Healthcare to the Home

Enabling Distributed Health Service Delivery by Removing Barriers to Entrepreneurial Exploration

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MERCATUS WORKING PAPER

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Philip E. Auerswald. "Healthcare to the Home: Enabling Distributed Health Service Delivery by Removing Barriers to Entrepreneurial Exploration." Mercatus Working Paper, Mercatus Center at George Mason University, Arlington, VA, August 2020.

Abstract

Increasing the overall share of health services provided directly to the home constitutes a significant—and as yet mostly unrealized—opportunity to improve healthcare in the United States. Home healthcare as I define it in this paper includes four service models: (1) medical house calls or home-based primary care, (2) health agency care or peer-to-peer health service delivery, (3) telehealth or remote medicine and mobile health (mHealth), and (4) exponential technologies for healthcare. Key to realizing the benefits of healthcare to the home is to remove barriers to entrepreneurial exploration that historically have constrained the evolution of service models in the healthcare industry, notably (1) labor market barriers to entry (e.g., licensing and certification requirements or scope-of-practice rules) and (2) technical barriers to entry (e.g., regulatory approvals, standards for interoperability).

JEL codes: I11, I18, L22, L26, L8, O3

Keywords: entrepreneurship, distributed health services, health service delivery, healthcare innovation, health service markets, home healthcare

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Acknowledgments

I would like to thank the Mercatus Center at George Mason University for supporting this research. Three anonymous reviewers contributed valuable insights that I incorporated throughout the paper. I further thank Eric DeJonge, Jody Ranck, and James Broughel for insightful conversations, and Steve Rossi for providing valuable research assistance.

This paper can be accessed at https://www.mercatus.org/publications/healthcare/healthcare-home-enabling-distibuted-health-service-delivery-removing-barriers-entrepreneurial-exploration

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1. Introduction

In March 2020, the coronavirus pandemic forced a sudden acceleration of the trend toward the virtual provision of healthcare via computer or mobile phone, a service model known as telehealth. This acceleration was necessary in the short term so that nonurgent health service provision could continue, despite lockdowns and self-isolation. Some have suggested that the acceleration of telehealth adoption promises long-term benefits by expanding options for consumers and lowering the overall cost of healthcare (Dyrda 2020; Lagasse 2020).

In this paper, I propose that a narrow focus on the expansion of telehealth options obscures a larger—and as yet mostly unrealized—opportunity to improve healthcare in the United States: increasing the overall share of health services provided directly to the home. Home healthcare as I describe it here is composed of four service models, including telehealth:

- Medical house calls or home-based primary care[1]
- Health agency care or peer-to-peer health service delivery
- Telehealth or remote medicine and mobile health (mHealth)
- Exponential technologies for healthcare[2]

I employ the term "distributed health service delivery" to refer to these four service models jointly.

[1] This includes community-based serious illness care (National Committee for Quality Assurance 2018).
[2] In particular, this refers to artificial intelligence and machine learning, blockchain, and the internet of things.

Each of the four elements of distributed health services has progressed rapidly over the past decade, more or less independently of the others. As these service models begin to converge and reinforce one another in the decade to come, the disruption of today's institution-centered modes of health service delivery in favor of patient-centered, largely home-based models is likely to intensify, whether or not such a change is deliberately advanced by policymakers. Such a transition has the potential to offer consumers lower-cost options that are as effective as or more effective than the current clinic- and hospital-centric care models. They could also provide significant public benefits along multiple dimensions.

Key to realizing the benefits of healthcare to the home is removing barriers to entrepreneurial exploration that historically have constrained the evolution of service models in the healthcare industry (Hwang and Christensen 2007). Indeed, enabling the home-centered future of healthcare in the United States may be less about designing and implementing new programs than about removing barriers to entrepreneurial exploration of two types:

1) Labor market barriers to entry (e.g., licensing and certification requirements and scope-of-practice rules)
2) Technical barriers to entry (e.g., regulatory approvals, standards for interoperability)

These two types of barriers involve absolute (and in many cases outdated) prohibitions that directly inhibit innovation in distributed health services. Because they are about ex ante

permission rather than ex post compensation, they constitute the most binding, and thus the most significant, barriers to entrepreneurial entry.[3]

The primary obstacles to realizing such benefits by expanding the provision of healthcare to the home are similar to those that impede innovation in health service delivery overall: oligopolistic market structures at various geographical scales of analysis, organizational inertia, and regulatory capture by industry incumbents and professional societies invested in clinic- and hospital-based healthcare provision.

Though some institutions have managed to achieve significant improvements in efficiency with existing service models, the disruptive innovations with the greatest potential to advance health service delivery in the next 3 to 30 years are not likely to originate from currently dominant incumbents (see, e.g., James and Savitz 2011). The leading innovation theorist Clayton Christensen (1997, p. xvi) summarizes the dynamic that invites entry by (low-cost, equally or more effective) challengers:

> Technologies can progress faster than market demand. . . . In their efforts to provide better products than their competitors and earn higher prices and margins, suppliers often "overshoot" their market: They give customers more than they need or ultimately are willing to pay for. [This also] means that disruptive technologies that may underperform today, relative to what users in the market demand, may be fully performance-competitive in that same market tomorrow.

Companies pursue these sustaining innovations at the higher tiers of their markets because that is historically what has helped them succeed. In mature markets, companies achieve the greatest profitability by offering the greatest number of features and charging the highest prices

[3] A third category—financial barriers to entry—is secondarily important because of the manner in which pricing and reimbursement policies for federally administered programs act as implicit subsidies that favor clinic- and hospital-based modes of care. Because such subsidies are unlikely to be eliminated in the near to medium term, it is preferable that they be structured in such a manner that they do not systematically disfavor home-based case. The COVID-19 pandemic had at least a short-term effect on reimbursement policies for home healthcare. Medicare started reimbursing the cost of oxygen provided to COVID-19 patients who were sent home in order to relieve hospital overcrowding. In parallel, many states have temporarily expanded telehealth coverage under Medicaid at the same time that they have waived in-state licensure requirements for telehealth. The category of financial barriers to entry constitutes a potential topic for a separate paper.

to their most demanding and sophisticated customers. However, by doing so, they unwittingly open the door to disruptive innovations at the bottom of the market. An innovation that is disruptive allows a whole new population of consumers at the bottom of a market access to a product or service that was historically accessible only to consumers with a lot of money, a lot of skill, or both. This line of argument suggests that innovations in healthcare provision to the home are less likely to come from currently dominant incumbents than they are from new entrants meeting previously unmet consumer needs.

This is where policy comes into the picture. Christensen, Grossman, and Hwang (2008, 425) further observe that

> because of the shackles that democracy imposes on those responsible for regulation, the employers that now pay for health care, and the companies that make health-care products and provide health-care services, need to initiate the regulatory changes that enable disruption. They must do this in the way that disruptive deregulation has always occurred—by innovating where the regulations can't reach, don't apply, or are off the radar screens that regulators most intensely monitor.

TEXT BOX 1. Healthcare in the Home: The Current Scope of Distributed Health Services

What fraction of the services currently provided in hospitals might ultimately be offered in the home? We do not know the answer to this question, but we do know that it is a far greater percentage than is reflected by current practice.

The following health services can be provided in the home with current technology, thereby improving access to care, reducing costs (primarily by reducing hospitalizations), and improving quality of life.

Medical House Calls or Home-Based Primary Care

- Physician, nurse practitioner, or home health coaches for both routine visits and urgent assessment, when necessary

- Home safety evaluations
- Wound checks, edema management
- Education via group sessions regarding disease processes, disease management, and pain management
- Local group therapy for depression, anxiety, post-traumatic stress disorder (PTSD), and other mental health issues
- Telehealth or remote medicine and mobile health (mHealth)
- Certified clinical hemodialysis technician monitoring of vital signs, weight, and so forth.
- Mobile device applications for behavioral modification (e.g., smoking cessation, alcohol moderation, nutrition, regular exercise, sleep habits, overcoming mental challenges)
- Education delivery via short online videos and potentially via courses
- Telephone visits
- Secure messaging
- Access to medical opinion via e-consult (e.g., cardiology, endocrine, rheumatology)
- Digital image-enabled dermatology and podiatry
- Computer-based cognitive behavioral therapy

Health Agency Care or Peer-to-Peer Health Service Delivery

- Nutrition education (improved access to healthful foods, cooking classes)
- Exercise classes (walking groups, dance classes, yoga, meditation)
- Dementia mitigation (language classes, music lessons, book clubs)
- Transportation
- Simple, noninvasive diagnostic testing
- Contact tracing

Source: This partial list was developed with the assistance of Katherine Auerswald.

2. The Economics of Rising Healthcare Costs and the Potential for Reductions

A great deal of analytical work has gone into developing a pathway to long-term reductions in healthcare costs—an objective frequently referred to as bending the cost curve (see, e.g., Orszag 2011; Gawande 2012). Indeed, concerns over the relative rise of healthcare costs go back at least two generations. In 1973, Godfrey Hodgson wrote in *The Atlantic*,

> The health care crisis is upon us. In response to soaring costs, a jumbled patchwork of insurance programs, and critical problems in delivering medical care, some kind of national health insurance has seemed in recent years to be an idea whose time has finally come in America. (Hodgson 1973)

Helland and Tabarrok (2019) have systematically explored the various hypotheses that have been advanced to explain the steady increase in the relative cost of healthcare in the decades since Hobson published this statement. These hypotheses include the following:

- Monopoly power and medical malpractice
- Waste and administrative costs
- Healthcare quality and the high value placed on life
- Labor costs

While finding some evidence to support each of these hypotheses, Helland and Tabarrok (2019) argue persuasively—in part by appeal to data from a cross section of industries beyond healthcare—that the most plausible cause of the steady long-term increase in the relative cost of healthcare is the rising relative cost of skilled labor. Reduced to its fundamentals, "Skilled labor has increased in value throughout the US economy, and the healthcare sector uses a lot of skilled labor, even aside from physicians. That reality has pushed up the price of healthcare" (340).

The economic mechanism responsible for this persistent increase in the relative cost of healthcare is known as the Baumol effect (also the Baumol cost disease), after the economist William Baumol (see Baumol 1967). The principle is simple but somewhat counterintuitive: the

increase in the (relative) cost of healthcare is actually a function of the decrease in (relative) costs elsewhere in the economy. Specifically, increases in the relative cost of labor-intensive services (such as healthcare and education) are a natural and inevitable consequence of the increased efficiency (and decreased labor intensity) of production in other industries. Referring to the labor-intensive sectors of the economy as "the stagnant sectors" and sectors in which efficiency has advanced rapidly (e.g., the production of computers and home appliances) as "the progressive sectors," Helland and Tabarrok (2019, 38–40) state that

> all prices cannot fall. Behind the veil of money, prices are ultimately relative prices—prices tell how much butter society must give up to get guns. But if butter becomes cheaper and society can buy more butter by giving up the same number of guns, then guns must have become more expensive—it takes more butter to buy the same number of guns. . . . [Consequently,] to understand why costs in the stagnant sector are rising, we must look away from the stagnating sector and toward the progressive sector.

The policy takeaway is simple: the only way to "bend the cost curve" in healthcare is to reduce the total cost of labor inputs. This can be accomplished in one of two ways: (1) using less labor in the context of existing service models, or (2) changing the service model in order to substitute technology and lower-cost labor for higher-cost labor.

As robust and well considered as it is, Helland and Tabarrok's (2019) analysis of healthcare costs does evidence the tendency of health policy analysis to take as a given both existing modes of service delivery (conventional inpatient and outpatient) and the existing capital-labor mix they represent. The way to address the particularly high cost of hospital-based healthcare, so the logic generally goes, is to reduce the cost of healthcare provided in hospitals. This sounds reasonable enough, but it actually misses the point. Evidence from the healthcare industry and the analogy to other industries suggest instead that the most effective way to reduce the cost of hospital-based healthcare is to provide consumers with lower-cost, equally effective

options that shift service provision away from high-cost settings and into the home.[4] If the change of setting allows for low-cost technology to substitute for high-skilled labor, then the Baumol cost disease may be curable—notwithstanding the fact that Helland and Tabarrok's analysis indicates that it has, retrospectively, constituted a chronic condition.[5]

Consider the analogy to the use of digital technologies in higher education. Decades after their introduction in colleges and universities, digital technologies did little to bend the curve of higher education costs. Real changes that students have experienced in the cost of higher education *itself* (as opposed to degrees awarded by accredited institutions of higher education that ostensibly document attainments in higher education) have occurred only recently, as entrepreneurial entrants have implemented entirely new service models situated outside colleges and universities. In response to the competitive challenge such new entrants pose in the provision of online education and low-cost certificate programs, dominant incumbents have only very recently been compelled to make real changes to their own programs. (As with the increased use of telehealth to which I alluded above, the trend toward the increased use of online education has also accelerated as a consequence of the coronavirus pandemic. Further changes to the cost structure of higher education are likely to follow.)

The same line of argument holds for the provision of healthcare to the home. Innovation by incumbent firms is likely to lag, not lead, innovation by new entrants. When regulation inhibits

[4] For analogies, see Christensen (1997) and Christensen, Grossman, and Hwang (2008), along with section 4. For specifics, see Mader et al. (2008), Shepperd et al. (2009), Cryer et al. (2012), Ernst and Young (2012a, 2012b), Topol (2012), and Rauch (2013). Terry (2013) offers a counterargument that describes the failure of health information to bring about significant change within the healthcare industry to date.

[5] As an anonymous reviewer of this paper stated succinctly and correctly, "The Baumol effect is a binding constraint only in the context of existing regulation and government subsidies that favor existing delivery models. If it is possible to use technology to substitute for skilled labor in healthcare, then costs are not constrained by the Baumol effect." Consequently, the reason healthcare has not seen productivity gains comparable to other sectors may be "because government-imposed regulatory barriers have blocked cost-saving innovations at the same time government encouragement of third-party payment has dried up demand for them. The real issue is how government regulation limits options for using a different mix of skilled and unskilled labor along with innovative communications technology to lower costs."

innovation and entrepreneurial entry (as arguably has occurred over time in the case of health IT), we should not be surprised if technology-driven benefits fail to materialize as initially imagined.[6]

Even in the absence of a favorable policy environment for distributed health service delivery, however, labor market shifts indicate that an increased demand for home healthcare workers overall—and potentially some degree of labor market substitution to counter the Baumol effect—is already underway. Of the five occupations the Bureau of Labor Statistics projects will experience the greatest growth from 2018 to 2028, two are related to home healthcare: home health aides and personal care aides. Given current trends, the demand for both is projected to increase by 36 and 37 percent, respectively, over the decade, compared with the 5 percent growth projected in all occupations. The median average wage for both of these occupations is $24,000 per year, compared with $110,030 for a nurse practitioner and $108,610 for a physician assistant. The Bureau of Labor Statistics reports that combined employment for health aides and personal care aides in 2018 was 3,253,000 jobs, with the growth from 2018 to 2028 projected at that time to total 1,185,800 jobs.

3. Elements of Distributed Health Service Delivery

Significant dimensions of novelty in the current healthcare environment notwithstanding, the central premise of this paper—that cost reductions and improved service are obtainable by providing healthcare in the home—is not a new one. Indeed, as Benjamin (1993) describes in a survey of home healthcare policy that was written nearly a generation ago, the premise dates back to the 1940s, and the fundamental rationale for encouraging home healthcare has changed little in the intervening years.

[6] Terry (2013) describes the failure of health information to bring about significant change within the healthcare industry to date.

One hundred years ago, health service provision in the home was the norm, not the exception (Risse, Numbers, and Leavitt 1977; Starr 1982). The capital requirements of the medical profession were minimal, so there was little reason for a doctor to have an office. Since it cost little (if anything) to certify as a physician, both the barriers to entry into medical practice and the relative wage paid to physicians were lower than today.

The advent of modern medicine over the past century changed this. In 1930, house calls constituted 40 percent of physician encounters; by 1950 that figure had dropped to 10 percent, and by 1980 it was just 1 percent (Kao et al. 2009, 19). Technologically driven increases in the complexity of healthcare coincided with the ascendancy of professional healthcare societies and the emergence of regulation and certification requirements that affected nearly every area of health service delivery. Doctors increasingly chose to practice in specialized fields that were reliant on expensive technologies that, for a combination of economic and regulatory reasons, were available only in hospitals; those who chose to practice primary care were able to see twice as many patients in their office as they could by providing healthcare in the home (Kao et al. 2009; Mishori 2009). Norms have changed to the point where many people today find it hard to imagine receiving medical treatment in the home.

However, in the past two to three decades, the advantages of hospital-based care have started to erode. Part of this erosion is owing to a reversal of the advantages of hospital-based healthcare:[7]

[7] The implication here is that exogenous changes have made hospitals less desirable, making it more desirable to use nonhospital settings. However, as my colleague Bob Graboyes pointed out to me, one can argue that, rather than fleeing the hospitals, a better approach might be to stop implementing policies that make hospitals unappealing. I leave the exploration of that line of argument to others. Additional reasons for the high cost of hospital-based healthcare include (1) costs of regulatory compliance, (2) exposure to legal risk, and (3) excessive reliance on disposable tools and materials.

- *High cost.* Dynamic increases in capital intensity, in combination with a complex set of institutional and behavioral factors, have overwhelmed static gains owing to economies of scale and driven significant increases in the cost of hospital-based care (Cutler and McClellan 2001; Henry Kaiser Family Foundation 2012; Cutler, Wikler, and Basch 2012).
- *Infections acquired in the hospital.* The concentration of illness in hospitals has created a category of systemic vulnerability in the healthcare system in the form of infections acquired in the hospital, with incidence rates exceeding 4 out of every 100 admissions (see Scott 2009; Klevens et al. 2007).
- *Iatrogenic injury and death.* The very professionalism of the hospital-based model has generated systems of such organizational complexity that incidents of injury or death in the course of medical treatment have become commonplace (Starfield 2000; Gawande 2009).[8]

Rapid technological advances, demographic trends, and long-term trends in the burden of disease are combining to favor healthcare to the home over clinic- and hospital-based health service delivery.

As I describe below, technologies and organizational innovations that enable healthcare provision both in the home and at a distance (which was not possible before the advent of advanced communications) have improved radically in terms of performance and cost. The aging of the population has created steady growth in the demand for semiprofessional forms of home-based healthcare assistance. The regrettable increase in the population-wide prevalence of chronic illness has created a parallel increase in the demand for routine treatments and diagnostic

[8] More broadly, Makary and Daniel (2016) estimate that medical error is the third-leading cause of death in the United States, accounting for 250,000 deaths per year.

support services, many of which can be provided in the home by individuals with relatively rudimentary training.[9]

3.1. Medical House Calls or Home-Based Primary Care

The once nearly obsolete practice of providing medical services in the home has recently experienced a resurgence, paralleling the growth of "minute clinics" and other options that offer consumers greater convenience and lower costs in healthcare (RAND 2016).[10] This resurgence has been largely independent of the advent of new technologies for providing healthcare at a distance. Rather, it has been driven by the increasing cost of both hospital and outpatient care, combined with accumulating evidence of the superiority of home-based care to hospital-based care along multiple dimensions (perhaps most notably inpatient satisfaction) (Mishori 2009; Rauch 2013).

Current programs that exist for medical house calls focus on patients who suffer from chronic illnesses. Examples in this category include the following:

- Independence at Home (national, fee-for-service Medicare demonstration, 14 participating practices, both for-profit and nonprofit) (DeJonge, Taler, and Boling 2009; Rauch 2013; CMS [Centers for Medicare and Medicaid Services] 2019)
- Department of Veterans Affairs (VA), Home-Based Primary Care (national, government) (Beales and Edes 2009; Egan 2012)
- Sutter Health, Advanced Illness Management (Northern California, private, nonprofit) (Rauch 2013)

[9] I thank an anonymous reviewer for contributing insights included in this paragraph.
[10] Home-based primary care involves matching each patient with a primary care team that typically includes a physician, a nurse practitioner, a registered nurse case manager, and a social worker. Patients receive both routine and preventive health services in the home.

- Visiting Physicians Association, a program of US Medical Management (national, for-profit)[11]

These programs include a physician who works with an interdisciplinary team that conducts visits to the home, where they perform diagnostics, urge compliance with treatment protocols, and otherwise assess and encourage patient progress. These programs are fundamentally organization-based rather than technology-based innovations in health service delivery. Rauch (2013, 5–6) describes their central elements:

> First, they attempt to prevent hospitalization by doing as much as possible at home, thus bringing care to the patient rather than the other way around. Many routine and some non-routine procedures can be performed in the home, and regular home visits can help identify and remediate problems before they become critical. . . .
>
> Second, the programs use multidisciplinary teams. Formulas vary, but a typical team might consist of a nurse or nurse practitioner, a care coordinator (who might also be a nurse), a social worker, and a physical or occupational therapist. All work with and under a primary care physician. . . .
>
> Third, teams provide coordination. . . . A typical model assigns each patient to a case manager charged with keeping team members on the same page, interacting with physicians and hospitals, and keeping care givers and family informed. Generally team members will meet regularly (say, weekly) to discuss patients, identify problems or gaps, and deploy personnel and resources to fill them. By comparison with the standard model, what the patient experiences is relatively seamless.[12]
>
> Fourth, programs attempt to serve patients' goals instead of merely treating diseases. They attempt to elicit and understand what clients want to get out of their treatments and their lives, and they ask—indeed, usually require—that patients and their families discuss and decide questions about goals of care. The goal, of course, is . . . to let the patient, rather than the medical system, be in charge, and to see patients as people rather than as bundles of diseases.

"Hospital at home" programs such as that initiated by Johns Hopkins University have gone further by providing hospital-level care in patients' homes (Cryer et al. 2012).

In October 2019, the US Centers for Medicare and Medicaid Services (CMS) released the results from the fifth year of the national Independence at Home demonstration. Through this demonstration, CMS provided incentive payments to home-based primary care providers who

[11] Further information is available at the Visiting Physicians website: http://visitingphysicians.com.
[12] This sort of team approach is the norm in the provision of mental health services.

succeeded in reducing Medicare expenditures for beneficiaries with multiple chronic illnesses, conditional upon meeting designated quality measures. In the fifth year of the trial, with participation capped at 10,000 patients, Independence at Home providers reduced expenditures by approximately 8.4 percent, resulting in savings to Medicare of $33.5 million (CMS 2019). During the full five years of the Independence at Home demonstration, participating practices saved Medicare approximately $85 million.

Though such services are increasingly available, they remain far from ubiquitous. A significant national study by Ornstein et al. (2015) found that while at least 2 million Medicare beneficiaries are homebound (approximately 5.6 percent of the elderly, community-dwelling Medicare population), only 11 percent of that number reported receiving primary care services in the home. Yao et al. (2016) found that the provision of home healthcare services was subject to significant skew, with 475 of the 5,000 providers of home-based primary care services to Medicare fee-for-service beneficiaries in 2013 being responsible for 44 percent of the total number of visits. The same study found significant disparities in geographical access to home-based primary care services: "The majority of Americans live more than thirty miles from any of the 475 primary care providers who made 1,000 or more home visits" (1404).

3.2. Health Agency Care or Peer-to-Peer Health Service Delivery

As Murkofsky and Alston (2009) chronicle, health agency care in the United States dates back at least to 1813, when wealthy women in Charleston, South Carolina, formed the Ladies Benevolent Society to provide care and comfort to poor, sick patients in their homes.[13] By the start of the 20th century, demand for such volunteer services had outpaced their growth. In

[13] Note that the term "peer-to-peer" as employed in this paper refers to demographic peers or neighbors, not to individuals who are peers because they suffer from the same illness.

1909, Lillian Wald formed the Henry Street Nurses Settlement House in New York City. Wald coined the term "public health nurse" and persuaded the Metropolitan Life Insurance Company to pay for the first visiting nurse benefit—first in New York and then, by 1911, nationwide—thus creating the first national system of insurance for home care. When Medicare was signed into law in 1965, it included funding for home care, which provided a new and significant revenue source for home health agencies. The number of home healthcare agencies participating in Medicare grew from 1,753 in 1967 to 10,444 in 1997. (Note that these are home healthcare visits by nurses, so they fall into a different category than the physician house calls described above.) However, substantial fraud and abuse accompanied this growth. Stricter enforcement of eligibility criteria for home healthcare and a number of measures included in the Balanced Budget Act, passed in 1997, reversed the growth of Medicare spending on home healthcare in a rather dramatic fashion. By 2001, more than one-third of all home healthcare agencies had closed (Murkofsky and Alston 2009, 2–5). Nonetheless, Medicare has continued to account for the largest percentage of spending on home healthcare.[14]

At the moment, the most powerful impetus for substantive change in the healthcare system is coming not from within the Medicare and Medicaid system but from citizens of moderate to high income who are increasingly dissatisfied with the menu of existing market offerings. Around the country, such citizens have organized so-called village networks to pool their resources so they can receive healthcare and other services in the home within their communities. These efforts are nascent, but they signal a market demand for institutional

[14] Sources of funding for home healthcare, according to CMS, are as follows: Medicare (37 percent), state and local government (19.9 percent), Medicaid (19 percent), private insurance (12 percent), and out of pocket (10 percent) (Murkofsky and Alston 2009, 7).

innovations that bypass the existing healthcare infrastructure to the extent possible.[15] A 2016 survey of 1,753 members of such villages found a majority reporting an improved sense of social connection and ability to remain in their homes. However, fewer village members reported that their membership in a village had improved their "physical health" (8 percent) or their "ability to get the medical care [they] need" (16.8 percent), which indicates that the villages' role as a platform for peer-to-peer health service delivery remains underdeveloped in comparison with other services these villages offer.

3.3. Telehealth or Remote Medicine and Mobile Health (mHealth)

Services delivered via information and communications technologies constitute a third dimension of distributed health service delivery. The telephone (over a landline) created some initial and still-relevant opportunities for providing healthcare at a distance (Eakin et al. 2007). The advent of the internet and personal computing expanded the field of remote medicine, in particular the expanded possibilities for remote monitoring and enabling diagnostics and even treatment from a distance. Mobile phones and tablet computers have opened up further possibilities for health service delivery.

Telehealth is the most widely used of the technology-enabled elements of distributed health service delivery.[16] Though still impeded by federal and state regulations, such as restrictive licensure requirements and prohibitions against prescribing medication without an in-person consultation, telehealth use has grown dramatically in the past five years. In particular, non-hospital-based provider-to-patient telehealth grew by 1,393 percent from 2014 to 2018,

[15] See, for example, Fried (2013). The emergence of village networks provides one example of how communities may organize themselves to manage a "health commons" (see McGinnis 2013; Fried 2013; Bahrampour 2014).
[16] CMS defines telehealth as follows: "Telehealth (or Telemonitoring) is the use of telecommunications and information technology to provide access to health assessment, diagnosis, intervention, consultation, supervision and information across distance." (This definition is drawn from the Medicaid.gov website: https://www.medicaid.gov/medicaid/benefits/telemedicine/index.html.)

which is 0.007 to 0.104 percent of all medical claim lines (Fair Health 2019). This growth is likely to accelerate as federal and state policies evolve in a favorable direction. For example, until recently, seniors in Original Medicare were eligible to receive certain telehealth services only if they lived in a rural area. Beginning in 2019, however, Medicare recipients across the country were eligible to be served by virtual check-ins with their doctors by phone or video chat. In April 2019, CMS finalized plans that allow Medicare Advantage plans to include additional telehealth benefits.

Mobile phone health applications represent another area of rapid growth. In a review focused on legislative obstacles and enablers of mobile health apps, Cortez (2014) categorized mobile health apps as follows:[17]

- *Connectors*: Apps that connect smartphones and tablets to FDA-regulated devices and procedures (e.g., inflating and deflating blood-pressure cuffs, performing stable ultrasounds, operating insulin pumps, and visually tracking whether wounds improve or heal)
- *Replicators*: Apps that turn a smartphone or tablet into a medical device by replicating the functionality of a medical device
- *Automators or customizers*: Apps that use questionnaires, algorithms, formulae, medical calculators, and other software parameters to aid clinical decision-making
- *Informers or educators*: Medical reference texts and educational apps that aim primarily to inform and educate
- *Administrators*: Apps that automate office functions, like identifying appropriate insurance billing codes or scheduling patient appointments

[17] Descriptions and examples drawn directly from Cortez (2014, 1182–90).

- *Loggers and trackers*: Apps that allow users to log, record, and make decisions about their general health and wellness

This list indicates the range of healthcare services that can be delivered over mobile phones—and, to varying degrees, over computers and landlines. Venture capital investments in digital healthcare totaled $8.1 billion in 2018—nearly eight times the total in 2011—which was greater by a comparable amount than venture capital investment in traditional healthcare sectors, such as biotech, medical devices, and medical software (Rockhealth 2018).

In testimony delivered to the House Committee on Small Business in 2013, Alan Portela, CEO of Airstrip (a mobile health service company), offered the following summary of the transformation the healthcare industry has been experiencing during the past decade:

> The changes and challenges faced by the healthcare system have been exacerbated as the Baby Boomer generation is reaching retirement age and 16 million formerly uninsured additional patients that will be added to the system as part of Healthcare Reform. The change in scope (Patient-Centered Model), coupled with the current caregiver shortages the industry faces and the move away from generalist doctors to specialists, will mean a greater reliance on mobile health and shared-medical technologies. The major driver behind this transformation is the prevention of disease and the management of chronic diseases while reducing costs. Approximately 75% of the US population has at least one chronic disease, with cardiovascular diseases representing three of the top five (COPD, hypertension, cardiac heart failure, diabetes and stroke). (Portela 2013, 2)

Different elements of distributed health service delivery have demonstrated the potential to meet these challenges by reducing costs while (often) improving service delivery.

Litan (2008) was among the first to analyze the potential cost reductions achievable through distributed health service delivery. Focusing on the use of remote monitoring via telemedicine in the Medicare system, Litan found that the greatest opportunities for cost reductions at that time fell into three categories: chronic illnesses (80 percent of Medicare expenditures), expenditures incurred during the last year of life (25 percent of Medicare expenditures), and mental health (a frequently unrecognized underlying factor correlated with

high rates of hospital readmission). Litan observed that "by improving communication between patients and healthcare professionals (that is, in terms of quantity of contacts as well as the quality of information exchanged), practitioners receive more information, at a greater detail, from which they can base treatment decision" (9). The results he anticipated included fewer and shorter hospitalizations related to an array of chronic illnesses: congestive heart failure, diabetes, chronic obstructive pulmonary disease (COPD), and chronic skin ulcers. Litan estimated a net savings of $197 billion cumulatively over a 25-year period through the increased use of telemedicine alone.

Given the pace of advances in technology, this estimate is lower than the cost reductions achievable through a full deployment of distributed health service delivery, as it considers only one of the four elements of such delivery. For example, an array of more recent studies found that the provision of healthcare services in the home leads to cost reductions of 10 to 30 percent, while at the same time achieving equal or better patient satisfaction and medical outcomes (Mader et al. 2008; Shepperd et al. 2009; Cryer et al. 2012; Ernst and Young 2012a, 2012b; Topol 2012; Rauch 2013). These reductions are in a separate category from, and potentially add to, the $197 billion in reductions estimated to be realizable through a fuller utilization of telemedicine.

3.4. Exponential Technologies for Healthcare

A final major trend with significant implications for distributed health service delivery is the advent of an interrelated set of technologies that include artificial intelligence (AI), blockchain, and the internet of things, often referred to collectively as exponential technologies.

AI based on machine learning algorithms is already having a significant impact in medical fields where large digital datasets are available for pattern matching, notably radiology.

More ambitious applications involve the use of AI in combination with medical "big data" to provide real-time support for clinical decision-making (Baig et al. 2019). Beyond the availability and improvement of the underlying machine learning algorithms, the development of AI-based clinical decision support tools is based on three data-focused preconditions: (1) data gathering, (2) data aggregation, and (3) data analytics:

- The potential for disruptive innovation in data aggregation refers to the fact that both commercial and government interests are increasingly seeing the value in the pools of data and thus are seeking to build and structure extremely large databases that can be "mined" for patterns.[18] In the coming decade, the aggregation of healthcare data may be facilitated by distributed ledger technologies (also known as blockchain) that have the potential to resolve issues related to the privacy, security, portability, and accuracy of medical data (Gordon and Catalini 2018).
- The potential for disruptive innovation in data analytics is that the conversion of data from analog to digital, and the search for patterns in data via machine learning algorithms, can be accomplished today at speeds that are orders of magnitude beyond the best attainable even a few years ago.[19]
- The potential for disruptive innovation in data gathering refers to the fact that human society, and the digital devices embedded within it, is generating data at an exponentially increasing rate. Information generated by personal computers—whether sitting on desktops or laps—is but a tiny fraction of this total. The overwhelming share is generated

[18] The most successful technology companies of the past decade—Google, Facebook, and Twitter foremost among them—realize economic value not from the sale of cloud-based services *to* their customers but, rather, from the use of the data gathered *about* their customers.

[19] Until recently, analyzing very large datasets was possible only by using the world's most powerful computers, at great cost. Today, both storage and computational resources are decreasing in cost at a dramatic rate. However, computers ultimately can offer answers that are only as good as the information humans provide on the context and social parameters of the question. Effective data analytics has embedded within it a deeply human element.

by devices and appliances as varied as automobile engines, thermostats, weather balloons, and mobile phones—and now also health-related monitors and sensors of many varieties. Ubiquitous connected devices in this latter category are examples of internet of things technologies for healthcare.

This convergence of exponential technological capabilities creates both opportunities and potential risks. Opportunities include

- the potential to amplify the capabilities of low- and midlevel healthcare workers (e.g., the home health aides and personal care aides I referred to above) through the deployment of advanced diagnostic support tools;
- the potential for cheaper and better services of many types;[20] and
- lower entrepreneurial barriers to entry.

Potential risks include

- new forms of unintended bias and exclusion based on the "training" of machine learning algorithms using existing large datasets, which may be nonrepresentative and otherwise skewed in ways that are difficult to detect; and
- the intensified concentration of health data.

As in other areas of technology, the objective of policy must be to realize the full benefits of opportunities while minimizing the adverse impact of risks.

Of the four categories of innovations driving distributed health service delivery, the advent of exponential technologies is as relevant to the transformation of care provided in hospitals and outpatient clinics as it is to care provided outside those settings. However, the

[20] The convergence of technologies described above is also important because it allows for population-based medicine to become routine. This is a significant methodological advance relevant not only to the development of new treatments and service protocols but also to the correction of old data on which existing protocols are based. Iterative processes assess the value of existing approaches, while peer-reviewed research remains significant in establishing the initial direction for a new treatment or service protocol.

inexorable shift toward not only electronic records but also use of the varied data sources described above will further reduce the advantage in data and diagnostic support that has long been held by doctors working in hospitals and outpatient settings.

4. Removing Barriers without Expanding the Federal Role

4.1. Labor Market Barriers to Entry

Key to addressing workforce shortages in the health sciences is to remove medically unwarranted restrictions on nurse practitioners providing the broad range of activities that—with proper physician oversight and technological support—they are capable of providing.[21] Yet even that is not likely to be an adequate solution, because "the number of homebound adults who could benefit from house calls is overwhelming in comparison to the number of qualified and willing providers" (Hayashi et al. 2009, 110).[22]

In the longer term, then, realizing the full benefits of distributed health service delivery will require the creation of a new category of certified, digitally empowered health workers who act simultaneously as health coaches, social support case workers, and frontline diagnosticians. The creation of such a job category could attract new, tech-savvy talent to the health service field and provide a pathway for formalizing and extending the skills of home health workers, personal care aides, and family caregivers, who, according to Hayashi et al., "are the front line of keeping

[21] The recommendations that follow draw from multiple sources, including Litan (2008) and Kauffman Task Force on Cost-Effective Health Care Innovation (2012).

[22] The recent controversy about access to care in the Department of Veterans Affairs system is arguably, to a significant extent, a reflection of a broader skilled labor scarcity in medicine, particularly in primary care (American Association of Medical Colleges 2019). Part of the solution to this problem may be a relaxation of binding constraints on primary care residency training created by Medicare's 15-year-long freeze on subsidized residency slots (Rampell 2013).

patients at home, though they receive little or no training" (2009, 114).[23] In this way, the national objective of bending the cost curve in healthcare will intersect with that of increasing opportunity in the workforce—particularly among young people, who have a comparative advantage in the use of technology, and among a growing number of workers over 60, who have a comparative advantage in the care of generational peers (or near peers).

Policy recommendations to reduce labor market and regulatory barriers to entry include the following:

- States should reform licensing restrictions to allow nurse practitioners and other nonphysicians to do more in terms of chronic and wellness care.
- States should accelerate adoption of the Interstate Medical Licensure Compact (American Academy of Child and Adolescent Psychiatry Committee on Telepsychiatry and AACAP Committee on Quality Issues 2017).
- The US Department of Health and Human Services should engage in an active dialogue with health boards and associations regarding the adjustment of accreditation and certification procedures to include a new category of professionals who specialize in mobile healthcare delivery.
- Congress should act to make the Independence at Home demonstration a permanent program.[24]

[23] Citing a 1998 study from the Department of Health and Human Services, Hayashi et al. further note that "over three-quarters (78%) of adults receiving long-term care at home rely exclusively on informal caregiving" (2009, 115).
[24] Independence at Home is a national, fee-for-service Medicare demonstration; it has 14 participating practices and is both for-profit and nonprofit.

4.2. Technical Barriers to Entry

In a study from the early biotechnology industry in Cambridge, Massachusetts—the first municipality in the country to implement guidelines for biotechnology research—Lowe and Feldman (2008) document how clarity in regulations can help reduce the risk faced by early innovators. They quote a biotechnology entrepreneur who noted that locating in Cambridge "allowed [our firm] to fit into a set of regulations that the university and the community had already accepted. A regulatory framework that provided a social structure for these new activities really was an important [locational] aspect" (273). Despite significant advances in the past five years, lack of regulatory clarity remains a significant impediment to realizing the full benefits of distributed health service delivery.

Our federal system of government, although a strength in many respects, creates a set of challenges for innovators who must contend with 50 different state laws related to telehealth licensure and 50 different state laws around privacy (US Department of Health and Human Services 2010). A priority for policymakers at the state level is to reduce the impediments such laws create for innovators by reducing their complexity and increasing their consistency across municipalities.

Policy recommendations to reduce technical and regulatory barriers to entry include the following:

- The FDA should establish an interim approval stage for new mobile devices that are determined to be subject to regulation. During this phase, the new device will be released only to physicians who have been trained to handle it and will monitor the results.

- Federal government agencies and relevant state authorities should avoid actions that would impede the development of properly anonymized data generated and aggregated outside the medical system. Recognizing the difficulty of reaching convergence on data-sharing standards among medical service incumbents, governments at all levels should seek, whenever possible, to reinforce de facto standards for data sharing that emerge among communities of nonmedical health service providers and data users.
- CMS should extend its administrative flexibility, and states should adopt laws that allow greater portability of licensure for telehealth service providers (Brooks, Turvey, and Augusterfer 2013; Kramer, Kinn, and Mishkind 2015).
- States and the federal government should work to harmonize definitions and regulations (e.g., licensure and privacy) as they pertain to telehealth service provision, organizing around the practices in pioneering states that have most successfully achieved cost reductions and service improvements through the use of telehealth.
- Policymakers should renew their commitment to reducing regulatory barriers to the deployment of ubiquitous, high-reliability broadband service (on which mobile healthcare provision depends).
- Relevant federal agencies should work to ensure that privacy rules for mobile health service delivery are not substantially more restrictive or onerous than those that apply in other industries where privacy is a first-order concern (e.g., financial services and education).

References

American Academy of Child and Adolescent Psychiatry Committee on Telepsychiatry and AACAP Committee on Quality Issues. 2017. "Clinical Update: Telepsychiatry with Children and Adolescents." *Journal of the American Academy of Child & Adolescent Psychiatry* 56:875–93.

American Association of Medical Colleges. 2019. *2019 Update: The Complexities of Physician Supply and Demand: Projections from 2017 to 2032*. Washington, DC: American Association of Medical Colleges.

Bahrampour, Tara. 2014. "Through a Growing Number of Senior Villages in the D.C. Area, Aging in Place Becomes Easier." *Washington Post*, February 6.

Baig, Mirza Mansoor, Hamid Gholam Hosseini, Aasia A. Moqeem, Farhaan Mirza, and Maria Lindén. 2019. "Clinical Decision Support Systems in Hospital Care Using Ubiquitous Devices: Current Issues and Challenges." *Health Informatics Journal* 25:1091–104.

Baumol, William J. 1967. "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis." *American Economic Review* 57:415–26.

Beales, Julie Leftwich, and Thomas Edes. 2009. "Veteran's Affairs Home Based Primary Care." *Clinics in Geriatric Medicine* 25 (1): 149–54.

Benjamin, A. E. 1993. "An Historical Perspective on Home Care Policy." *Milbank Quarterly* 71 (1): 129–66.

Brooks, E., C. Turvey, and E. F. Augusterfer. 2013. "Provider Barriers to Telemental Health: Obstacles Overcome, Obstacles Remaining." *Telemedicine Journal and e-Health* 19:433–37.

Bureau of Labor Statistics. 2020. *Occupational Outlook Handbook*. Washington, DC: Bureau of Labor Statistics. https://www.bls.gov/ooh/.

Christensen, Clayton. 1997. *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*. Boston: Harvard Business School Press.

Christensen, Clayton M., Jerome H. Grossman, and Jason Hwang. 2008. *The Innovator's Prescription: A Disruptive Solution for Health Care*. New York: McGraw-Hill.

CMS (Centers for Medicare and Medicaid Services). 2019. "Independence at Home Demonstration Performance Year 5 Results: Fact Sheet." Press release, October 25.

Cortez, Nathan. 2014. "The Mobile Health Revolution?" *U.C. Davis Law Review* 47:1173–1230.

Cryer, Lesley, Scott B. Shannon, Melanie Van Amsterdam, and Bruce Leff. 2012. "Costs for 'Hospital at Home' Patients Were 19 Percent Lower, with Equal or Better Outcomes Compared to Similar Inpatients." *Health Affairs* 31:1237–43.

Cutler, David M., and Mark McClellan. 2001. "Is Technological Change in Medicine Worth It?" *Health Affairs* 20 (5): 11–29.

Cutler, David, Elizabeth Wikler, and Peter Basch. 2012. "Reducing Administrative Costs and Improving the Health Care System." *New England Journal of Medicine* 367:1875–78.

DeJonge, K. Eric, George Taler, and Peter A. Boling. 2009. "Independence at Home: Community-Based Care for Older Adults with Severe Chronic Illness." *Clinics in Geriatric Medicine* 25:155–69.

Dyrda, Laura. 2020. "Telehealth May See Big Long-Term Gains Due to COVID-19: 10 Observations." *Becker's Hospital Review*, April 17.

Eakin, Elizabeth G., Sheleigh P. Lawler, Corneel Vandelanotte, and Neville Owen. 2007. *Journal of Preventive Medicine* 32 (5): 419–34.

Egan, Emily. 2012. *VA Home Based Primary Care Program: A Primer and Lessons for Medicare*. Washington, DC: American Action Forum.

Ernst and Young. 2012a. *mHealth: Mobile Technology Poised to Enable a New Era in Health Care.* New York: Ernst and Young.

———. 2012b. *Progressions Global Life Sciences Report 2012: The Third Place—Health Care Everywhere*. New York: Ernst and Young.

Fair Health. 2019. "A Multilayered Analysis of Telehealth: How This Emerging Venue of Care Is Affecting the Healthcare Landscape." Unpublished white paper.

Fried, Carla. 2013. "Village People: Community Networks Help Boomers 'Age in Place.'" Bloomberg, January 24.

Gawande, Atul. 2009. *The Checklist Manifesto: How to Get Things Right*. New York: Metropolitan Books.

———. 2012. "Big Med." *New Yorker*, August 13.

Gordon, William J., and Christian Catalini. 2018. "Blockchain Technology for Healthcare: Facilitating the Transition to Patient-Driven Interoperability." *Computational and Structural Biotechnology Journal* 16:224–30.

Hayashi, Jennifer, Linda DeCherrie, Edward Ratner, and Peter A. Boling. 2009. "Workforce Development in Geriatric Home Care." *Clinics in Geriatric Medicine* 25:109–20.

Helland, Eric, and Alexander Tabarrok. 2019. *Why Are the Prices So D*mn High? Health, Education, and the Baumol Effect*. Arlington, VA: Mercatus Center at George Mason University.

Henry Kaiser Family Foundation. 2012. "Healthcare Costs, a Primer: Key Information on Healthcare Costs and Their Impact." Working paper, Henry Kaiser Family Foundation, Washington, DC.

Hodgson, Godfrey. 1973. "The Politics of American Health Care: What Is It Costing You?" *The Atlantic*, October.

Hwang, Jason, and Clayton M. Christensen. 2007. "Disruptive Innovation in Health Care Delivery: A Framework for Business-Model Innovation." *Health Affairs* 27:1329–35.

James, Brent C., and Lucy A. Savitz. 2011. "How Intermountain Trimmed Health Care Costs through Robust Quality Improvement Efforts." *Health Affairs* 30 (6): 1185–91.

Kao, Helen, Rebecca Conant, Theresa Soriano, and Wayne McCormick. 2009. "The Past, Present, and Future of House Calls." *Clinical Geriatric Medicine* 25 (1): 19–34.

Kauffman Task Force on Cost-Effective Health Care Innovation. 2012. "Valuing Health Care: Improving Productivity and Quality." Working paper, Kauffman Foundation, Kansas City, MO.

Klevens, R. Monina, Jonathan R. Edwards, Chesley L. Richards Jr., Teresa C. Horan, Robert P. Gaynes, Daniel A. Pollock, and Denise M. Cardo. 2007. "Estimating Health Care-Associated Infections and Deaths in U.S. Hospitals, 2002." *Public Health Reports* 122 (2): 160–66.

Kramer, G. M., J. T. Kinn, and M. C. Mishkind. 2015. "Legal, Regulatory, and Risk Management Issues in the Use of Technology to Deliver Mental Health Care." *Cognitive and Behavioral Practice* 22:258–68.

Lagasse, Jeff. 2020. "COVID-19 May Permanently Alter the Telehealth Landscape, from Reimbursement to Utilization." *Healthcare Finance News*, April 21, 2020.

Litan, Robert E. 2008. "Vital Signs via Broadband: Remote Health Monitoring Transmits Savings, Enhances Lives." Working paper, Better Health Care Together, Washington, DC.

Lowe, Nichola J., and Maryann P. Feldman. 2008. "Constructing Entrepreneurial Advantage: Consensus Building, Technological Uncertainty and Emerging Industries." *Cambridge Journal of Regions, Economy and Society* 1:265–84.

Mader, S. L., M. C. Medcraft, C. Joseph, K. L. Jenkins, N. Benton, K. Chapman, M. A. Donius, C. Baird, R. Harper, Y. Ansari, J. A. Jackson, and W. Schutzer. 2008. "Program at Home: A Veterans Affairs Healthcare Program to Deliver Hospital Care in the Home." *Journal of the American Geriatric Society* 56:2317–22.

Makary, Martin A., and Michael Daniel. 2016. “Medical Error: The Third-Leading Cause of Death in the US.” *BMJ* 353:i2139.

McGinnis, Michael. 2013. “Caring for the Health Commons: What It Is and Who’s Responsible for It.” Unpublished manuscript.

Mishori, Ranit. 2009. “Having Almost Become Extinct, House Calls Stage a Welcome Recovery.” *Washington Post*, March 24.

Murkofsky, Rachel L., and Karen Alston. 2009. “The Past, Present, and Future of Skilled Home Health Agency Care.” *Clinics in Geriatric Medicine* 25 (1): 1–17.

National Committee for Quality Assurance. 2018. *Serious Illness Care: Person-Driven Measures for Accountability*. Washington, DC: National Committee for Quality Assurance.

Ornstein, Katherine A., Bruce Leff, Kenneth E. Covinsky, Christine S. Ritchie, Alex D. Federman, Laken Roberts, Amy S. Kelley, Albert L. Siu, and Sarah L. Szanton. 2015. “Epidemiology of the Homebound Population in the United States.” *JAMA Internal Medicine* 175:1180–86.

Orszag, Peter. 2011. “How Health Care Can Save or Sink America: The Case for Reform and Fiscal Sustainability.” *Foreign Affairs*, July/August.

Portela, Alan. 2013. “Mobile Medical App Entrepreneurs: Changing the Face of Health Care.” Prepared testimony delivered before the House Committee on Small Business Subcommittee on Health and Technology, Washington, DC, June 27.

Rampell, Catherine. 2013. “Solving the Shortage in Primary Care Doctors.” *New York Times*, December 15, 2013, A5.

RAND. 2016. “The Evolving Role of Retail Clinics.” RAND Research Brief RB-9491-2. Santa Monica, CA: RAND Corporation.

Rauch, Jonathan. 2013. *Opportunity Knocks at Home: How Home-Based Primary Care Offers a Win-Win for U.S. Health Care*. Washington, DC: Brookings Institution.

Risse, G. B., R. L. Numbers, and J. W. Leavitt, eds. 1977. *Medicine without Doctors: Home Health Care in American History.* New York: Science History Publications.

Rockhealth. 2018. “2018 Year End Funding Report: Is Digital Health in a Bubble?” Unpublished report. https://rockhealth.com/reports/2018-year-end-funding-report-is-digital-health-in-a-bubble/.

Scott, R. Douglas, II. 2009. “The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention.” Working paper, Centers for Disease Control and Prevention, National Center for Preparedness, Detection, Division of Healthcare Quality Promotion. http://www.cdc.gov/hai/pdfs/hai/scott_costpaper.pdf.

Shepperd, S., H. Doll, R. M. Angus, M. J. Clarke, S. Iliffe, L. Kalra, N. A. Ricauda, V. Tibaldi, and A. D. Wilson. 2009. "Avoiding Hospital Admission through Provision of Hospital Care at Home: A Systematic Review and Meta-analysis of Individual Patient Data." *Canadian Medical Association Journal* 180 (2): 175–82.

Starfield, Barbara. 2000. "Is US Health Really the Best in the World?" *Journal of the American Medical Association* 284:483–85.

Starr, Paul. 1982. *The Social Transformation of American Medicine*. New York: Basic Books.

Terry, Nicolas P. 2013. "Information Technology's Failure to Disrupt Health Care." *Nevada Law Journal* 13:722–56.

Topol, Eric. 2012. *The Creative Destruction of Medicine: How the Digital Revolution Will Create Better Health Care*. New York: Basic Books.

US Department of Health and Human Services. 2010. *Special Report to the Senate Appropriations Committee: Telehealth Licensure Report*. Washington, DC: US Department of Health and Human Services.

Yao, Nengliang, Christine Ritchie, Fabian Camacho, and Bruce Leff. 2016. "Geographic Concentration of Home-Based Medical Care Providers." *Health Affairs* 35 (8): 1404–9.