Telehealth innovation

Current directions and future opportunities

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Current Directions and Future Opportunities

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TABLE OF CONTENTS

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INTRODUCTION

Telehealth reflects a dynamic and evolving field of practice in terms of applications, settings, and users as a result of advances in underlying enabling technologies. Today, forces as diverse as large-scale humanitarian crises, national healthcare reforms, healthcare workforce shortages, and a growing burden of chronic disease underscore the growing importance of technology-enabled models of care delivery that can facilitate remote access to healthcare services at scale. As a result, telehealth has become one of the fastest-growing service areas in the healthcare sector, and a tipping point in its more widespread diffusion throughout the health system is believed to be at hand.

Telehealth supports the delivery of healthcare, public health, and health education services at a distance, as well as provides a *collaboratory* platform for sharing knowledge and expertise and engaging communities in participatory research. Further, regardless of whether care services are delivered in-person or virtually, there is broad agreement that telehealth should not be viewed as representing a different type of healthcare. Instead, telehealth represents a different method of delivery for services that can be either similar in scope or supplemental to those that are provided during in-person encounters. As a result, both should be held to the same quality and practice standards and not be subject to regulatory distinctions between them.

For telehealth to realize its full potential to transform healthcare delivery at a system level a complete redesign of the care delivery process from a physical to virtual model is urgently called for. Although it is anticipated that telehealth applications will continue to evolve as developments in enabling technologies take place, key to the translation of telehealth innovations into practice at scale and on a sustained basis is 1) the availability of use cases that clearly identify the problem or need that is being addressed as well as benefits that may be realized through telehealth, 2) a supportive enabling market infrastructure for promoting market adoption and diffusion, and 3) evidence of cost-effectiveness and best practices for informing successful implementation at scale.

Telehealth represents both a model for care delivery and a business model for managing care. Both need to be coupled for telehealth to work effectively in practice. Doing so can promote successful adoption, implementation and integration at scale. This review identified a lack of research evidence around business cases, particularly those that focus on value creation or explore opportunities for value co-production among all stakeholders as a key barrier to adoption at scale. Advancing research in areas of health service innovation and value creation will help to advance service business models that are critical for sustaining telehealth at scale.

BACKGROUND

Definition

The lack of a standard nomenclature when referring to the delivery of care at a distance highlights the open and continuously evolving nature of the field of telehealth. At its core telehealth refers to the use of information and telecommunications technologies for facilitating the delivery of healthcare, public health, and health education services at a distance, across a variety of settings, and involving diverse users. Telehealth also supports the engagement of communities in collaborative or community-based participatory research. .[1] [2] [3] [4] [5] [6] [7] [8]

Today, telehealth encompasses four distinct service modalities:

1. Store-and-Forward
2. Live and Interactive Video
3. Remote Patient Monitoring
4. Patient Engagement Mobile Apps

These service modalities support the remote delivery of a broad range of applications, primarily in out-patient settings and often involving direct interaction between consumers and providers. However, instead of each modality relying on unique, distinct technology platforms, advances in areas such as mobile communications and cloud computing are increasingly rendering distinctions between the service modalities obsolete in terms of the underlying technology platforms through which those interventions may be delivered and accessed.

It is conceivable that in the not too distant future the prefix ‘tele’ will gradually fade from use as the technology-enabled elements for the remote delivery of health services become seamlessly integrated into healthcare delivery systems to the extent that telehealth will become the standard for the way that healthcare services are delivered and accessed. To realize that outcome will, however, rely on research to advance innovative service intervention designs and business models, as well as practices that can support healthcare organizations with the adoption, implementation and spread of telehealth interventions at scale.

[1] http://www.americantelemed.org/about/about-telemedicine
[2] https://www.hrsa.gov/ruralhealth/telehealth/
[3] https://www.telehealth.va.gov/about/index.asp
[4] http://www.cchpca.org/what-is-telehealth
[5] https://www.healthit.gov/telehealth
[6] http://www.medpac.gov/docs/default-source/reports/june-2016-report-to-the-congress-medicare-and-the-health-care-delivery-system.pdf?sfvrsn=0
[7] https://www.fsmb.org/Media/Default/PDF/FSMB/Advocacy/FSMB_Telemedicine_Policy.pdf
[8] http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf

Table1: The Continuum of Telehealth Services and Modalities

Targeted Applications	Service Modalities	User Settings
▪ Primary Care ▪ Specialty Consultations ▪ Behavioral Health ▪ Physical and Occupational Therapy ▪ Home Monitoring ▪ Chronic Disease Management ▪ Health Education	▪ **Store-and-Forward (asynchronous)** involves the transmission of multimedia medical data from one provider to another for clinical evaluation outside of a real-time interaction. ▪ **Live and Interactive Video (synchronous)** involves two-way live audiovisual interaction between a consumer and provider by computer, phone, or home health monitoring devices. ▪ **Remote Patient Monitoring** involves transfer of personal health and medical data from a community setting to a remote provider for monitoring and providing related support. ▪ **Patient Engagement Mobile Apps** involve the use of wearable sensors, smartphone apps, and other mobile monitoring and communication devices to provide consumers with interactive care education and outreach services.	▪ Medical Centers ▪ Outpatient Hospital Departments ▪ Physicians Offices ▪ Homes ▪ Schools ▪ Workplaces ▪ Community Service Settings ▪ Wherever the consumer is

Objectives

This paper identifies innovations that will advance the impact of telehealth and provide new industry opportunities within the next 3-5 years through an assessment of future directions in telehealth as well as the supporting evidence base of current technology capabilities, global telehealth practices, and barriers to the implementation and diffusion of telehealth at scale. The resulting technology-enabled solutions are expected to improve the effectiveness of care services delivered remotely, increase patient engagement in care, and improve health outcomes. The findings can inform strategies for the advancement of telehealth services at scale and on a sustained basis through innovations in areas of research and development, service delivery, and business models.

Methods

The research methodology includes an environmental scan of peer-reviewed articles and the gray literature for technology developments, practice trends, and public policy developments in areas supporting adoption at scale, such as reimbursement, licensure, and liability. Interviews with 11 key opinion leaders on telehealth innovations and best practices were also conducted. These subject matter experts (see Acknowledgements section) were asked a set of standard questions and their responses were recorded. The findings were further informed through input from 70 key stakeholders convened for the Global Innovation in Telehealth: Public and Private Sector Opportunities Summit sponsored by the Transatlantic Telehealth Research Network (TTRN) in Sacramento, California on September 26, 2017. Information was gathered on stakeholder views of how telehealth will continue to evolve as developments in enabling technologies, particularly in areas related to wireless communications, sensors, Big Data, and artificial intelligence, take place. This information was used to further inform the findings regarding how underlying market infrastructure for promoting innovation and adoption as well as evidence of best practices will impact the translation of telehealth innovations at scale, influence the sustainability of telehealth solutions, and drive industry opportunities over the next 3-5 years.

CURRENT STATE OF INNOVATION WITHIN TELEHEALTH

Global Landscape

Telehealth has become one of the fastest-growing segments of the healthcare industry. A key driver has been the increasing recognition among stakeholders of the potential for telehealth to both facilitate increased access to services and improve outcomes while managing healthcare resources more effectively.

On a global basis, national health systems face similar challenges that are transforming how they organize, deliver, and finance care: a shortage of physicians, nurses, allied health personnel; aging populations that are living longer and are more independent; a growing prevalence of chronic conditions; and the transition from volume- to value-based payment systems where providers find themselves increasingly at-risk financially on the basis of outcomes.

Key market drivers include the rapid growth in telecommunications infrastructure together with technology advancements in Big Data and artificial intelligence, and growing healthcare consumerism and patient-centered models of care.

Opportunities to shift the settings where care services are delivered are opening up and presenting new opportunities for innovative service delivery applications that demonstrate improved efficiency, cost-effectiveness, and quality of care.

As a result, telehealth is well positioned to serve as a critical strategic technology resource in health care and become a *standard of care* for delivering and accessing quality healthcare services at a distance.

The current state of telehealth as highlighted in the following examples bodes well for continued favorable market developments in advancing telehealth:

- The **U.S. Veterans Administration** (VA) provided telehealth services to more than 702,000 Veterans during fiscal year 2016, with nearly 45% of *visits* involving Veterans living in rural areas. Of these 702,000 Veterans using telehealth, 150,600 Veterans used remote patient monitoring services at least once from October 2015 to September 2016. As of May 2016, the most common conditions for Veterans using remote patient monitoring were hypertension (almost 19,000 Veterans) and diabetes (about 14,000 Veterans).[9]

- The **American Hospital Association** (AHA) reports that two-thirds of U.S. hospitals connect with patients and consulting practitioners at a distance through the use of video and other technology. An important

[9] http://www.gao.gov/assets/690/684115.pdf

milestone in telehealth was the announcement by **Kaiser Permanente**, a major integrated health system, that it currently provides more virtual encounters than in-person encounters. More than half of Kaiser Permanente's total visits (52%) are now conducted through online portals, virtual visits or the health system's apps rather than in-person encounters.[10] [11]

- **The Healthcare Information and Management Systems Society** (HIMSS) reports that the increase in the adoption of telehealth solutions from 58% in 2015 to 61% in 2016 has been driven by the rise in the adoption of two-way video, an increase in the use of concierge services, and the use of consumer-grade remote patient monitoring devices. An emerging trend has been for healthcare organizations to move towards multiple approaches to deploying telehealth-enabled services. The number of organizations using just one model decreased in 2016 to roughly 48% from 59% in 2015, while the number of organizations using three models rose to 12% from just over 9%.[12]

- A survey of healthcare executives in 2016 by telehealth vendor **Avizia** on how and why they use telehealth reported that 63% of providers use telehealth in some way. The most common service lines using telehealth include stroke (44%), behavioral health (39%), staff education and training (28%), and primary care (22%). The most popular telehealth service modalities have been computer workstations on wheels or *tablets on a stick*, with 40% of responding organizations reporting usage.[13]

- Digital health incubator, **Rock Health**, reports that video-based telehealth adoption by consumers more than tripled from 7% in 2015 to 22% in 2016 with the majority of uses occurring in the last three months of that year, and 83% of consumers expressing moderate or extreme satisfaction with the service modality. Given that those who use telehealth are highly satisfied overall, the largest barrier to long-term replacement of many in-office visits is getting patients to their first virtual visit.[14]

- A 2017 **American Well** consumer survey found that two-thirds of consumers are willing to see a doctor over video and that 20% would switch providers if their current doctor does not provide video visits. The willingness to switch is greater among younger adults and parents with children. A major driver is the greater convenience and associated time and cost savings associated with a video visit when compared with an in-person encounter. Data from American Well shows that its patients have been able to resolve their healthcare needs through telehealth encounters 85% of the time.[15]

[10] http://www.aha.org/advocacy-issues/factsheets/fs-telehealth.pdf
[11] https://mhealthintelligence.com/news/kaiser-ceo-telehealth-outpaced-in-person-visits-last-year
[12] http://www.himssanalytics.org/research/himss-analytics-essentials-brief-2016-telemedicine-study
[13] https://www.avizia.com/research-report-closing-telehealth-gap/
[14] https://rockhealth.com/reports/digital-health-consumer-adoption-2016/
[15] http://go.americanwell.com/rs/335-QLG-882/images/American_Well_Telehealth_Index_2017_Consumer_Survey.pdf

- The **National Business Group on Health**, which represents more than 400 large U.S. employers and over 55 million American employees, retirees, and their families, supports the use of a wide array of telehealth technologies to supplement rather than supplant or substitute regular sources of care, particularly primary care. A 2016 survey reported that approximately one-third of employers currently offer telehealth behavioral services to employees and their beneficiaries. The number of employers reporting that that they plan to make telehealth services available to employees in states where it is allowed increased from 70% in 2015 to 90% in 2016.[16]

- In the **World Health Organization's (WHO) European Region**, countries have been actively leveraging health sector and health information system reform as the foundation for delivering telehealth services in a more strategic and integrated manner, particularly within the context of universal health coverage. In 2015, just over two-thirds of member states (70% or 19 countries) report that national eHealth or telehealth policies address how telehealth contributes to universal health coverage. Teleradiology (83% or 38 countries) and remote patient monitoring (72% or 33 countries) are the most prevalent applications of telehealth. Projects are progressing from small-scale pilots to large-scale implementations, and even larger regional initiatives are emerging beyond the national level.[17]

- Globally, more than half of the **WHO Member States** now have an eHealth strategy, and 90% of eHealth strategies reference the objectives of universal healthcare or its key elements. National electronic health record systems are now reported in 47% of countries, international standards are being implemented for interoperability, and legal frameworks protecting the privacy of electronically held patient data are in place in a majority of countries. Mobile health (m-Health) interventions are by far the predominant modality for delivering telehealth services, with more than 83% of countries reporting at least one m-Health initiative. The number of established m-Health programs reaching maturity has been increasing since 2010.[18]

Commercial Development Parameters

Traditional drivers in the adoption and use of telehealth have been the shortage of providers and geographic barriers to accessing services, particularly in rural and underserved areas. The expansion of telehealth services has more recently been driven by advances in technology and increasingly the transformation of national health systems globally. However, the scope and scale of telehealth practices to date have largely been restricted by laws and regulations that govern how telehealth may be practiced and paid for, which ultimately incentivize

[16] https://www.businessgrouphealth.org/topics/engagement/telehealth/
[17] http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf
[18] http://africahealthforum.afro.who.int/IMG/pdf/global_diffusion_of_ehealth_-_making_universal_health_coverage_achievable.pdf

adoption and use, more than it has by technology factors. U.S. providers often encounter a patchwork of conflicting and disparate legal and regulatory requirements for coverage and practice as a result of an inconsistent state-by-state approach to governing how telehealth may be practiced, and the fact that the majority of payment flows in healthcare continue to favor delivery processes tied to traditional care settings.[19] These barriers continue to present formidable non-technical challenges to scaling and sustainability:

- Respondents to the **American Telemedicine Association**'s 2017 Leadership Survey believe that inadequate coverage and payments (71%), licensure (53%), and resistance to change (50%) more than technical elements related to bandwidth (19%) and privacy/ cybersecurity (15%) represent leading barriers to increased adoption and, as a result, are more likely to hinder accelerated growth of the industry. Increased consumer demand for telehealth (48%) and the shift to value-based reimbursement (26%) are the top ranked trends identified by respondents that will drive the growth of the telehealth market, compared with technology improvements (6%).[20]

- A technology challenge in facilitating broad availability of telehealth services is access to broadband, which can be particularly acute in rural areas where the need is perhaps greatest. The **American Hospital Association** reports that limited access to adequate broadband services prevents some rural facilities from deploying telehealth. AHA recommends simplifying the federal programs that support the expansion of broadband. For example, the Federal Communications Commission's Rural Healthcare Program, which supports broadband adoption, is seen as administratively burdensome and its subsidy for remote healthcare providers is often insufficient. AHA recommends that lowering participating providers' burden and increasing the funding cap would ensure the program meets its goal of ensuring that all rural communities have the broadband access they need.[21]

- U.S. public policy towards telehealth vary from state to state, with no two states alike in how telehealth is defined, reimbursed or regulated. Although **Medicaid** reimbursement for live video exceeds that for store-and-forward and remote patient monitoring, coverage restrictions limit the patient's home as an originating site. **Medicare** has even more restrictive geographic and originating site limitations. However, as the aging of the population drives growth in the number of beneficiaries, Medicare will be under increasing pressure from patients and their extended caregivers to guarantee access to virtual care services for the management of chronic conditions. Other common restrictions include the types of specialty services, and providers that can be reimbursed. **Private payers** are not

[19] http://www.americantelemed.org/policy-page/state-telemedicine-gaps-reports
[20] http://thesource.americantelemed.org/resources/telemedicine-executive-leadership-survey
[21] http://www.aha.org/advocacy-issues/factsheets/fs-telehealth.pdf

subject to the same coverage and practice restrictions, and states laws requiring parity in covered services, although not necessarily the reimbursement amount, offer private payers relatively greater flexibility in coverage decisions.[22]

- In the **WHO European Region**, a lack of funding to develop and support telehealth (71% or 30 member states) and a lack of legal regulations or legislation (42% or 18 countries) are leading barriers to implementing and sustaining telehealth interventions. There is broad recognition of the need for both national policies and strategies for eHealth, universal health coverage or national health information systems as pre-requisites. To ensure progress and the long-term sustainability of investments, sustainable funding that is insulated from changes in the national political landscape are also needed. Another key recommendation is consideration for the development of targeted, intersectoral strategies and policies to guide national telehealth implementation.[23]

- Globally, barriers to the implementation of telehealth in **WHO Member States** are along the same lines as those reported in Europe: a lack of funding, a lack of infrastructure, competing health system priorities, and a lack of legislation or regulations governing telehealth programs. To overcome these barriers, it has been recommended that health policies view the contribution of information and communications technologies as an essential and central component rather than an add-on for delivering healthcare services and improvements in health. More importantly, data requirements for universal healthcare need to be developed as part of a country-level integrated eHealth approach to information management.[24]

Much more needs to be done to promote an enabling infrastructure for the commercial development of the telehealth sector at scale, as well as to ensure consistent quality in the delivery of services. In the U.S., for example, variations in state laws and regulations make it difficult for multistate employers to offer telehealth services more broadly and raise their costs as a result.[25] The patchwork of state-level laws related to coverage and payment, compared to an environment without any restrictions on the patient setting, provider or technology, challenge adoption at scale and business model sustainability. Overall, this lack of a standardized approach at a national level as well as of uniform incentives at an encounter level inhibit the adoption and integration of telehealth into care delivery models and prevent providers from realizing the full benefits. Conflicting state regulations must be reconciled if not harmonized for telehealth to fully reach its potential. In particular, the portability of licensure across U.S. state lines remains a controversial issue that prevents the growth of telehealth services within the U.S.

[22] http://www.cchpca.org/sites/default/files/resources/50%20STATE%20PDF%20FILE%20APRIL%202017%20FINAL%20PASSWORD%20PROTECT.pdf
[23] http://www.euro.who.int/__data/assets/pdf_file/0012/302331/From-Innovation-to-Implementation-eHealth-Report-EU.pdf
[24] http://africahealthforum.afro.who.int/IMG/pdf/global_diffusion_of_ehealth_-_making_universal_health_coverage_achievable.pdf
[25] https://www.businessgrouphealth.org/topics/engagement/telehealth/

Looking forward, the global transition to value-based payment systems rather than technology is what will drive business models, and thereby promises to provide greater opportunities and flexibility for providers in their future ability to deploy telehealth in new models of care and systems improvements. In the United States, the implementation of the **Medicare Access and CHIP Reauthorization Act** (MACRA) has several provisions while CMS has authorized waivers that expand eligibility and payment for the use of telehealth. The **Centers for Medicare and Medicaid Services** (CMS), for example, have several efforts underway that waive certain telehealth restrictions in selected models and demonstrations within Medicare that have the potential to expand access to telehealth in urban areas and patients' homes as well as allow originating site participants to receive cost-based payment.[26]

In other promising market developments in the U.S., the Interstate Medical Licensure Compact has officially started accepting applications from qualified physicians who wish to obtain multiple licenses from participating states. The **Utilization Review Accreditation Commission** has launched an independent, third-party telehealth accreditation program that certifies that vendors have met standards that represent industry best practices, as well as offers vendors a framework in which to continue innovating while meeting standards of accountability.[27] The 21st Century Cures Act has charged the **U.S. Food and Drug Administration** (FDA) to implement a number of policy changes that address digital health, including mobile medical applications. The FDA's Digital Health Innovation Action Plan has outlined its intention to develop a precertification program for software that might obviate the need for premarket submissions and lead to a more expedited and streamlined review process.

Evidence Base

Important to the advancement of an enabling market infrastructure will be the ability to strengthen the evidence base in areas of efficacy, effectiveness, and benefits. The U.S. **Agency for Healthcare Research and Quality**'s (AHRQ) review of the evidence base for telehealth has led to the creation of an evidence map of systematic reviews that assess and examine the impact of telehealth on clinical outcomes, utilization, and cost. The evidence map indicates that the most consistent evidence has been in remote patient monitoring as well as communication and counseling for chronic conditions, and in psychotherapy for behavioral health (Category A). A number of areas, such as maternal health, child health, and triage for urgent care, require more primary literature and review (Category C). The review found a paucity of efficacy data in a number of well-established practice areas such as consults, tele-ICU services, triage in urgent and primary care, and dermatology (Category B). The findings highlight areas for

[26] https://www.gao.gov/assets/690/685987.pdf
[27] https://www.urac.org/accreditation-and-measurement/accreditation-programs/all-programs/teleheatlh/

further research. In Category A, the recommended focus is implementation and practice-based research, Category B could benefit from additional systematic reviews, and Category C from additional primary research. One of the weakest evidence categories was the impact on cost and utilization, and the reviewers recommend that greater attention be accorded to this issue. Additionally, the reviewers recommended that research studies that evaluate telehealth in new models of care and payment are needed.

The **National Quality Forum** has developed a new framework that establishes measures and measure concepts that should inform future evaluation work on the impact of any of the four telehealth modalities on cost and quality of care. The framework's central organizing principle was that the use of any of these telehealth modalities should provide healthcare services to those who may not otherwise receive them in a timely, effective manner. The measures are categorized into four domains: (1) access to care; (2) cost and financial impacts; (3) patient, provider, and community experience; and (4) effectiveness, including clinical, operational, and technical effectiveness. Factors that are considered in the framework include the need for travel, the timeliness of care, the impact on patient empowerment, and the ability of remote monitoring to enhance personalized medicine efforts. The framework also serves as a conceptual foundation to inform the development of new measures that may be needed to assess the quality of care provided.[28] In Europe a similar framework has been recommended by the European Union (https://ec.europa.eu/digital-single-market/en/telemedicine). This framework, the Model for Assessment of telemedicine, includes seven domains that European health care decision makers find important when making decisions on investing in telehealth: (1) health problem and characteristics of the application, (2) safety, (3) clinical effectiveness, (4) patient perspectives, (5) economic aspects, (6) organizational aspects, and (7) socio-cultural, ethical and legal aspects.

[28] https://www.qualityforum.org/Publications/2017/08/Creating_a_Framework_to_Support_Measure_Development_for_Telehealth.aspx

ISSUES FOR INDUSTRY CONSIDERATION

It has been suggested that a tipping point in the adoption of telehealth is at hand. Increased consumer demand, research activity and investment in telehealth are at a stage where the "law of accelerating returns" suggests that technological advances will be exponential rather than linear, and that as the technology increasingly proves itself to be effective greater resources will need to be deployed towards furthering its reach and impact. In addition to advances through technology research and development, assessments of telehealth and the capacity for innovation should also consider the legal and regulatory considerations governing use practices and coverage. The ability to effectively connect both the technology-enabled model of care delivery with the business model for managing care will promote greater adoption and, since organizational change management is central to successful implementation and integration at scale, evidence of best practices that can inform strategies for the effective redesign of workflow and managing data in a process of continuous learning and adaptation are critical. Research in areas of service innovation can also contribute to advancing the design of innovative service business models.

Innovation Practices

Thinking Outside of the Box

Although incremental innovation is the dominant form of innovation in the healthcare sector, it is time to start thinking "out of the box" and be bolder if not more radical in how we envision and approach future challenges in healthcare. A radical or disruptive innovation is one that involves a significantly different approach to addressing challenges within the healthcare sector, while incremental innovation concerns an improvement to an existing product, service, process, or method whose performance has been significantly enhanced or upgraded as a result. To meet the challenges of more elderly, chronically ill patients and the lack of hospital beds, new approaches to designing services using technologies that can help address the challenges confronting the global healthcare system need to be envisioned. Radical innovation is generally a complex process, rather than a discrete event, and generally implies a more challenging, lengthy and risky process. The diffusion of radical innovations nearly always depends on incremental improvements, refinements and modifications. Within the healthcare system there is an increasing imperative to learn how to create radical innovation. Involvement of the end user will also be a critical part of future innovation in the healthcare system in order to design more tailored solutions.

Leveraging Advances in Enabling Technology Areas

In the near term, telehealth will continue to leverage consumer technologies, such as mobile communication platforms and advances in synergistic technology areas such as sensors and data analytics, to expand access for populations to virtual care services that can be delivered synchronously, remotely, and on-demand. Internet of Things (IoT)-based services and the use of wearable sensors and other connected care technologies will enable a greater capacity for remote monitoring and making healthcare data more readily available for analysis and use in providing feedback to empower individuals to self-manage aspects of their health. Connected smart home technologies from Amazon, Google, and Apple, for example, are positioned to become the de facto personal digital health assistants and to serve as the home hub to support device connectivity and integrate data flow. As virtual care becomes more mainstream, consumer experiences of healthcare services will become increasingly blended in terms of their physical and online world interactions, new practice guidelines and standardized operational practices will emerge to assure consistent delivery and quality of care services, and opportunities for value creation and capture will emerge for different stakeholders. However, legal, ethical and social implications are also likely to come to the fore with these advances in the form of privacy and security concerns. In many ways, interoperability is key to data analytics for improved outcomes while cybersecurity is critical for achieving telehealth at scale. Another example is the Danish Future Patient research project that focuses on telerehabilitation of patients with heart failure where heart patients use step counters, sleep sensors and social media to track disease progression and symptom management.

Speeding time To Market With New Test-beds for Innovation

The United Kingdom's National Health Service (NHS) characterizes the innovation process as *combinatorial*, a reflection of the likelihood for system changing gains to come from aligning multiple and oftentimes complementary technologies rather than there being a *silver bullet* to address challenges. Building on the concept of *combinatorial innovation*, the NHS recently established a test-bed initiative to implement and evaluate innovations in defined geographic areas that reflect place-based plans for the future of health and care services and require local stakeholders to work collaboratively to create sustainable financing models. Test-bed innovations combine technologies from fields as diverse as biosensors, medtech and drug discovery, mobile communications, and artificial intelligence.[29] To promote faster uptake and spread, the NHS has also launched an innovation diffusion funding mechanism, the NHS Innovation Accelerator (NIA), to fast-track tried-and-tested medtech devices and apps through an explicit national reimbursement route that guarantees automatic reimbursement when an approved innovation is used. Telehealth innovations supported by NIA include telehealth-related applications

[29] https://www.england.nhs.uk/2016/01/embracing-innovation/

such as the MyCOPD self-management app and the AliveCor remote monitoring app.[30]

Supporting Organizations to Successfully Implement Solutions

While telehealth aligns with the strategic transformation of health systems as providers transition to a value-based payment system (i.e., redesigning care delivery processes to realize efficiencies in workflow and productivity, increased patient engagement and satisfaction, improved clinical and financial outcomes), this transition requires significant investment, resources and planning. In addition, change management practices are critical on the part of provider organizations if technology-enabled service innovations are to be realized in practice and at scale. The dynamic and evolving telehealth ecosystem and infrastructure also requires a greater level of collaboration between stakeholders, and service business models will most likely need to be reconceptualised and continuously adapted as technology-enabled services models evolve. In the U.S., for example, more investment in research into service innovations to promote alternative care delivery models has been called for. It is estimated that out of every $100 spent on healthcare, less than 30 cents is spent on improving how care is delivered (total of $5.0 billion or 0.3% of total healthcare expenditures) and, among 22 industries, health systems rank 19th (0.1% of revenue) and private insurers rank last (0.04% of revenue) in their investments in innovation.

Telehealth Research

Putting Consumers at the Center of the Design Process

Telehealth solutions need not only be designed for compatibility with other technology infrastructure elements and care delivery processes but also, and perhaps more importantly, put user experience at the core of design efforts.[31] It is also important moving forward for providers to offer a standardized user experience across the different consumer devices that patients may use to access virtual services. Design guidelines for the development of telehealth solutions for a consumer-centered experience should also give consideration to data *liquidity* issues to avoid the creation of data silos and risk greater care fragmentation, assure consistent care quality, and improve the overall patient experience of care: integration of data back with the primary health record; meeting consumer expectations for control over their health and data, and providing interoperability based on open standards for customer-driven data exchange throughout the healthcare system. As the number of virtual interactions between patients and their providers and the data they generate increase, patient protection measures in the form of data security safeguards and

[30] https://www.england.nhs.uk/2016/06/treatment-innovations/
[31] https://www.eiu.com/public/topical_report.aspx?campaignid=digitalhealth

provider authentication and verification methods will become increasingly critical to the design of scalable patient-centered care solutions.

Integrating Telehealth Solutions into the Clinical Workflow

Interrelated data challenges at the implementation level for healthcare providers include the need for greater standardization of data practices and a more structured approach to the integration of solutions and data into the workflow. Electronic health record (EHR) interoperability and telehealth solution integration into clinical workflows are key priorities in the telehealth field.[32] [33] [34] EHR vendors have already started to integrate video capabilities into platforms to facilitate easier workflow integration for clinicians, a development that should support the transition from on-demand to scheduled video visits. The development of standardized approaches for the documentation, management, and analysis of data from various telehealth devices will better support the integration of actionable insights into the workflow of care teams and their ability to promote effective care management and coordination across the care continuum. In addition, with greater standardization of telehealth data practices will come greater consistency in data quality to drive Big Data and advanced analytics capabilities.

Driving Value Creation through Big Data and Advanced Analytics

Artificial intelligence capabilities potentially represent a critical enabling technology development in next-generation telehealth service models through the application of machine learning and other advanced analytical methods to data from a wide variety of sources, and the ability to then deliver actionable insights that are proactive, customized, and predictive to individuals in a manner that is context aware and lifestyle sensitive. It is the capabilities afforded by Big Data and advanced analytics that will drive value creation underlying business models, while the resulting predictive analytics will revolutionize the care management process. Data flows back to the patient are going to be critical to patient engagement, and predictive modeling in the future will be less about providing clinical decision support at the clinician level and more about facilitating decision making to support behavior change at the patient level. The challenge in realizing these capabilities is going to be the quality of the underlying clinical data available for analysis, the degree of interoperability to support data exchange between different data systems, and the ability to integrate data into existing care models, such as the patient-centered medical home, to mitigate the risk for data silos and care fragmentation.

[32] http://www.himssanalytics.org/essentials-brief/essentials-brief-2017-outpatient-telemedicine-study
[33] https://www.avizia.com/research-report-closing-telehealth-gap/
[34] http://www.himssanalytics.org/essentials-brief/essentials-brief-2017-outpatient-telemedicine-study

Closing Research Gaps and Strengthening the Evidence Base

From the perspective of research design, telehealth studies are heterogeneous in terms of the use cases, technologies evaluated, and outcomes targeted. A recent review found that as of January 2016, more than 15,000 peer-reviewed articles and 400 systematic reviews had been categorized as telemedicine or telehealth by the National Library of Medicine. The authors stated that while the AHRQ evidence map found sufficient evidence for telehealth in limited situations, the evidence gaps that remain together with the wide variability of clinical conditions, patient populations, methodological approaches, technologies, and quality of evidence that have been reviewed in the published literature are inconclusive about which uses of telehealth are more effective to offer sufficient evidence to overcome existing payment and regulatory restrictions and expand use. There have been calls for more rigorous studies to identify which forms of telehealth are most effective for different settings and populations, through the inclusion of populations who have historically been underserved in terms of their access to healthcare services and who stand to benefit most from improved access through telehealth services, as well as a greater emphasis on the cost-effectiveness of interventions, the use of larger sample sizes, more diverse geographic representation, and a broader range of conditions and services.

Increasing the Focus on Demonstration of Economic and Societal Value

Recent economic studies on telehealth have revealed that the design of telehealth interventions many be decisive for the economic consequences and the societal business case of telehealth. In a scoping review of economic evaluations alongside randomized controlled trials of home monitoring in chronic disease management, telehealth equipment costs constituted between 16% and 73% of the total costs of the program. In some cases these costs are greater than the potential cost-savings. Similarly, a study of claims and enrollment data for 300,000 patients in California showed that direct-to-consumer telehealth may not only increase access by making care more convenient for certain patients, but also lead to increased utilization and healthcare costs. In the study it was estimated that only 12% of telehealth visits replaced actual in-person visits to providers whereas 88% represented new healthcare utilization. The researchers concluded that designers of new telehealth services should consider whether telehealth will result in increasing access and utilization of healthcare and whether the value of the clinical effects or effects on patient convenience justify the increases in utilization and costs. In addition, the researchers proposed consideration of strategies for effectively managing access such as higher co-pays or selective targeting of populations. Therefore, future economic studies of telehealth need to be more expansive and include multiple dimensions of the costs of the technology, changes in utilization, and other factors in order to provide a comprehensive analysis of the business case for telehealth.

Market Development

Redesigning Care Delivery and Translating Telehealth into Practice

Another critical requirement in research is to advance understanding of how to spread and sustain telehealth innovations in health service delivery organizations and within the context of the complexity inherent to the healthcare service economy. In general, the motivation of providers to adopt telehealth has been driven by their anticipation of the shift to value-based care as well as their desire to increase patient access to services in areas that have not been readily available as well as to expand their reach to new patients. However, for telehealth to realize its full potential to transform care delivery, a complete redesign of the care delivery process from a physical to virtual model is required. Both the Kaiser and VA examples are good case studies of effective organizational practices for the *systemization* of telehealth adoption and implementation throughout the organization, and then its *routinization* into standard practice. Both of these aspects are critical in underlining what is required when redesigning care delivery around a virtual care delivery model: readiness to change (in terms of the leadership, vision, capital investment, etc.) and the willingness to disrupt the status quo (in terms of changing culture, mindsets, behaviors, etc.). Simply overlaying technology onto existing care processes is not going to realize telehealth's full potential.

Developing Value-driven Business Cases

Frameworks for assessing the potential of technology-enabled care solutions to create new forms and types of value are needed for informing the design of business models. The broad definition that telehealth encompasses reflects a complex ecosystem, which in itself highlights a potential barrier to the adoption of telehealth at scale. Namely, there is a lack of research on *business cases*, particularly those that focus on value creation and capture as well as explore opportunities for value-co-production among all stakeholders. The fact that telehealth is not a one-size-fits all solution and that each telehealth market segment presents a unique use case, value proposition, business model and maturity level warrants closer examination of the respective value-driven business cases within each segment in order to advance the field overall. Further, there are four primary stakeholder perspectives in healthcare innovation that need to considered in assessing value creation and capture, those of the payer, patient, regulator, and provider. The newly-proposed NQF measure framework represents new ways in which value may be measured and captured, while the ATA position on telehealth as a mitigation strategy for climate change are two examples of how new value propositions can be conceptualized and advanced.

CONCLUSION

From a technology perspective, it is becoming clear that the future of health care is increasingly digital and data-driven, and there is an ever increasing need to improve the way health care can be provided remotely. Underlying this has been the large-scale infrastructure investments in health information technology in recent years, which today offers considerable opportunity for leverage as part of technology-enabled strategies for delivering care services virtually and supporting healthcare providers in their ability to manage care at scale. Telehealth is fast becoming one of the key technology applications as part of this transformation, but uncertainty still surrounds the degree to which healthcare organizations are truly willing to disrupt their traditional healthcare delivery models by redesigning their care delivery model using technology-enabled solutions. In the U.S. the VA has provided an early prototype model for success in the public sector. However, as telehealth diffuses beyond the VA through other public and private sector delivery settings the challenge will be to develop a more business-driven model that creates value for all major stakeholders. In addition to more comprehensive economic analyses, consideration of the broader legal and regulatory environment is also necessary if telehealth is to be fully implemented at scale globally. Only by addressing telehealth in a systematic and whole-system or holistic manner will telehealth be able to be expanded and scaled, and its full potential realized across health systems globally.

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