loop autonomous systems, use of big data and artificial intelligence which will transform our national and global health systems expanding their scale, scope, and capacity of our current day limitations of healthcare delivery.