Adam Seth Litwin, Cornell University
aslitwin@cornell.edu

Adam Seth Litwin is Associate Professor of Industrial and Labor Relations at Cornell University. He is also an associate editor of the *Industrial and Labor Relations Review*. As a technologist, he writes on issues involving technological change, work, and workers, much of which has been informed by industry studies in health care. His work has been recognized by the Sloan Foundation and the Aspen Institute, among others.
ABSTRACT:

The COVID-19 pandemic stressed the health care sector’s longstanding pain points, including the poor quality of frontline work and the staffing challenges that result from it. This has renewed interest in technology-centered approaches to achieving not only the “Triple Aim” of reducing costs while raising access and quality, but the “Quadruple Aim” of doing so without further squeezing wages and abrading job quality for frontline workers.

How can we leverage technology toward the achievement of the Quadruple Aim? I view this as a “grand challenge” for health care managers and policymakers. Those looking for guidance will find that most analyses of the workforce impact of technological change consider broad classes of technology such as computers or robots outside of any particular industry context. Further, they typically predict changes in work or labor market outcomes will come about at some ill-defined point in the medium to long run. This decontextualization and detemporization proves markedly problematic in the health care sector: the non-market, institutional factors driving technology adoption and implementation loom especially large in frontline care delivery, and managers and policymakers understandably must consider a well-defined, near-term, i.e., 5-10-year, time horizon.

This study is predicated on interviews with hospital and home health agency administrators, union representatives, health care information technology (IT) experts and consultants, and technology developers. I detail the near-term drivers and anticipated workforce impact of technological changes in frontline care delivery. With my emergent prescriptions for managers and policymakers, I hope to guide sectoral actors in using technology to address the “grand challenge” inherent to achieving the Quadruple Aim.

KEYWORDS:

1. health care workforce
2. health care management
3. health policy
4. health information technology (HIT)
5. Quadruple Aim
6. Triple Aim
INTRODUCTION
Neither managers nor health policymakers needed a pandemic to see the hardships facing health care’s frontline staff. Long before the word COVID entered our lexicon, low pay and poor working conditions drove a structural shortage of labor willing to undertake work as orderlies, licensed practical nurses (LPNs), certified nursing assistants (CNAs), and home health and personal care aides, among other roles. Even in the best of times, this hindered efforts to achieve the vaunted “Triple Aim”—the phrase coined by Berwick, Nolan, and Whittington (2008)—of boosting access and care quality while simultaneously reducing costs.1 Less than a decade later industry scholars and insiders grew concerned that administrators and policymakers might inch toward the Triple Aim on the backs of beleaguered frontline workers. In response, Bodenheimer and Sinsky (2014: 573) recommended augmenting it by “adding the goal of improving the work life of health care providers, including clinicians and staff,” thus conceiving of the “Quadruple Aim.”

While concerns over the health care workforce are not new, the pandemic spotlighted them, drawing the notice of the media and other once passive consumers or observers of the sector. This COVID-induced attention has fomented interest in technological solutions. For example, journalists note that increased reliance on service robots could reduce demand for environmental service (EVS) workers as well as orderlies and those transporting food, drugs, and linens in hospital hallways. That not only allows administrators to reallocate the pandemic-stretched frontline workforce, but also to reduce the number of “essential” workers exposed to SARS-CoV-2 (e.g., Hetrick, 2020; Lerman, 2020). They also surmise that employers will continue substituting technology for labor once the pandemic passes. Were this to occur, the improved optimization of costs, access, and quality could come at the expense of even more downward pressure on wages and working conditions. Furthermore, given that information technology (IT), robots, and the like will never operate completely independently of collaborating human labor, this ill-planned, almost accidental technological substitution could actually dampen the effectiveness of the technology itself.

Sectoral managers and policymakers grappling with these issues will discover a spate of research on the drivers of technological change and the effects of these changes on work and workers. To its credit, social science has transcended simple dichotomies of manual vs. cognitive and low-skill vs. high-skill to consider exactly what different technologies excel at and where they fall short. Unfortunately, most of this research aims to induce broad, generalizable principles, robbing its findings of specificity and applicability for managers. Nowhere is this more apparent than in the health care sector.

In most settings, one can reasonably assume administrators or managers undertake something of a cost-benefit analysis when considering a technological investment. The same is true of health care provider organizations. However, in health care, the non-market, institutional factors driving technology adoption and implementation loom especially large. Aside from the general discombobulation that arises from separating the delivery of care from its financing, other factors, both economic and moral, justify an active role for policymakers. And, when policymakers and administrators seek guidance from researchers, they will find large-n, cross-industry analyses. These studies assume the conventional calculus of costs and benefits will dominate at some point in the ill-defined “long run,” and conclude that some technologies will “displace” workers while others will “augment” them. This lacks the specificity, credibility, and actionability that policymakers and administrators require.

1 Purists will rightly note that this distillation of the “Triple Aim” sounds more like Kissick’s (1994) “Iron Triangle of Health Care” in which cost containment, system access, and care quality necessarily trade off of one another. I follow Ford (2018), among others, in casting the Triple Aim in these terms.
This piece aims to provide all three (specificity, credibility, and actionability) to those eager to make sense of these issues in such an anomalous context. It does so via interviews with relevant actors—including health care administrators, technology developers, and union leaders—as well as analyses of secondary data, in an effort to answer three, overarching questions. First, while health care providers are assuredly motivated by costs and benefits, how does that play out on the ground, particularly when neither those providing nor receiving the care are the ones paying for it? That is, what factors are likely to drive technology adoption and implementation in the U.S. health care industry? Second, rather than assuming that “computers” or artificial intelligence (AI) writ large will remake frontline care delivery, I ask what are the new technologies that have the potential to affect employment, wages, skill requirements, and the organization of work? And, third, what are the potential consequences of these technologies for the frontline workforce?

I find that employers can implement seemingly identical technologies along two very distinct paths leading to radically different labor market outcomes for frontline workers. Since it falls to policymakers to craft the right sorts of incentives for employers and provider organizations, I outline the key “choice points” that will guide us toward and then along the more broadly beneficial path for the full range of stakeholders. This path, which I refer to as the “high road,” has the Quadruple Aim as its destination rather than just some or even perhaps all of the legs of the Triple Aim. Along the high road, the benefits of technological change are shared among patients, providers, and health care workers. I conclude that emerging technologies will only benefit frontline workers if organizations deploy them 1.) toward the fulfillment of value-based care; 2.) under the auspices of policymakers and managers open to experimentation; and 3.) via the adoption of work-centered rather than technology-centered design and implementation processes.

The remainder of the Introduction explains the “industry studies” research approach I adopt as well as the data and methods underpinning the subsequent analysis. The following sections offer primers on the frontline health care workforce and the idiosyncratic nature of the sector as well as a brief look at two useful analytical frameworks. Each of three subsequent sections tackles one of the organizing questions detailed above, after which I map and describe the “high road” path and the managerial and policy choices that will help us get there.

**Approach and Data**

Most social science research begins with an overarching theory that it then sets out to prove or improve. Investigators balance the twin goals of internal and external validity, aiming to generate credibly causal but suitably generalizable results. In doing so, they must often ignore the complex mix of processes generating their empirical data. Unfortunately, this approach proves more useful for researchers than for those looking to apply the research. With respect to technological change, these adoption and deployment processes may well differ between the production of steel for construction companies, frozen food for consumers, education for children, and health care for patients. Consequently, even carefully undertaken social science research in this space may lack specificity, credibility, and actionability to administrators, policymakers, and others looking to science for the “right” answers. For these purposes, industry studies researchers offer an alternative approach. Industry studies research respects existing theories and explanations, but privileges the idiosyncratic, data-generating processes of clearly-defined economic sectors and the markets, firms, organizations, workplaces, and other institutions through which they operate on the ground. These studies, whose early exemplars include Adam Smith’s (1776) analysis of the division of labor in a pin factory and John R. Commons’s (1909) longitudinal investigation of cobbler, continue into the present and into the health care sector, as illustrated by Osterman’s (2017: xvii-xviii) recent treatment of the long-term care sector. In teeing up the study, he notes
We need to examine...the labor market circumstances of employees, the incentives facing employers, and the larger legal, political, and regulatory systems within which they operate. What combination of incentives, exposure to new ideas, availability of skilled workers, regulatory reform, and pressure will lead employers to rethink how they organize their work and structure their production?"

The present study, predicated on one of a series of industry studies of the workforce impact of technological change, does the same. It unabashedly sublimates practitioners’ and policymakers’ need for causal credibility over disciplinary researchers’ need for generalizability. It relies on primary data in the form of interviews with such sectoral actors as hospital and home health agency administrators, union representatives, and health care IT experts and consultants. I also attended health care technology conferences and trade shows to speak less formally to investors, consultants, developers, and others active in the frontline health care technology space. All told, I conducted 32 interviews, either in person or via web or telephone. I also employed existing research to explain or flesh out ideas inspired in the initial analysis of the primary data. Finally, I used government-collected labor market data as a basis for situating this report, in particular, for illuminating trends in pay and employment.

THE FRONTLINE HEALTH CARE WORKFORCE IN THE U.S.

The Jobs

The healthcare sector stands above most others in terms of its contribution to total employment, either presently or projected. On the eve of the pandemic, total employment in the U.S. sat at 152 million—with health care making up about 12% (BLS, 2018b; Kaiser Family Foundation, 2020). As shown in Fig. 1, of the occupations I analyze, nurses are the largest as about 2.6 million of them presently work in the sector. Note also there are nearly 2.1 million personal care aides, whom we will see have far fewer skills and receive much lower pay. The totals for food service workers, janitors, and laundry workers include only those employed in the health care sector. With respect to 10-year projections, health care and its associated occupations are expected to account for a large share of new jobs projected through 2028, due in large part to demographic shifts (BLS, 2018a). Overall, fully 40% of the 8.9 million new jobs expected to be created will be in health care and social assistance, increasing the sector’s share of overall employment from 12.4% in 2018 to 13.8% in 2028. And, eight of the 30 fastest-growing occupations fall within the sector. By 2028, if not sooner, health care will be the largest major employment sector in the U.S.

Turning to specifics in Fig. 2, BLS predicts job growth of nearly 18.8% in health care relative to an economywide projection of 5.2%. We see the largest projected job growth for home health aides (36.6% projected job growth), personal care aides (36.4%), and RNs (12.1%)—the last of which is actually the highest paid and most unionized job class analyzed. Unfortunately, both of the direct care jobs anticipating sizable demand increases pay poorly and require, at most, a high school education. Interestingly, demand for laundry workers in the sector is projected to fall, despite the fact that across-the-board demand for these workers (not shown in the figure) is expected to increase slightly. Medical transcriptionists are the only other occupation I analyze showing negative projected growth over the 10-year time horizon. While speech recognition technology could be a

---

2 For the full study from which I condensed this paper, see Litwin (2020b). The other studies in the series include Benner, Mason, Carré, and Tilly (2020); Gutelius and Theodore (2019), Carré, Tilly, Benner, and Mason (2020), and Viscelli (2018).
future driver of job decay for this occupation, these numbers probably stem from the transition from paper-based health records to EHRs, into which most practitioners just enter patient data directly.

The generally favorable findings with respect to the quantity of jobs does not extend to a description of their quality. Fig. 3 shows median annual earnings, first for all U.S. workers, then for the entire health care sector, and finally for the occupations that I consider. While not my focus, I also have included for comparative purposes the wages for physicians and surgeons. [—Insert Fig. 3 about here.—]

At first glance, sectoral pay appears to exceed that for all occupations economywide—a fact driven mostly by salaries for physicians and surgeons. Note that of the occupations on which I focus, LPNs, medical records technicians, and RNs earn more than the median worker economywide. RNs, in particular, make 86% more than the median worker economywide.

However, many jobs earn less than the national median, including home health aides and personal care aides. Laundry workers make the least of any of the occupations in Fig. 3, 40% less than the median U.S. earner. Janitors and cleaners are not paid much better. In the case of laundry workers and janitors, wages are less likely to be buoyed by health care sector-specific wage norms, since so many of these incumbents do not work in the health care sector at all. And, even those that may visibly appear to work in health care settings often work for contractors, further driving down their wages relative to those they work alongside (Bernhardt, Batt, Houseman, & Appelbaum, 2016).

While I can hardly overstate the importance of wages, they are but one measure of job quality. Given the physical nature of frontline health care work, I might also assess job quality on the basis of workplace injuries or illnesses. The injury data plotted in Fig. 4 aid us in this effort. As depicted, the likelihood of incurring an injury or illness in health care varies a great deal by occupation. Those occupations that are less hands-on incur substantially fewer injuries and illnesses than the economywide average. Others, namely CNAs and orderlies, incur substantially more injuries and illnesses, explaining why both score so poorly on this facet of job quality. [—Insert Fig. 4 about here.—]

As I will detail later, U.S. employers—not the government—serve as the primary conduit for health care access. Employers are motivated both economically and normatively to provide workers quality health insurance, sometimes directly and other times through union health plans. Thus, access to employer- or union-provided health insurance, while becoming more rare, remains a principal attribute of a “good” job (Litwin & Phan, 2013). [—Insert Fig. 5 about here.—]

Fig. 5 shows the rates for employer- or union-provided health insurance for the same set of occupations examined in previous figures. Perhaps owing in part to their high union density, 82% of RNs report such access to employer-provided health care, more than any other listed occupation. However, the entire sector reports access to health insurance at a rate that is 22% greater than the economy at large. Just three occupations offer workers insurance less than 40% of the time—home health aides, laundry workers, and personal care aides. Direct care workers, in particular, work for cash-strapped, private home care agencies, making these employees poorly compensated and presenting a challenge for them to join together to form a union.

While I focus more on economic proxies for job quality, psychological ones paint a similarly grim picture. Broad survey evidence collected long before the pandemic suggests that RNs are burnt out, dissatisfied, and frustrated with their work (McHugh, Kutney-Lee, Cimiotti, Sloane, & Aiken, 2011; White, Aiken, Sloane, & McHugh, 2020). Those lower on the skills ladder report similar symptoms, exacerbated by having to balance the often conflicting demands of their superiors with those of patients (Dixon, Tompkins, Allgar, & Wright, 2004; Eisner & Britten, 1999).
RUNNING HEADER: Technological Change in Health Care Delivery

The Workers

Women and people of color hold a disproportionate share of jobs in the sector, as shown in Table 1. Women comprise 48.3% of employment across all occupations in the U.S.; relative to that baseline, women are overrepresented in all but two of the occupations I analyze—janitors and orderlies.

The table illustrates a similar trend with respect to race. Black workers represent 11.7% of the workforce across all occupations; they are overrepresented in every one of the occupations shown in Table 1 except for medical transcriptionists and RNs. Latinos make up 16% of workers across all occupations, but are overrepresented in what turn out to be three of the lowest-paying occupations. Finally, note that Asian workers, who make up 8.7% of all U.S. workers, are overrepresented in the health care sector compared to the rest of the economy. The physicians and surgeons category—not shown in the table—accounts for some of this. However, Asian workers also make up a disproportionate share of home health and personal care aides as well as RNs.

Table 2 reveals that workers in the health care sector have completed more education, on average, than workers economywide. More than one-third of the U.S. workforce has a high school diploma (or equivalent) or less, whereas just less than one-quarter (22.7%) of health care workers report that level of education. In fact, 60.1% of RNs have earned a bachelor’s degree or more. Nonetheless, five of the occupations I analyze are majority populated by those without any tertiary education. Nearly half of home health and personal care aides, in particular, report having a high school education or less.

While I do not show it graphically, overall, health care workers skew older than the broader labor force. Across the economy, about a quarter of the workforce is 55 or older. Aside from CNAs and orderlies, every health care profession finds this age group overrepresented. That suggests that shortages, where they already exist, are likely to worsen, which could encourage technological solutions even for jobs that cannot be easily automated.

Frontline health care workers also stand out with respect to union membership. Relative to the rest of the economy (and excepting public education), collective bargaining continues to thrive in the health care sector. Fig. 6 provides comparative data on union density. Overall private-sector union density currently sits at 6.2%, but sectoral density is some 40% greater (8.8%). While these data are broken down slightly differently than the data underpinning the demographic analysis, three occupational categories shown here, including LPNs and RNs, have densities greater than the economywide average of 10%. Consequently, we can reasonably consider unions and collective bargaining as an institutional tool for influencing the adoption and impact of technology in frontline care delivery.

BACKGROUND

Economics and business textbooks declare the prototypical firm will invest in new technology when the benefits from doing so exceed the costs. When seeking to explain how these investments in “technological capital” will impact employment and wages—“human capital”—at these same firms, an instructor would ask whether these two production inputs complement or substitute for one another in production. Perhaps this makes for a sensible start, but the peculiar structure of the health care sector, not to mention the nature of managerial power in organizations, hinders the applicability of this approach to the health care sector.

A Sector Like No Other
Health care administrators and policymakers hardly need a lesson in what makes the sector so anomalous. But, given the implications of these idiosyncrasies for technology investment, I highlight some key distinctions here. Namely, most health care providers contemplating investment in a given technology are ill-positioned to appropriate its benefits. This stems from the nation’s historical and institutional separation between the financing and delivery of care, which drives a wedge between “customer,” i.e., the patient, and the “payer,” i.e., the party actually paying for care. Fig. 7 depicts this system. The striped and dashed arrows represent flows of money and of services, respectively.

Were this a market like most others, the figure would show a dyadic relationship between the patient and their provider, with payments flowing toward the provider and services back to the patient. In this case though, the patient sits between a column of payers, represented by the rounded boxes along the left-hand side, and a similar flank of providers, represented in triangles down the right-hand side. Those delivering frontline care staff this latter set of organizations and care settings.

With notable exceptions, patients do not pay their providers directly. Rather, patients pay their employers via foregone wages, the government via taxes, and private insurers via conventional monthly premiums. Employers also pay taxes to state and federal entities and premiums to private insurers, from which the payers—namely Medicare, Medicaid, and private insurance—pay the providers.

Perhaps the single most important driver of technological investment and its impact on the frontline workforce derives from one key contingency—the arrangements under which payers actually compensate providers. There are two archetypical financing models—conventional fee-for-service (FFS) and a more recent and innovative set of practices that fall into a category I label value-based care (VBC). In neither case do providers set prices based on their own costs—including investment and debt service on technology investments—and a careful consideration of what customers and the market will bear—again, the tacit assumption when thinking about how businesses face technology investment decisions economywide.

Under the conventional FFS model, the health plan, i.e., the insurer, pays the provider on a claim-by-claim basis according to pre-negotiated rules regarding what procedures are covered and at what rate. The provider then pockets the difference between what it collects from the payer (plus co-payments or co-insurance from the patient) and the cost of providing the care. Consequently, providers benefit from providing the services of each claim as efficiently as possible and from generating as many reimbursable claims as possible, with an emphasis on those treatments that leave more claims revenue in excess of costs.

Alternatively, rather than paying providers on the basis of individual claims, insurers can contract to reimburse providers on a capitated basis, usually per-member-per-month (PMPM). Under the VBC model, the provider internalizes the risk of its patient population, effectively assuming the role of health care insurer or health plan in addition to its role as health care provider. The provider must finance all necessary care from the capitated payment (once again, plus co-payments or co-insurance from the patient), leaving the residual revenue after costs of care delivery as its profit.

This distinction is far from semantic. Neither model can elide the high fixed costs associated with getting new technologies online, including the necessary training and work process reorganization. But, the FFS model inclines providers to invest in technology that increases patient throughput and the number of billed services, with an eye toward those services that can be rendered and billed for most profitably. The VBC model instead drives providers to invest in technology that prevents patients from needing costly treatments, namely by improved prevention and management of

---

3 Fig. 7 is a simplified version of that found in Cohn (2009).
chronic diseases—an issue that has become more acute as patients live longer and with more complicated co-morbidities. It also rewards improved provider coordination, to the extent such coordination improves the quality and efficiency of care delivery (Gittell et al., 2000).

Aside from influencing providers’ incentives to adopt new technologies, payment models constrain the behavior of provider organizations as employers. Historically, the FFS model left providers relatively flush with cash, as plans placed few limits on the number and nature of claims providers could submit for reimbursement. This increased the overall size of the pie available for dividing between provider organizations and their employees. In contrast, the VBC model forces providers to be more cost conscious, since the amount of monthly income is fixed. Thus, the VBC model yields a smaller pie, suggesting greater constraints to wage-setting for those providers operating chiefly under the VBC model.

This explanation admittedly exaggerates the binary distinction between the FFS and VBC models. Most health plans marketed today contain at least some cost-sharing and care-management elements indicative of the VBC model. Government policies promote VBC, and insurers, who have long seen value in it, have become increasingly able to sell it to employers and policyholders as a cheaper form of care delivery.

With respect to technological investment, there are two key upshots to the transition from FFS to VBC. First, the sector will likely under-invest in technologies that could actually benefit the patient and the system writ large, particularly where elements of the FFS model persist. All alone, this discrepancy between the “private” and the “social” benefits of technology investment sets the stage for a policy fix. Second, this separation suggests that while VBC may promote technological investment, it does so outside of the better-resourced FFS model. Thus, workers will not automatically share in whatever gains the technology engenders, and in fact may see resources redirected from wages and benefits toward technology investment and debt service.

Broad Theories of the Labor Market Impact of Technological Change
Despite their shortcomings, broad-based academic studies of technological change offer at least two useful frameworks. I summarize them very briefly here.

Scale, Substitution, and Reinstatement Effects
In analyzing and then diagnosing the labor market impact of technological change, economists discern between substitution and scale effects. More recent literature has added another effect it labels reinstatement. By default, those concerned with technological displacement tend to focus on the first of these: if the cost of technology falls relative to the cost of labor, i.e., wages, then employers will want to shift their resources from labor to capital, thereby making production or service delivery more capital-intensive and less labor-intensive. Consequently, demand for labor will fall, eroding employment, wages, and job quality writ large. This technological substitution, which for some workers might lead to unemployment, has become the dominant upshot of the more apocalyptic, often less sectorally grounded treatments of the impact of technological change (e.g., Kaplan, 2015; Rifkin, 1995).

Fortunately for workers, technological change drives at least two mitigating effects as well. By reducing the overall costs of production or service delivery, technological changes allow the employer to produce more than he or she had been. This scale effect will lead to increased use of all production inputs, including labor. As a result, in this case, the positive scale effects resulting from technological advances will at least partially offset the negative substitution effects arising from those same advances. More recently, Acemoglu and Restrepo (2019) have pointed out that just as new technologies assume some of the work once done by human labor, they also engender new tasks for labor. Thus, reinstatement works much the same way as scale to counter the displacement
effects associated with technological substitution. Which effects dominate—and therefore, whether workers benefit or suffer, in the net—thus becomes an empirical question, one that cannot be answered by textbook theory alone. Indeed, this theoretical ambiguity is what calls for studies like this one that examine a single sector or specific technologies in depth. With respect to health care and as I will discuss, the likelihood of a long-term, limitless structural increase in the demand for care should cushion workers from potentially impactful technological advances. Nonetheless, even if researchers could sort this out, it remains the case that those workers bearing the brunt of substitution will not necessarily be the same ones that benefit from scale and reinstatement effects. Indeed, scholars of organizations, work, and employment, among other fields are more likely to shed light in these issues.

Work-Centered vs. Technology-Centered Adoption
The notion of a work-centered approach to technology adoption comes from the distinction technologists have long made between technology-centered and human-centered technology design. The former represents the dominant and default paradigm in which developers strive as best they can to minimize the role of humans in the production or service delivery process. In other words, they automate as many functions as possible, leaving the residual functions to human workers. Technology-centeredness derives from an assumption that people are clumsy and error-prone relative to the machines that could replace them (Carr, 2014: 160). University engineering programs perhaps unintentionally reinforce this doctrine by depriving students of training in anything related to “human factors.”

We all know inept humans. However, tech-centeredness ignores the fact that technology itself remains fallible. And, when a computer malfunctions, it will require a worker to step in to correct the problem and to undertake the tasks designers had intended the machine to do. What happens, however, when those few remaining workers find their skills have atrophied? Even more problematic, in a hospital setting, even those whose skills have yet to go stale still may lack the situational awareness to step directly into a dire situation that calls for immediate action.

Human-centered design begins not with an evaluation of the technology’s capabilities, but rather with “careful evaluation of the strengths and limitations of the people who will be operating or otherwise interacting with the machine” (Carr, 2014: 164). In fact, human-centered design forms the core of my notion of a work-centered approach to technology adoption or automation.

Aside from human-centered design principles, work-centered automation also implies an integrated (cf. sequential) approach in the adopting organization, i.e., the medical office, hospital, or home health agency, in the case of frontline care delivery. It begins with the employer’s evaluation of their people rather than with the technology vendor’s attempt to minimize the need for labor. It then calls for greater worker involvement in how the technology is configured, deployed, and iteratively improved upon (Arora, Dyer, & Kochan, 2020)—all of which has been shown to improve its effectiveness in health care settings, in particular (Litwin, 2011). If necessary, one could justify this technology-related manifestation of worker voice entirely on efficiency or instrumental grounds, as it will leverage frontline workers’ deep knowledge of the care delivery process while helping employers achieve necessary buy-in. Other would argue that “voice is important...” in its own right, “...whether or not it improves economic performance, and whether or not it alters the distribution of economic rewards” (Budd, 2004: 13).

SECTOR-SPECIFIC DRIVERS OF TECHNOLOGY ADOPTION
Technology could well aid us in reaching the Triple Aim. The “grand challenge,” however, comes in attaining or at least approaching the Triple Aim without exacerbating existing workforce-related problems. My interviews revealed four “imperatives” transpiring on the ground as the sector and
provider organizations reach for the Triple Aim—(1) increasing access, (2) responding to demographic trends, (3) consolidating and coordinating, and (4) facilitating chronic disease prevention and management. The first two are rooted in societal goals, suggesting that the impetus comes from policymakers. The latter two are organizational responses to the economics of care provision, at least as they shine through the prism of our existing institutions for care financing.

To start, policymakers have long been pressuring providers to increase access. As a rule, providers embrace this directive, particularly when governments subsidize it or payers fund it. In simplest terms, increasing access to care amounts to increasing the share of the U.S. population with health insurance. The Affordable Care Act took direct aim at this issue, and did reduce the uninsured share of the population to below 10%. The Department of Health and Human Services (DHS) has a number of other objective measures of access it aims to boost. For example, DHS hopes to increase the proportion of the population with coverage for clinical preventive services as well as the share of the population with a “usual primary care provider.” Following this, the agency also recognizes the relative shortage of primary care providers and has developed a set of sub-goals for addressing this issue as a means of increasing access (DHS, 2019). And, as the lack of access disproportionately impacts POC, it may help explain the disproportionate toll that COVID-19 has taken on communities of color (Tai, Shah, Doubeni, Sia, & Wieland, 2021; Wilder, 2021).

Increasing access almost certainly requires policy solutions along the lines of the ACA. However, new forms of technology that facilitate patients’ access to medical services, particularly once these services are covered by public or private payers, may also help along these lines. Increasing access also increases costs—but using technology can mitigate these higher costs, particularly if doing so increases access without a concomitant need for more staff.

Similarly, policymakers have pressured providers to prepare for and respond to changing demographics. Life expectancy in the United States has risen slowly but steadily since 1960—from 54.6 to 74.3 years for women and from 50.7 to 70.0 years for men (World Bank, 2018). Add to this the arrival of the baby boomer generation into retirement, several decades of declining birth rates, and restrictive immigration policies, and the implications start to take shape. While we welcome improvements in the treatment and prevention of life-shortening medical conditions, we also must recognize the challenges of an aging population from a health policy perspective—namely, increased prevalence of chronic and co-morbid conditions and thus, a swelling of unmet demand for long-term care that will continue into the foreseeable future. The shortage of direct care providers will be even more pronounced in rural areas, which have higher proportions of elderly, disabled, and impoverished residents, implying elevated levels of Medicare and Medicaid eligibility and enrollment (Baernholdt, Yan, Hinton, Rose, & Mattos, 2012).

The elderly and the otherwise infirm often require regular, ongoing care, and understandably, prefer to receive that care at home. In many ways, the desire to age in place, while originating with the patient, also allows for the most cost-effective method and location of care delivery. However, it also necessitates the mobilization of an entire sub-sector of direct home care workers—namely home health aides and personal care attendants. And, as Osterman (2017) has documented, the haphazard way in which the sector has been allowed to evolve appears unsustainable.

In the course of responding to these policy pressures as well as broader economic exigencies, provider organizations have taken other steps that influence the size and shape of technological change. Sectoral consolidation has been the primary structural response to runaway costs and the fixed-cost intensity of care delivery, not to mention the increasing bargaining power of private payers. Consolidation generally takes the form of a merger of two to three community hospitals, sometimes under the umbrella of a large hospital chain. Aside from creating more opportunities for hospitals to leverage scale economies, these mergers imbue inpatient providers with more bargaining power vis-à-vis the insurers with whom they must negotiate. This same bargaining power
brought about by horizontal integration may also translate into monopolization of the product market, with all of the usual pitfalls for “customers”—patients, in this case.

Increases in organizational scope—like those in size—have also become more apparent over the last decade. Vertical integration—incorporating multiple parts of the production or service-delivery process under a single organization’s control—is usually considered in a manufacturing context, but it works in the health care sector also. A single health care provider organization can coordinate across one or more hospitals, a host of primary care and specialist physician medical offices, outpatient care or surgical centers, skilled nursing facilities, and home health agencies. Doing so could facilitate transitions from one care setting to another as well as improve coordination of care more broadly. To the extent the ACA and other institutions have promoted a shift from FFS to VBC, this coordination can deliver the sorts of cost reductions and quality improvements that create value that providers can actually appropriate. And, if providers can capture at least some of that value, they are likely to invest in technologies that can help them do so.

Consolidation and increased coordination of care delivery, when engendered by changes in payment models, also puts responsibility on providers for such costly chronic conditions as diabetes and congestive heart failure, thus encouraging investments in population health management and chronic disease prevention. It also focuses providers’ efforts on reducing what otherwise amounts to a substantial portion of the nation’s $3.3 trillion annual health care bill.

That a clearly defined entity bears financial responsibility for chronic conditions paves the way for the transition away from what some derisively label a “sick care” system as opposed to a health care one. However, this transition also necessitates a complete switch from the episodic treatment of acute health conditions to the management and ideally prevention of chronic, debilitating, and often terminal ones—physical or mental conditions that last more than a year and cause functional restrictions or require ongoing monitoring and treatment. Fully 60% of adults in the U.S. have one or more of these conditions, inclusive of hypertension, lipid disorders, diabetes, asthma, osteoarthritis, and mood and anxiety disorders (Buttorff, Ruder, & Bauman, 2017). Whereas treatment requires waiting for the onset of symptoms, prevention calls for upfront monitoring, health coaching, and patient education. As a number of sources told us, treatment often takes place in a hospital, where care delivery is costly, dangerous, and inefficient; prevention takes place elsewhere, often even in the patient’s home. Thus, as one respondent noted, this imperative drives the larger movement to “keep patients away from the hospital.”

Like prevention, disease management similarly requires that patients be guided, reminding them to take their medication, to remember to get refills and keep their doctor’s appointments, and, more broadly, to engage in health-enhancing behaviors such as exercise and to refrain from health-eroding behaviors, e.g., smoking. Since this requires creating and maintaining regular lines of communication between providers and patients—even when the patient may be relatively asymptomatic—many of the same technological solutions called on to reduce barriers to access can similarly aid efforts to prevent and manage chronic diseases. Finally, while increased preventive care could not have forestalled the spread of the novel coronavirus per se, it could have made those with asthma, diabetes, and other COVID-19 risk factors—again, disproportionately the poor and POC—more resilient to SARS-CoV-2.

TECHNOLOGIES MOST LIKELY TO INFLUENCE FRONTLINE HEALTH CARE WORK

My sources offered up dozens of specific manifestations and applications of new technologies just now beginning to diffuse across the sector. From this emerged three admittedly overlapping

---

4 Marianne Williamson, a longshot candidate for the Democratic nomination in the 2020 U.S. presidential election, used this phrase frequently. She may have first read it in Marvasti and Stafford (2012).
technology types or “families,” listed along the left-hand side of Table 3. Along the top of the table are the four imperatives outlined in the previous section.

[—Insert Table 3 about here. —]  

**Digital Communications, Telehealth, and Telepresence**  
Every significant technological advance that arose in my interviews relies on the vast improvements in digital communications of the last two decades. Broadband and wireless technologies power telehealth and telepresence more broadly, not to mention an endless list of smartphone apps that will impinge on care delivery. In simplest terms, this category includes one’s smartphone and internet-connected computer. In their first incarnation, these devices provided patients with a wealth of information of inconsistent quality that could be used to self-diagnose, self-treat, or perhaps to better understand information provided to them by their physician (Adams, 2010; Gottlieb, 2000). However, respondents made clear that as bandwidth and processing power become cheaper, providers themselves increasingly embrace these technologies in ways that respond to the four sectoral imperatives.  

While the shift from paper-based records to integrated EHRs is now largely finished in both the hospital and medical office settings, nearly all of the respondents referenced the plodding acceptance and use of digital communications technologies in the health care space. Multiple respondents also noted that EHRs, finally firmly ensconced in care-delivery routines, are now being optimized toward care coordination, particularly across large, multiple-setting care delivery systems. In this sense, providers lean on digital communications technology to respond directly to the consolidation and coordination imperative.  

Interestingly, in the course of discussing the initial deployment and subsequent optimization of EHR systems, some interviewees also recounted unpleasant memories of the transition from paper. The legacy of organizational and technological hiccups seems to have weighed on the minds of providers, suggesting why they are just now starting to push the bounds of the technology in ways that paper-based systems or even nonintegrated digital systems simply did not allow (Jamoom, Heisey-Grove, Yang, & Scanlon, 2016; Sieja et al., 2019). As a result, increasing comfort with and use of these technologies facilitates the growth of hospitals and health delivery systems both in terms of their size and the range of services they can offer and coordinate across. Notwithstanding the negatives of concentrated market power, larger hospital systems theoretically could increase access for patients. Similarly, I learned that digital communications technologies can further extend the reach of a health system by allowing for “virtual hospitals,” in which specialists care for patients at a distance. While the COVID-19 pandemic has brought renewed attention to digitally enabled, remotely provided care, the concept is by no means new or untested.  

Aside from hospitals providing specialty care remotely to chronically ill patients in their own homes, hospitals can now assume telemetry work that once had to be done onsite. This allows technologically-advanced hospitals to serve as digital data hubs for other, usually smaller, often rural hospitals. In this case, physicians and nurses based at the “hub” monitor patients and digest vast streams of data generated through the conventional, remote hospital’s EHR and telemetric systems, freeing up the minds of onsite providers to “pay more attention to the patients and less to the machines” (Allen, 2017). Managers and administrators say this spatial division of labor and innovative use of multiple data streams facilitates the diagnosis of sepsis or the onset of a stroke, for example, to a degree that busy, onsite providers generally cannot match.  

Of course, the improved capability and reliability of internet-enabled devices has cleared the path for telehealth, defined broadly as the distribution of health-related services and information via IT. Included under telehealth are endless sub-categories capturing the provision of different health care services, including telepharmacy, telepsychiatry and, most commonly, telemedicine.
Even prior to the pandemic, telemedicine—which typically denotes the provision of remote clinical services, including diagnosis and monitoring—presented what I see as among the most compelling threats to existing models of care delivery. Entirely new companies have sprung up to provide routine, ambulatory care to patients via their computers, smartphones, and tablets. These companies offer virtual urgent care and behavioral health services in all 50 states. A small part of their business is direct-to-consumer or direct-to-patient services, where the patient pays a per-appointment fee regardless of their insurance status. The majority of their business, however, comes through contracts with health plans or with large, self-insured employers, who pay a capitated, per-member-per-month (PMPM) or per employee- per-month (PEPM) fee, and then a discounted per-visit fee. And, depending on the terms of the patient’s policy, he or she also will be charged a co-payment or co-insurance fee, much like for a conventional office visit.

Primary care physicians, already strapped due to a shortage in their ranks, seem to appreciate that some of their patients have an alternative avenue for receiving routine care quickly and efficiently. Those developing these technologies reminded us that clinicians have essentially been providing uncompensated telemedicine services for years, in the form of answering quick questions or returning and explaining lab results, for example. Thus, they report, the redirection allows primary care physicians (PCPs) to focus on cases for which they actually can bill: those they deliver in person, that are less routine and less clear-cut, and thus, more in need of their expert judgement.

Providers can rely on this technology to respond to another imperative—providing virtual monitoring and management of such chronic diseases as diabetes and hypertension. With respect to the pandemic, this could prove helpful in caring for those who think they may have been exposed to or are suffering from COVID-19. A number of innovators have taken virtual patient monitoring and disease management one step further, removing the physician or other provider from the interaction altogether by embedding specialist knowledge in mobile apps. These apps prompt the patient to enter information at regular intervals and sometimes accept information more passively from activity trackers, glucometers, or other devices. They then process this information to provide the patient with alerts and reminders based on accepted treatment protocols and best practices.

There is another avenue by which this technology responds to the chronic care imperative. Too often, those with chronic conditions forgo regular appointments for monitoring and disease management, seeing them as too bothersome or inconvenient. Recall that the structural shortage of primary care providers presents at least one hurdle for these patients, suggesting that telemedicine could offer a technological means for addressing the sectoral imperative to increase access to the system. Consequently, when considering the potential effectiveness of a virtual appointment or a smartphone app for disease management, the more appropriate comparison should probably be to a complete absence of disease management, which is, of course, much more likely to result in an expensive and injurious acute condition.

Aside from leveraging telepresence toward telemedicine to keep patients at home, in California, in particular, we are starting to see these same technologies deployed for use in the home, but not for virtual visits per se. Instead, large providers might have physicians supervise LPNs remotely, allowing the latter to intake patient data in the patient’s home in preparation for diagnosis and treatment by the offsite physician. At present, these arrangements seem to be working effectively for managing post-operative care as well as for the treatment of wounds and minor burns. However, licensing boards have proven an obstacle to more wide-scale adoption.

I’ve previously noted the aging U.S. population will require a greater amount of chronic disease management as well as long-term care. Such care can be provided at home via a combination of humans and technology in a variety of ways. Labor representatives, in particular, favor the use of smartphones and tablets to provide support for the caregiver, be it substantive (in the form of up-to-date clinical information on the patient/client or best practice protocols) or social and emotional (in
the form of easily accessible and well-developed caregiver networks). However, these sorts of technologies that raise the profile of the home care worker—rendering him or her the “locus” of care delivery—have not been widely disseminated or tested. Still, early indications are that augmented home health—in which an aide takes on the role of care coordinator for their client—using the smartphone not simply for clocking in and clocking out, but for connecting the home health or personal care aide to the rest of the care team, can bring positive results as part of broader interventions that reconsider the role of home health and personal care aides (National Academies of Sciences, 2016).

What I did see demonstrated at trade shows was a much more widely adopted application of digital communications to address the demographic shifts driving the ever-expanding demand for home care. Examples of electronic visit verification (EVV), which tracks and verifies the labor provided by caregivers to Medicaid recipients and their families, essentially serving as way for direct care workers to clock in and clock out. Developers have convinced policymakers that EVV streamlines the efficiency with which personal care and home health services are delivered. On its face, EVV is intended to ensure that when a caregiver bills for services, he or she actually has provided them. As a result, lawmakers aiming to thwart fraud against those receiving care and those funding it—taxpayers—essentially have mandated the use of EVV by making Medicaid payments dependent on its use. However, as with any online service, punching in and out digitally allows for the collection of all sorts of additional data and opportunities for micromanagement, including location information. The technology has other implications for home care work, to which I will return later.

Service and Cleaning Robots
Robots have long since matured beyond the imprecise, dangerous, and heavy machines once kept tightly caged away from errant or glassy-eyed assembly workers on the industrial shop floor. Today’s robots are agile, sensitive to their surroundings, and much less dangerous to co-workers, at least in a physical sense, than earlier iterations. More important, modern workplace robots can undertake far more than a static, predetermined sequence of movements and other actions. Many instead operate semi-autonomously—accepting external commands from users as well as maneuvering and operating on their own by taking in, processing, and reacting to information absorbed through sensors. Indeed, respondents made clear that these semi-autonomous robots appear likely to disrupt health care labor markets and health care work over the next five to 10 years.

In the hallways of technologically-inclined hospitals, in addition to navigating providers and patients, one will encounter semi-autonomous robots in the form of “smart carts” that deliver meals and pick up dirty trays, deliver clean linens and take away the soiled ones, pick up and remove rubbish as well as hazardous medical waste, deliver clean medical supplies, and transport prescriptions to nursing stations. They rely on overlapping laser, sonar, and infrared sensors to traverse the halls to their destination while avoiding human and nonhuman obstacles.

A prototypical robot of this sort can run for about 10 hours on a single charge and can make its own way to its charging station when necessary. In between charges, it undertakes tasks on a scheduled basis as well as on demand. It cards in and out of secure areas, the same as human staff, opening doors and calling the elevator as needed. The carts are essentially interchangeable, carrying a meal from dietary services in the basement up to a patient room, and then stopping to pick up and remove dirty linens for delivery to the laundry facility. Extremely sensitive cargo such as narcotic drugs remain secure, only accessible via fingerprint sensor. In many cases, workers are pinged on their smartphones when a requested delivery is on its way.

In general, employers deploy these robots to reduce costs and make more efficient use of relatively expensive labor. Employers may even argue their deployment increases access; this is an
argument that will soon be testable empirically. Hospitals and other facilities can also reasonably claim that the use of robots facilitates growth in the scale and scope of their organizations and facilities, thereby helping organizations respond to the imperative that they consolidate and better coordinate care delivery. Often, designers account for the use of semi-autonomous robots in their sketching out of new facilities, providing the technology with its own travel lanes or even a dedicated “robots only” elevator bank. In fact, developers market their services as a way of getting more use out of costly investments in additional square footage.

In pre-COVID fieldwork, I neither witnessed nor heard of the widespread use of robots for cleaning and disinfection, though I saw few obstacles to their adoption for this purpose. For starters, a great number of hospitals have outsourced their cleaning, and outsourcing generally serves as a layover on the flight to complete automation (Litwin, Avgar, & Becker, 2017). Second, despite the apparent, nonroutine nature of cleaning, the improved ability for robots to sense and respond to their surroundings renders this challenge moot. Likewise, changes in how we disinfect—for example, the use of high-energy ultraviolet light—obviates the need for actual workers (Mims, 2020). As it turned out, the COVID-19 pandemic hastened adoption of janitorial robots (e.g., Hetrick, 2020; Lerman, 2020). It also hastened concerns that these robots could remain in place post-pandemic, leading to permanent reductions in demand for those undertaking cleaning tasks (Litwin, 2020a). However, press coverage also suggests limited use of “robot nurses”—a label that is too generous in its implications for these robots’ abilities and usefulness (LoScalzo, 2020).

Before moving onto the third form of technology making an impact in the health care space, I should pause to note the sort of robotic technology that does not appear ready to disrupt the sector or its labor market: “home care” service robots. My research provided no evidence that robots are anywhere near ready to step in to fill the anticipated growing need for home care workers, consistent with sociologist Jerry Jacobs’s answer to the question, “Will the Robots Take Care of Grandma?” He answers with an emphatic no, noting that “Robots do not provide physical care for the elderly, not even in Japan” (Jacobs, 2019: 1). Nothing I observed and no one I spoke to offered information to contradict this statement, including union members or their leaders. As Jacobs and some of the interviewees pointed out, there are technologies that can make staying at home easier, such as those that vacuum a rug or order food when the refrigerator runs low on milk or eggs. Simply stated, semi-autonomous robots cannot navigate houses or apartments with the same apparent ease and manageable cost as they can a hospital or other large institution. As a result, I strained to find ways that this particular technology could respond to the chronic disease prevention or changing demographic imperatives detailed above.

Artificial Intelligence

On the one hand, AI is similar to semi-autonomous service and cleaning robots in that both have digital communications technologies, the first of the technology families, subsumed within them. On the other hand, robots already traverse hospital hallways, whereas the adoption and diffusion of AI in the health care sector has only just begun (Topol, 2019). So, why is it on the minds of nearly every single person I interviewed? I have concluded that much of what I heard was—perhaps well-founded—fear of the unknown. Workers, developers, and others can easily picture their own smartphone when prompted to consider digital communications technology. Likewise, semi-autonomous robots already have assumed some work that humans once undertook. While developers may know AI’s capabilities, neither managers nor workers have a solid grasp of what it can and cannot do, let alone what it might look like. In fact, in the wake of the pandemic, much of what was lauded as the futuristic application of AI to fight COVID-19 seemed more like the effective use of well-programmed digital communications technologies (Garrity, 2020). In reality, AI can tackle
some errands more efficiently and more thoroughly than humans, and it can assume tasks that human workers could not even conceive of, let alone undertake.

Until recently, the most useful workplace technologies were those that could reliably execute repetitive tasks—that is, tasks that were routine, predictable, and amenable to programming. And, as long as a task could be reduced to simple, static steps—whether physical or cognitive—the worker assigned to the job rightfully could fear technological displacement (Autor, Levy, & Murnane, 2002, 2003). At least symbolically, this rule of thumb regarding programmability was disposed of in January 2011 when IBM’s AI-infused computing system, Watson, bested two previous champions in a televised set of “Jeopardy!” games. That win set the stage for the application of AI to all sorts of practical problems in a range of industries and sectors, including health care. In fact, its developers targeted utilization management decisions in lung cancer treatment as Watson’s first commercial application, partnering with a renowned cancer center and a large insurer in 2013 (Upbin, 2013).

What makes AI so useful is its ability to “learn” by crunching or absorbing vast amounts of information and data—a particular form of AI called “machine learning” (ML). Increasingly, AI also can process unstructured textual or spoken inputs, using natural language processing (NLP). NLP translates free text into standardized or structured data. ML, with the help of NLP, allows the application or the machine to uncover associations and correlations that can serve as the basis for future decision rules. This ability contrasts with its aforementioned predecessor workplace technologies that required manual programming by human beings, leaving it to humans alone to determine the most effective ways to undertake a task or work through a complex issue, and then program those “best practices” into the machine.

My visit to one particular conference of health care technologists made clear that developers and investors see great possibilities for AI-enabled chatbots—software that can conduct a conversation verbally, either by auditory language or textual display—in particular, in many aspects or subspecialties of care delivery. For example, the use of AI can expand access if patients seeking primary care or mental health services could receive them through an app on their smartphones. This increased access could come at relatively low cost, too, explaining why so much venture capital has gravitated toward these technologies. Much as I discussed above with respect to telemedicine and telehealth, some of this increased access will benefit patients who might not have sought an actual office visit, and others would be utilizing the chatbot in place of a conventional appointment. What remains unclear is the overall quality of care one might receive from a chatbot relative to that given by a conventional, in-person provider or even from a less conventional teleprovider.

Respondents also think advances in AI will boost access to care through professionally mediated clinical decision support (CDS) systems. CDS systems link health or patient observations with health knowledge to influence health choices by clinicians for improved health care (Healthcare Information and Management Systems Society, 2010). They have long been embedded in most EHR systems; however, prior to the advent and incorporation of AI into these systems, all of the rules and their associated alerts needed to be manually entered into the system explicitly and regularly updated. So, for example, if a particular drug combination were newly found to be contraindicated, then onsite information systems personnel or vendor-employed programmers (by pushing system updates) could add the appropriate alert to the system. However, there was no easy way to regularly determine the latest research-based protocols. Likewise, there was no easy way to identify associations between fields unless they were explicitly sought, and even then, this excluded the use of unstructured data living in the medical record. With ML, software now can analyze vast amounts of historical patient data in the context of established best practices and cutting-edge, peer-reviewed research to generate its own decision rules. It can crunch millions of case histories to develop a probable diagnosis and to suggest the most predictably effective treatment associated
with it. It could even uncover links between published studies that human readers—especially those from disparate medical specialties—would have missed.

As I learned from the interviews, similar technology could aid organizational efforts to consolidate and to improve coordination. In part due to policy incentives, the diffusion of EHR systems has finally picked up pace. Once information has been converted from paper to bits, it can feed AI that can warn clinicians a patient is at high risk for a particular iatrogenic condition such as sepsis. AI can also render these systems more user-friendly: NLP, for example, allows the use of digital technologies to extract, structure, and compose clinical notes simply from listening to providers’ natural conversations with their patients. The same data also can power ML to facilitate earlier diagnoses of chronic diseases, allowing for more precise direction of preventive care and for earlier treatments and, thus, improved prognoses. One also can imagine technologies that use AI in a way that bypasses clinicians altogether. In a limited sense, our smartphones already serve as personal health assistants, tracking our steps. A growing number of patients also use their phones to track vital signs and even blood sugar. Once we address well-founded privacy concerns, we can link these data to the data in our personal medical records and then to the aforementioned information resources living in the cloud. Then, AI will make it much easier for patients with chronic diseases to monitor and manage their conditions without frequent visits to a hospital or medical office.

Just as we saw with the previous two tech “families”—telepresence and robots—there are few obvious ways in which AI will fundamentally address demographic challenges. Home care clients already use AI-infused devices in all sorts of small ways that enrich and facilitate their daily lives, potentially interacting with or substituting for some functions of direct care workers. That Siri can dial 911 and Alexa can adjust the thermostat have no doubt made aging at home easier—but the use of such AI-enabled virtual assistants does not fulfill the fundamental need for onsite caregivers to undertake the wide variation of physical and cognitive demands engendered by this work.

These three tech families substantially overlap in the real world. In fact, the true power of any of them to disrupt health care delivery comes from combining them. As noted above, AI-infused chatbots, for example—dependent on digital communication and telepresence, allowing them to tap the cloud as a means of continuously updating their knowledge by leveraging ML—are among the most coveted targets for venture capital in the health care space. Fieldwork identified that enterprising developers have already worked to provide this dual technology a physical presence, effectively yielding a cloud-connected, AI-augmented, semi-autonomous robot. Nonetheless, the research also makes clear that the three aforementioned technology families are those that health care administrators and providers call upon to address the four imperatives and that the examples I cite above are those most likely to reshape work in the health care sector. Just how these technologies will alter work depends on a number of choices we make regarding how to respond to the four imperatives. This is the issue to which I now turn.

THE IMPACT OF NEW TECHNOLOGIES ON FRONTLINE HEALTH CARE WORKERS: KEY CHOICEPOINTS FOR POLICYMAKERS AND MANAGERS

Even without action on the part of policymakers and administrators, technological advances in frontline care will not come to a screeching halt. They will continue at their dilatory pace, but more critically, on their current path. Along this status-quo path, frontline workers will continue to suffer from the psychological and economic impact of poor job quality, negative effects that will ultimately redound to patients and other stakeholders. COVID may induce permanent changes with respect to the use of telehealth and perhaps even robot cleaners, but neither chatbots nor CDS will be used optimally. The effectiveness of AI technologies will also be dampened without investments in training and the wholesale creation of new occupations. Existing policies will ensure the adoption of EVV continues apace on the home care side, with all of its corrosive effects on care delivery work. In
all cases, structural increases in the demand for care—scale effects—will temper the negative wage and employment effects of technological change. However, scale will do nothing to remediate job quality or supposed shortages.

Nonetheless, bold action on the part of policymakers and administrators can move us off of the default path and onto the “high road.” These actors can make jobs more rewarding and less demoralizing. They can also stem worker shortages by increasing pay, which means they can also reasonably demand commensurate increases in frontline worker responsibilities. Both parties can make clear choices that will position technological change—perhaps even with COVID’s aid—to occasion a remaking of frontline care delivery that moves us closer to the Triple Aim, at the same time addressing the work and employment-related issues that plague frontline care delivery. The key distinction between the default path and the high road lies in the fundamental differences between what I labeled the technology-centered and the work-centered approaches to technological change. The latter begins not with the goals of the engineers or the technology developers, but with the Quadruple Aim: minimize the tradeoffs between access, cost, and quality, all while improving the nature of frontline care delivery work.

Behold the Power of Payment Models
The EVV-related language in the 21st Century Cures Act, while antithetical to the Quadruple Aim, demonstrates the instrumentality that policy has to shape organizations’ technological choices and outcomes. In particular, the organizational and institutional wedge between those who finance care and those who provide it presents a level of complexity absent in studies of technological change in nearly any other sector. While cost-benefit calculus applies to health care providers, their calculation hinges entirely on the structures and rules connecting them to payers. Thus, if a given technology improves the optimal mix of access, cost, and quality without allowing any of that benefit to accrue to the provider, we have a classic economic externality. My fieldwork, particularly conversations with health care industry consultants, made clear that the discrepancy between the social benefit of technology adoption and the private benefit to the party expected to pay for it systematically curbs investment in new technology.

The most common illustration of this phenomenon relates to technologies that improve the quality of care delivered. A given hospital or medical office may be convinced that a new machine or device provides more precise or more reliable results than legacy technology. However, under the conventional FFS model, the owners of the facility cannot appropriate the incremental benefits arising from the use of this technology. Thus, they will not purchase it. This dynamic explains why health maintenance organizations (HMOs) and other such integrated health care provider/payers as Kaiser Permanente and Health Partners were the first to adopt EHRs, technologies that ultimately influenced employment outcomes for medical records technicians and transcriptionists, among others. It also hints at the adoption proclivities for smaller-scale, more specific technologies.

I witnessed a prime example of this at one of the hospitals I visited. The chief financial officer explained that despite its production of a clearer and more detailed digital image, the hospital had only recently invested in tomosynthesis—three-dimensional (3D) breast imaging. Tomosynthesis combines X-rays taken from multiple angles, yielding fewer false positives, identifying more cancers, and doing so earlier than traditional 2D mammography. Unfortunately, the machines also cost substantially more than those used for traditional mammography. With the reimbursement from payers set at a single level for breast imaging no matter how providers capture the images, this hospital, and presumably many others, simply would not make the purchase.

Conversely, if administrators spot a technology that can increase the efficiency with which their hospital can undertake a particular procedure or perhaps the number of these procedures it can perform annually, then the facility may well make the investment. In this case, the technology
appears to be able to increase access and lower costs, and even the traditional FFS model would allow the hospital to appropriate the gains arising from the investment. This shrinks the discrepancy between the private and social benefits attendant to this technology.

Hospital use of semi-autonomous robots exemplifies this flavor of technological investment. Facilities do not expect payers to increase their rates simply because robots, rather than human beings, transport food or clean rooms. Rather, both robot developers and administrators tell us that despite their high upfront costs and regular maintenance fees, robots will generate efficiencies through cost savings relative to the continued use of labor to undertake these tasks. If they are correct,\(^5\) then the use of robots in this manner should provide both private net benefits to the hospital and social ones to a broader range of stakeholders—with the possible exception of those whose work is directly affected by the deployment of robots, such as hospital orderlies. Just how the deployment affects orderlies hinges on the specific decisions managers make around how potentially displaced workers will be treated in the course of the deployment of new technologies, a matter to which I will return below.

Policymakers have a number of options regarding payment rules. They can acknowledge the institutional power of Medicare and Medicaid to drive the use of the right technologies and in the right manner. As one hospital administrator told us, “As CMS goes, so go the private payers.” Though not uniformly the case, private payers often follow the lead of the Centers for Medicare & Medicaid Services (CMS) when deciding which services to cover and at what rate—a recent example being the many manifestations of value-based care, including accountable care organizations (ACOs) and bundled payments. Therefore, if Medicare and Medicaid take a more favorable view of telehealth—as they did in their response to the pandemic—or of new forms of care coordination and care delivery that elevate the role of home care workers or that promote new forms of telehealth or AI-infused care delivery, private payers are likely to follow suit. Of course, this domino effect will occur more quickly once researchers demonstrate the efficacy of the “high road”—the path that optimizes across access, cost, and quality without displacing the ill-effects of these innovations upon the frontline health care workforce.

Additionally, hastening the shift in payment models from those resembling fee-for-service toward those encouraging value-based care would make providers responsible for the quality of care delivered—making it in their best interest to provide high-quality care, ideally but arguably without restricting access or increasing costs. This in turn would encourage more technology adoption. In fact, this trend is well under way, as elements of VBC appear in an increasing share of health plans and health reform ideas. The ACA encouraged the creation of ACOs and Medicare has made increasing use of bundled payments, both aimed at urging providers to be entrepreneurial in their quest to deliver care that optimizes across the Triple Aim.

Private insurers recognized long ago that price-conscious health plan customers—be they employers or individuals—gravitate toward HMOs and other plans with aspects of cost containment attendant to VBC. Thus, instead of paying providers based on the quantity of care they provide and then forcing them to comply with rigid treatment protocols, policymakers can incentivize value in the system and then afford providers’ independence toward achieving their goals. Some will adopt new technologies and some will not, but they will make these choices based on their own ground-level knowledge of whether new technologies will help them better serve patients.

\(^5\) I am not completely convinced that these savings will materialize. Many hospitals choosing to outsource EVS, for example, have found that downstream expenses dwarf more easily measured, upfront savings arising from this strategy, and have reverted to their previous employment arrangements for EVS workers. See Litwin et al. (2017).
More specifically, policymakers’ doubling down on VBC also encourages the adoption and use of new technologies as part of a response to the four sectoral imperatives. Clearly, value exists in the economies of scale and scope that derive from organizational consolidation and coordination, suggesting one can work right down the respective column from Table 3. That is, further encouragement of VBC will drive organizations to leverage digital technologies and telepresence toward the optimization of EHRs—eventually, even enhanced or augmented with AI capabilities—and the increased use of service robots in hospital settings. Likewise, providers are likely to take steps on their own to invest in telemedicine and telehealth and to develop or purchase access to mobile medical and health apps—again, some infused with AI—on behalf of their patients. In doing so, they will be responding to the imperative that they prevent and manage chronic diseases on behalf of (and in partnership with) their patients. One can make analogous arguments regarding the other two sectoral imperatives, increasing access and responding to demographic trends.

Promote and Embrace Experimentation
While only policymakers can adjust payment rules, managers and regulators must work hand-in-glove to bring about worthwhile experimentation. And, with respect to health care, policymakers and managers have long demonstrated a relative openness toward experimentation, perhaps best exemplified by the gradual emergence of HMOs in the 20th century and by the establishment and expansion of ACOs in the 21st. Now, they must decide just how experimental they are willing to be as they respond to the four sectoral imperatives. Based on the interviews, their first area of deliberation should be payment and reimbursement rules.

Restrictive reimbursement rules retard the adoption of new technologies by provider organizations, limiting the flexibility to embrace technology as part of a response to the four imperatives. Telemedicine offers a case in point. As an RN told us, doctors and nurses have been providing “low-tech” telemedicine for decades—calling patients to report test results or responding to patients’ descriptions of their symptoms by writing a prescription. However, regulations previously prohibited providers from billing for these services delivered by phone—and in fact, generally still do, but for the changes engendered by COVID-19. As part of the larger effort to redirect low acuity patients away from doctors’ offices and emergency rooms, CMS and Congress temporarily relaxed restrictions limiting provider reimbursements for telehealth.

There are a number of explanations for policymakers’ reluctance to loosen regulations and why even it is only temporary. Many doctors have concerns that telemedicine will undermine their business, leading patients to see “virtualists” from their home rather than PCPs in their office. Likewise, payers worry that providing coverage for telemedicine will lead patients to “overconsume” the service and physicians and others to “overprovide” it, potentially trying to bill insurers for all of the telephonic work they had been performing gratis for so long.

When early, pre-COVID-19 experience suggested these concerns were overblown, CMS responded by ever-so-slightly loosening the rules that prevented Medicare reimbursement for telehealth services. Those elderly and disabled citizens relying on government insurance, in some cases, now can apply these benefits toward virtual office visits, psychotherapy, consultations, and certain other medical or health services. As a result, we were likely to see more providers turning to digital communications and telepresence to increase access, even had we not been confronted with a pandemic. Whether forced experimentation brought forth by COVID-19 will lead to lasting regulatory changes regarding telehealth remains unclear.

In my view, policymakers should not stop there. They should also revisit rules that constrain the optimal use of new technologies. As an extreme example, rules requiring that providers be licensed separately in each of the 50 states place severe limits on the use of telehealth—any entrepreneur interested in providing telehealth services must develop services state by state. As one such
telemedicine executive explained, calls come in 24 hours a day and can come from any of the 50 states. But it is often the case that no virtual PCP licensed in the patient’s state is available and online. As it turns out, COVID-19 made clear the challenges state-based licensing poses to telehealth technology developers have larger consequences, too (Chandrashekar & Jain, 2020). State-based licensing hindered policymakers’ and health systems’ ability to move licensed caregivers to the neediest places when they were across state lines. Clearly, state-by-state licensing exists for a number of reasons, some only historical and others that continue to make sense even in today’s connected world. So, these rules should not be repealed hastily, but should be revisited in light of new ways that could allow technology to better serve patients by providing immediate benefits with respect to access and cost.

Aside from rethinking the state-based licensing regime, policymakers could nudge licensing boards to experiment with scope-of-practice rules that presently constrain the effectiveness of new technologies. For example, I noted above that California, in particular, has allowed limited use of LPNs in the home, using point-of-care technologies that effectively extend the reach of physician providers. In general, if technology could facilitate shifting of responsibilities down the skill chain, from RNs to LPNs, for example, for low-acuity patients, then it could effectively boost access and lower costs. However, this would require LPNs be granted broader authority and authorized to administer a wider range of low-risk drugs. Policymakers should pay close attention and consider these proof-of-concept studies, encouraging licensing boards to allow their scope to expand in both geographic and functional terms when they appear to be working.

Perhaps more feasible than the experimental loosening of the medical licensing regime would be a relaxing and possibly harmonizing of federal and state reimbursement rules and requirements for scope of practice. While we should not do this hurriedly, we should consider the ways that new technologies—when used by people with the right skills—allow for the delegation of tasks to those closer to the patient. Likewise, we should take a “blue sky” approach to constructing new health care occupations that take advantage of new technologies, including AI, and connect them to patients in ways that make patients, providers, and payers better off without making anyone worse off.

Ideally, managers will follow policymakers’ lead by opening their own organizations up to experimentation. In fact, there is a very fine line separating the work of policymakers from that of managers when it comes to managing the politics of technological change. The concerns that physicians raise with respect to telemedicine hint at the larger political obstacles hindering technology adoption—many of which transpire in organizations themselves.

One of the great benefits of digital technologies is their ability to decentralize knowledge by disseminating up-to-date information to providers at the point of care. However, as the interviews made clear, it was never simply a “lack of information” that prevented RNs from taking on the work of physicians, for example. Rather, concrete scope-of-practice regulations—at the policy level—clarify the nature of the tasks that each licensed role in a state can undertake, either with or without supervision. For unlicensed roles, the limitations generally are spelled out by employers, usually in the collective bargaining agreement itself (where one is in place). Consequently, in order to deploy technology toward addressing the four sectoral imperatives, states must update their existing regulations to allow for new work structures that devolve more responsibility to the front lines. Likewise, managers and high-status providers, namely physicians and surgeons, must allow these adjustments to take place at the point of care. Practice administrators, for example, can do this by demonstrating to those with high occupational status the ways in which new uses of technology can scrub what they probably consider time-wasting, low-value activities from their daily schedules, freeing them up to undertake more complex and more lucrative work for themselves. The research
underlined the notion that RNs, LPNs, and CNAs, among others, would welcome the opportunity to work closer to their full scope, something their employers and unions have long clamored for.

Finally and relatedly, home care provides fertile ground for experimentation involving the application of emerging technologies toward expanded care delivery responsibilities. Conversations with union leaders illuminate the obstacles to the high-road use of technology that elevates home care workers into onsite care coordinators. Multiple union representatives told us that home health and personal care aides are often not comfortable using new technology. Even when workers are technically adept, smartphones and tablets are prohibitively expensive, and maintaining a regular data plan will prove especially financially challenging on home care workers’ wages. Consequently, the home health agency that employs the aide would need to purchase the device and the app and to invest in the necessary training. Unfortunately, under the present reimbursement model, the agency does not have much of an incentive to do this, nor do they have the bargaining power vis-à-vis the states to compel more public funding. This suggests a lost opportunity to improve care quality and to reduce overall costs by shifting work to less expensive, underutilized home care aides. More critically, it precludes the use of technology to improve the quality of these jobs by boosting skill levels and wages—what many believe to be the only way to attract more people to the field of home care.

**Reimagine Training**

Both policymakers and managers need to revisit their notions of training. Managers must understand that before workers can leverage new technologies intended to promote clinical decision support or the augmented home health model, for example, they must have the requisite training to take on these enhanced roles. While this may seem obvious, case study research suggests that managers often undermine the effectiveness of new technologies by failing to identify specific workers for training based on their roles and responsibilities in caregiving (Mantzana, Themistocleous, Irani, & Morabito, 2007). We also have concrete evidence of what happens when leaders overlook training. Statistical analyses of medical error rates at a multi-unit hospital system having recently undertaken wide-scale automation reveal that the subjective nature of decision-making requires that frontline workers be trained not only on the technical aspects of new systems, but also in the intricacies of care quality and patient safety (Aron, Dutta, Janakiraman, & Pathak, 2011).

Since elevating responsibilities necessitates enhanced training, policies that encourage work-centered technology adoption must also encourage the requisite training and development. Policymakers could adjust reimbursement and even tax policy to assist leaders in this effort. They, like sectoral leaders and managers, could also collaborate with health care unions, asking them to absorb responsibility for training and certification, just as craft unions have long done in the construction sector.

**Reform Organizations**

Training imparts knowledge, but managers establish the work rules and the culture that allow workers to use it. Workers must feel that they have the authority to use their new tools to make decisions at the point of care, i.e., that leaders “have their back.” IT research has long touted the necessity of parallel investments in “organizational complements” alongside technological investment (Brynjolfsson, Hitt, & Yang, 2002), and more recent empirical work reveals how difficult it can be—especially in the health care sector—to devolve power and authority to the frontlines (Litwin & Eaton, 2018).
**Engage and Encourage the Workforce**

Workers need even more than the training, the tools, and permission to use them. Managers must ensure that frontline workers accept or "buy into" the new, technologically-enabled methods of care delivery, without which sought-after productivity improvements will be delayed, dampened, or altogether undetectable. Research from both the IT and industrial relations fields highlights the importance of deep worker engagement in the earliest stages of the technological adoption process, perhaps even involvement in evaluating and choosing between technological options (Arora et al., 2020; Litwin, 2011). Such involvement can counter vendors’ tendencies toward technology- cf. work-centered approaches. Furthermore, those workers expected to use the technology must be provided a degree of employment and wage security, a credible promise that their optimal use of the new systems will not erode their own or their coworkers’ economic wellbeing.

Finally, those managers feeling constrained by norms or in some cases even laws requiring consultation with workers individually or via their unions should instead embrace these institutions. They can be enlisted to aid management’s monitoring of technological deployment and use, particularly where workers have been formally or informally provided the aforementioned employment and wage security or even where workers were provided pay increases in exchange for accepting the new technology (Freeman & Medoff, 1984; Latreille, 1992; Willman, 1986). These same institutions will also have their ears to the ground with respect to training needs and deficiencies, information already shown to be of great value to managers (Litwin, 2011). Furthermore, research in the U.S. reveals that unions can help mid-level or facility-level managers make the case for technological investment to higher-ups more focused on short-term gains and losses (Litwin, 2017).

**WHAT DOES THE HIGH ROAD LOOK LIKE?**

Readers will not be surprised that unions play a pivotal role in a high-road technology adoption scenario—the one that achieves the full Quadruple Aim rather than all or just parts of the Triple Aim. Health care unions’ most salient efforts likely will involve countering employers’ and policymakers’ near-instinctive tendency toward technology- rather than work-centered approaches. In the wake of sectoral consolidation, union members should be well-poised to do this: where employers exhibit structural market power, collective bargaining will be a better force than markets for leveling the competitive playing field and promoting care quality and service to patients. At the workplace level, union power could manifest itself in the realization of work-centered deployment methods that tap workers’ implicit and explicit knowledge of front-line service delivery processes. Not only would this engender necessary worker buy-in to technology decisions, it could improve the speed of deployment and the effectiveness of the technology once installed. Moreover, by educating management on the downstream performance benefits attendant to work-centeredness, union members can forestall the erosion of skill and job quality. In so doing, employers may need front-line workers to develop greater skills and take on more responsibilities. This justifies a parallel push to negotiate increased employer support for joint training programs.

We might also see unions take a broader approach in their lobbying efforts at the state and national levels. For starters, union members could join with management and licensing boards to urge for the relaxation of laws and regulations that inhibit the diffusion of telehealth, in particular. They could initiate this effort now, jointly asking policymakers to maintain the pandemic-induced steps lawmakers recently have taken on this front. They also could push for the expansion of programs like Service Employees International Union (SEIU) 775 Benefits Group’s e-hiring hall, in part by pointing to the important role that union-run hiring halls have played in other sectors. They may even be able to have the use of these institutions de facto mandated by regulation if they are able to link the establishment and issuing of new home care certifications to the use of these hiring
halls. This could effectively redefine home care work, in particular, allowing for material improvements in job quality. In fact, unions could argue that changes like those they are seeking may be the only real solution to structural worker shortages. By doing this, they will also be making a tacit argument for the elimination of EVV. Therefore, they can claim that they are helping patients (or clients) at the same time they are addressing the realities of the labor market for home care workers. With respect to the four sectoral imperatives along this imagined path, access would remain a critical issue. However, an easing of cost and quality pressures would allow for increased public investment to facilitate access to care. Sectoral consolidation would continue apace: it would be driven by and itself drive the shifting of organizational resources from treatment to the prevention and management of chronic diseases. There would continue to be excess demand for labor across the sector, largely due to structural increases in demand for health care services arising, in part, from an aging population.

I see a far wider variety of technology and its applications along the high road than I do along the default path—that which accepts the Triple Aim rather than reaching for the Quadruple Aim. Aside from providers deploying technology to facilitate volume, they would do so in ways that target care quality. They would be rewarded not only for consolidation as they would be on the default path, but improved coordination between providers aids quality improvement, for which VBC payment models reward them. Much of this increase in care quality would come from proactive behavior by providers recognizing that prevention is cost effective and better for patients. Furthermore, home care agencies, free from the yolk of EVV, could instead use technology in ways that improve the quality of home care work, simultaneously addressing dire issues in the direct care labor market while improving the efficiency of home care delivered. AI would magnify the utility of nearly all of these technologies. Not only would it remain embedded in provider-facing CDS systems and EHRs, it would improve the effectiveness of patient-directed chatbots and app-based personal health assistants.

So much of this apparent panacea would arise from the shift in payment models from FFS to VBC—which would bring a greater challenge for both employers and workers. As noted previously, the VBC payment model, with its fixed, upfront, or bundled payments, pushes employers to reorient their relations with workers. Under VBC, provider organizations face tighter budget constraints, which will influence pay and employment issues more broadly. Collective bargaining can serve as a doubly useful institution under these circumstances. Aside from workers negotiating for a larger share of payments as wages, labor and management could recognize a shared interest in generous or at least fair payment rules. Thus, union members could effectively increase the size of the entire pie before securing a larger slice for workers.

Notwithstanding these new constraints, the possibilities for digital communications and telepresence along the high road and their resulting, beneficial labor market impact abound. Despite initial fears that telemedicine or telehealth might leave front-line providers missing patient interaction, I have found that in some cases, telehealth actually engenders more patient-provider intimacy than does conventional care delivery. Instead of seeing a given patient once every three months in the office, providers actually get to know them even better through day-to-day video interactions. In a sense, they see themselves resurrecting the notion of a house call, seeing patients in their natural environments, building a connection not only to the patient, but to his or her spouse, children, and even pets.

Aside from these intrinsic benefits, providers of telehealth—telehospital care, in particular—also work more comfortably than their peers toiling in conventional hospitals. A piece in *Politico* (Allen, 2017) described the work environment in one particular telehospital by contrasting it to the loud, fluorescently lit, bleach-smelling facilities that typically come to mind when we think about hospitals:
Instead of bright fluorescent lighting, beeping alarms and the smell of chlorine, Mercy Virtual Care has striped soft rugs, muted conversation and a fountain that spills out one drop a minute. The mess and the noise are on screens, visible in the hospital rooms the staffers peer into by video—in intensive care units far away.

Consequently, by making work more comfortable in this way, telehealth can also extend careers, a key issue for occupations for which employers claim a shortage. An aging or injured nurse, for example, still can work in front of a bank of computer screens. Likewise, the pressure that telehealth can take off of onsite nurses likely reduces their rates of burnout and turnover as well. The CMO of a telemedicine provider told us explicitly that their company recruits providers on this very basis: These are the doctors, usually 65 or older, who have had a great career, but they can’t do it anymore. They just don’t want to trudge and do the 40-hour workweek anymore, but they still want to be doctors. And we give them an opportunity to spend 10, 20 hours a week being the great doctors they are but not feeling overwhelmed with all this paperwork and the busyness of the day that they’d have to do as a full-time doctor.

Finally, recall the limited ways in which California, in particular, has allowed for the use of digital communications technologies—telepresence—in the home not by patients, but by LPNs working remotely with a physician. We can expect these arrangements to become more permissible and thus more prevalent. Not only will we witness the application of technology in this way across the states, but we will see it applied to a growing set of symptoms and conditions. Aside from the benefits to patients in terms of access and cost, this use of telepresence should increase demand for LPNs, while boosting their pay and their job quality more broadly.

Digital communications technology, when deployed along the high road, also can yield positive effects for home care workers. Electronic visit verification, the default-path use for digital communications technologies in home care, provides just one example of how advancements in digital communications and telepresence can be embedded in hardware and software—a smartphone and its associated apps, in this case—to affect the jobs of health care workers. An alternative, high-road strategy would be one in which the core technology allows for better optimization across the Triple Aim elements without externalizing the costs of these improvements off onto other stakeholders, namely workers, employers, or taxpayers. I referred to this earlier as “augmented home health”—in which an aide takes on the role of care coordinator for their client—using the smartphone not simply for clocking in and clocking out, but for connecting the home health or personal care aide to the rest of the care team.

In the high-road example, EVV—essentially mandated by law—would be absent. Instead, I imagine a provision along the lines of H.R. 3461, sponsored by Rep. Matt Cartwright (D-Pa.). While his bill makes no mention of technology whatsoever, its goal of training direct care workers to take on deeper clinical responsibilities carries an implicit technology imperative—one that is consistent with the high-road outcomes laid out here.

Augmented home health not only exemplifies the high-road, work-centered approach to bringing more technology to home care, but may well be the only realistic path for home care over the next five to 10 years. While I heard many ways in which technology can be deployed to improve efficiency at the edges, I found no silver bullet—not even the futuristic elder care robots that some imagine to be on the horizon. Home care clients already use AI-infused devices to enrich and facilitate their daily lives, but not in ways that have material implications for home health and personal care aides. Only by enacting fixes that are both structural and technological in nature will the demand for direct care workers be met. What I envision on this high road has the added benefit of boosting wages and working conditions, too, for these occupations.
Where do service robots figure along the high road? I expect their diffusion to continue apace in the hospital setting, though I see big differences in how they are deployed. Under the work-centered approach that characterizes the high road, rather than viewing the use of robots as a way to relieve themselves of labor, employers would instead consider how robots could assume some of the less enjoyable, lower-valued-added tasks for which workers have long been responsible. As one developer of hospital robots put it, “With robotics like [ours], dietary workers can spend more time helping patients get the ketchup packet opened and less time running up and down the hallways and going up and down on the elevator.” Glibness aside, he correctly notes that service robots do not provide compassionate care in the same way humans can, and patient perceptions of genuine empathy now contribute materially to hospital performance metrics.

Along the high road, employers would embrace the notion that robots can relieve workers of some tasks while enhancing their ability to take on others. As I have noted, automating some tasks complements or supports workers in their performance of higher-value-added, less-automatable tasks.

In their own analysis, the 1199 SEIU Training and Education Fund (TEF) (2019) provided two specific examples of what we would label the high-road response to the robotization of front-line care delivery: orderlies, whom the collective bargaining agreement refers to as “patient transporters,” presently move both patients and supplies around the hospital. In many hospitals, robots already assume much of the responsibility for moving supplies, and there are few technological barriers, at least, to robots taking on patient transport.

Along the high road, once patient transporters are relieved of their responsibility for moving supplies, they could leverage their unique ability to interact with patients as well as their knowledge of the facility and the campus to transport and set up new telehealth carts and to prepare patients for their telehealth interactions. They could also devote more time and effort to the discharge process, which research has shown plays an outsized role on patients’ overall satisfaction with their hospital stay. For example, they could take steps to ensure the patient has a safe and reliable ride home, as well as to their next scheduled doctor’s appointment.

This enhanced role, which 1199 SEIU TEF calls “transporter and telehealth tech”—would require an additional modicum of technical skill and perhaps even some incremental training on patient interaction. However, in this new role, patient transporters would be relatively safe from technological displacement and would be undertaking a more high-value-added set of workplace tasks.

The same report also offers up a high-road plan for dietary clerks, a second job service robots could soon displace. Dietary clerks/workers would prepare meals based on clinician instructions, dietary and treatment guidelines, and individual patient needs and preferences, and then deliver those meals to patients. Robots have already assumed much of the responsibility for food delivery and are poised to take on even more. However, they have yet to take on responsibility for the preparation of meals, nor will they soon be equipped to facilitate patient coaching and socialization.

Once dietary clerks/workers cede their delivery responsibilities to semi-autonomous service robots, they would have more time to discuss dietary alternatives with patients. They could also help patients download and familiarize themselves with smartphone and tablet apps for in-hospital use for meal selection as well as those that will help them maintain the appropriate diet once they are discharged. They could also supply the patient with other educational materials, as needed, and could follow up with the patient after discharge.

Once again, this new role—that of a “healthy foods ambassador”—would demand more from the worker in terms of technical, domain, and customer service expertise. However, it would also lead these workers to allocate more of their time toward high-value-added patient interactions that will largely remain the province of workers rather than robots. Note that in both cases, technological
change would benefit workers by boosting their job security. These managerial decisions around implementation, endorsed by the union, also would also boost workers’ skill levels, increasing the likelihood of increased wages and job quality (1199 SEIU Training and Employment Funds, 2019). Thus, investments in new technology—semi-autonomous service robots, in this case—would generate value not only for patients, providers, policymakers, and citizens looking to optimize across the components of the Triple Aim, but also for the health care workforce working alongside them.

Finally, AI would likely be embedded in nearly all of the technologies I have discussed, particularly when they are deployed along the high road. To the extent that AI helps providers capture the value associated with care quality, they are more likely to invest in it. Furthermore, openness to experimentation would allow providers to use it as a means of delivering more care at lower cost, making great inroads with respect to increasing access. The question is, would this AI displace frontline workers, either entirely or in a way that drives down their wages and erodes job quality?

While I cannot claim to have seen it in action yet, the research suggests that AI could be deployed alongside rearrangements in work structures to tackle the deficit of primary care providers in the U.S. Rather than endeavor to apply AI in a science fiction-like attempt to replace physicians or nurses, we could instead use it to equip a new generation and new classification of caregivers filling the void left by physicians turning to more lucrative specialty care. In a plan most clearly propounded by technological futurist Martin Ford (2015), we could insert AI into the exam room for use by a newly designated health care occupation. We would train these new practitioners to be adept at both interacting with and examining patients and interfacing with a standardized diagnostic and treatment system, the latter powered by AI and ML. In its initial incarnation, the machine would sit physically in the exam room alongside the practitioner and the patient. Later on, the machine could instead be used by teleproviders providing care remotely.

Used in this way, AI would allow us to substitute lower-cost practitioners for more expensive ones in the disposition of routine cases. These same “bridging” practitioners could aid in handling the surge of patients needing help with the management of their chronic diseases. While patients requiring more specialized care could still be directed to physicians or specialists, the vast number of patients not requiring this expensive, and sometimes all-too-scarce expertise could receive their services more quickly and less expensively.

What makes this a high-road application of technology? Aside from helping us achieve the Triple Aim, it moves us a step further to the Quadruple Aim. As Ford notes, it addresses access, costs, and quality issues while establishing and then sustaining demand for a new kind of health care professional, educated to the bachelor’s or master’s level. And, given the shortage of primary care providers, the use of these new practitioners need not come at the expense of jobs for existing practitioners. Instead, these positions could help to fill an existing gap in the system, one that is even more acute in rural areas. Furthermore, and most important from a labor market perspective, “College graduates would benefit significantly from the availability of a compelling new career path, especially as intelligent software increasingly erodes opportunities in other sectors of the job market” (Ford, 2015: 151).

CONCLUSION
This study posited what I see as a “grand challenge” for the health care sector: leveraging technology toward the achievement of the vaunted Triple Aim while at the same time addressing longstanding workforce issues. That technology could aid administrators and policymakers in reducing costs while boosting access and quality—the Triple Aim—will not surprise anyone. However, were the system to stay on its default path—given the factors driving adoption and the specific technologies becoming more apparent on the frontlines—workers will not benefit. We will fall short of the Quadruple Aim. As a result, administrators will continue to struggle with workforce shortages and frontline worker
demoralization, costs ultimately borne by patients. Workers will miss out, and the cost, access, and quality goals will suffer indirectly from the suboptimal use of new technology and of workers themselves.
### Table 1. Sex and Racial Composition for Selected Health Care Occupations, 2014-2018

<table>
<thead>
<tr>
<th>occupation</th>
<th>% female</th>
<th>% male</th>
<th>white</th>
<th>black</th>
<th>Latino</th>
<th>Asian &amp; Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>all U.S. occupations</td>
<td>48%</td>
<td>51.7%</td>
<td>63.6%</td>
<td>11.7%</td>
<td>16%</td>
<td>8.7%</td>
</tr>
<tr>
<td>entire healthcare sector</td>
<td>77.7%</td>
<td>22.3%</td>
<td>62.7%</td>
<td>15.7%</td>
<td>11.8%</td>
<td>9.8%</td>
</tr>
<tr>
<td>food service</td>
<td>83.1%</td>
<td>16.9%</td>
<td>51.3%</td>
<td>26.0%</td>
<td>14.2%</td>
<td>8.5%</td>
</tr>
<tr>
<td>home health aides</td>
<td>89.9%</td>
<td>10.1%</td>
<td>35.0%</td>
<td>32.7%</td>
<td>22.7%</td>
<td>9.6%</td>
</tr>
<tr>
<td>janitors &amp; cleaners</td>
<td>28.5%</td>
<td>71.5%</td>
<td>49.8%</td>
<td>23.1%</td>
<td>19.4%</td>
<td>7.7%</td>
</tr>
<tr>
<td>laundry workers</td>
<td>82.4%</td>
<td>17.6%</td>
<td>51.7%</td>
<td>25.9%</td>
<td>16.5%</td>
<td>5.9%</td>
</tr>
<tr>
<td>licensed practical nurses (LPNs)</td>
<td>88.5%</td>
<td>11.5%</td>
<td>57.2%</td>
<td>24.5%</td>
<td>11.0%</td>
<td>7.2%</td>
</tr>
<tr>
<td>medical records technicians</td>
<td>90.6%</td>
<td>9.4%</td>
<td>64.8%</td>
<td>13.9%</td>
<td>12.8%</td>
<td>8.5%</td>
</tr>
<tr>
<td>medical transcriptionists</td>
<td>85.9%</td>
<td>14.1%</td>
<td>75.0%</td>
<td>6.7%</td>
<td>7.4%</td>
<td>10.9%</td>
</tr>
<tr>
<td>nursing assistants (CNAs)</td>
<td>89.1%</td>
<td>10.9%</td>
<td>47.0%</td>
<td>31.6%</td>
<td>12.8%</td>
<td>8.6%</td>
</tr>
<tr>
<td>orderlies</td>
<td>40.9%</td>
<td>59.1%</td>
<td>41.6%</td>
<td>34.1%</td>
<td>14.6%</td>
<td>9.7%</td>
</tr>
<tr>
<td>personal care aides</td>
<td>84.1%</td>
<td>15.9%</td>
<td>44.0%</td>
<td>25.1%</td>
<td>19.1%</td>
<td>11.8%</td>
</tr>
<tr>
<td>registered nurses (RNs)</td>
<td>89.3%</td>
<td>10.7%</td>
<td>71.7%</td>
<td>10.5%</td>
<td>6.4%</td>
<td>11.5%</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau American Community Survey.

Notes: Numbers may not sum to 100 due to rounding. The all U.S. category incorporates every sector of the economy. The entire healthcare sector includes 2017 industry Census codes 7290-8290, inclusive. For home health aides, orderlies, and personal care aides, we also include the social assistance subsector, 2017 industry Census codes 8370-8470, inclusive. For the remaining occupations, we only consider those working in the healthcare sector, as we have defined it. Food service includes 2018 Census occupation codes 4000-4160, inclusive.

### Table 2. Educational Attainment Composition for Selected Health Care Occupations, 2014-2018

<table>
<thead>
<tr>
<th>occupation</th>
<th>Less Than HS</th>
<th>HS</th>
<th>Some College</th>
<th>Bachelor’s Degree</th>
<th>Graduate Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>all U.S. occupations</td>
<td>10.5%</td>
<td>25.3%</td>
<td>32.2%</td>
<td>20.1%</td>
<td>11.7%</td>
</tr>
<tr>
<td>entire healthcare sector</td>
<td>4.7%</td>
<td>18.0%</td>
<td>38.4%</td>
<td>21.4%</td>
<td>17.5%</td>
</tr>
<tr>
<td>food service</td>
<td>19.7%</td>
<td>42.6%</td>
<td>32.5%</td>
<td>4.5%</td>
<td>0.7%</td>
</tr>
<tr>
<td>home health aides</td>
<td>18.8%</td>
<td>38.8%</td>
<td>31.7%</td>
<td>8.5%</td>
<td>2.2%</td>
</tr>
<tr>
<td>janitors &amp; cleaners</td>
<td>21.5%</td>
<td>46.5%</td>
<td>26.8%</td>
<td>4.1%</td>
<td>1.1%</td>
</tr>
<tr>
<td>laundry workers</td>
<td>29.2%</td>
<td>51.4%</td>
<td>17.3%</td>
<td>1.7%</td>
<td>0.4%</td>
</tr>
<tr>
<td>licensed practical nurses (LPNs)</td>
<td>1.7%</td>
<td>23.5%</td>
<td>70.1%</td>
<td>3.6%</td>
<td>1.0%</td>
</tr>
<tr>
<td>medical records technicians</td>
<td>1.2%</td>
<td>19.5%</td>
<td>59.0%</td>
<td>16.8%</td>
<td>3.4%</td>
</tr>
<tr>
<td>medical transcriptionists</td>
<td>1.0%</td>
<td>16.7%</td>
<td>49.8%</td>
<td>28.6%</td>
<td>3.9%</td>
</tr>
<tr>
<td>nursing assistants (CNAs)</td>
<td>10.9%</td>
<td>35.1%</td>
<td>45.4%</td>
<td>6.8%</td>
<td>1.7%</td>
</tr>
<tr>
<td>orderlies</td>
<td>7.2%</td>
<td>31.1%</td>
<td>45.8%</td>
<td>12.5%</td>
<td>3.4%</td>
</tr>
<tr>
<td>personal care aides</td>
<td>15.7%</td>
<td>34.7%</td>
<td>37.3%</td>
<td>9.6%</td>
<td>2.8%</td>
</tr>
<tr>
<td>registered nurses (RNs)</td>
<td>0.4%</td>
<td>1.2%</td>
<td>38.3%</td>
<td>49.4%</td>
<td>10.7%</td>
</tr>
</tbody>
</table>

Source: U.S. Census Bureau American Community Survey.

Notes: Numbers may not sum to 100 due to rounding. The all U.S. category incorporates every sector of the economy. The entire healthcare sector includes 2017 industry Census codes 7290-8290, inclusive. For home health aides, orderlies, and personal care aides, we also include the social assistance subsector, 2017 industry Census codes 8370-8470, inclusive. For the remaining occupations, we only consider those working in the healthcare sector, as we have defined it. Food service includes 2018 Census occupation codes 4000-4160, inclusive.
### Table 3. Emerging and Potentially Impactful Technologies for Addressing Sectoral Imperatives in Health Care Delivery

<table>
<thead>
<tr>
<th>technology family</th>
<th>increasing access</th>
<th>responding to demographic trends</th>
<th>consolidating and coordinating</th>
<th>facilitating chronic disease prevention &amp; management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>digital communications, telehealth, &amp; telepresence</strong></td>
<td>virtual hospitals and health centers</td>
<td>electronic visit verification (EVV)</td>
<td>optimization of electronic health records (EHR) systems</td>
<td>telemedicine/telehealth</td>
</tr>
<tr>
<td></td>
<td>telemedicine/telehealth</td>
<td>smartphone as the “locus of care”/augmented home health</td>
<td></td>
<td>mobile medical/health apps</td>
</tr>
<tr>
<td><strong>service and cleaning robots</strong></td>
<td>pick-up and delivery robots</td>
<td>pick-up and delivery robots</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>cleaning and disinfection robots</td>
<td>cleaning and disinfection robots</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>artificial intelligence/machine learning/natural language processing</strong></td>
<td>artificial intelligence (AI)-enabled chatbots</td>
<td>AI-enabled virtual assistants</td>
<td>AI-enhanced EHR systems</td>
<td>machine learning (ML)-enabled diagnosis, treatment, and prevention</td>
</tr>
<tr>
<td></td>
<td>professionally-mediated clinical decision support (CDS) systems</td>
<td></td>
<td></td>
<td>AI-powered personal health assistants</td>
</tr>
</tbody>
</table>
Fig. 1. Employment in Selected Health Care Occupations, 2019


Notes: For home health aides, nursing assistants, and personal care aides, I have included those in the “social assistance” subsector. However, healthcare sector employment excludes the “social assistance” subsector. Food service captures the Food Preparation and Serving-Related Occupations major occupational category Standard Occupational Classification (SOC).
Source: BLS Employment Projections.

Notes: The all U.S. category incorporates every sector of the economy. The entire healthcare sector includes 2017 Census industry codes 7290-8290, inclusive. It does not include social assistance. For the individual occupations aside from food service, I only consider those working in the same set of 4-digit industries. Food service captures the Food Preparation and Serving-Related Occupations major occupational Standard Occupational Classification (SOC).

Fig. 2. Ten-Year Employment Projections for Selected Health Care Occupations, 2018-2028

Notes: Note: Health care sector employment excludes the “social assistance” subsector. Food service captures the Food Preparation and Serving-Related Occupations major occupational category Standard Occupational Classification (SOC). The figure provided for physicians & surgeons is actually the mean as BLS does not provide median earnings data for the most highly-compensated occupations.

*Fig. 3. Median Annual Earnings for Selected Health Care Occupations, 2018*
Source: BLS Survey of Occupational Injuries and Illnesses.

Notes: Incidence rates represent the number of injuries and illnesses per 10,000 full-time workers and were calculated as \( \frac{N}{EH} \times 20,000,000 \), where \( N \) = number of injuries and illnesses, \( EH \) = total hours worked by all employees during the calendar year, 20,000,000 = base for 10,000 equivalent full-time workers (working 40 hours per week, 50 weeks per year). Injuries and illnesses include sprains, strains, tears, fractures, cuts, bruises, burns, carpal tunnel syndrome, and tendinitis. The injury data include both health care and social assistance as there is no easy way to further disaggregate them.

Fig. 4. Incidence Rates for Nonfatal Occupational Injuries and Illnesses Involving Days Away from Work for Selected Health Care Occupations, 2018
Source: U.S. Census Bureau American Community Survey.

Notes: Numbers only reflect access to health insurance for those in work. The all U.S. category incorporates every sector of the economy. The entire health care sector includes 2017 industry Census codes 7290-8290, inclusive. For home health aides, orderlies, and personal care aides, I also include the social assistance subsector, 2017 industry Census codes 8370-8470, inclusive. For the remaining occupations, I only consider those working in the health care sector, as I have defined it. Food service includes 2018 Census occupation codes 4000-4160, inclusive.

Fig. 5. Access to Employer- or Union-Provided Health Insurance for Selected Health Care Occupations, 2014-2018
RUNNING HEADER: Technological Change in Health Care Delivery

![Bar chart showing unionization rates for various health care occupations]

<table>
<thead>
<tr>
<th>Category</th>
<th>Unionization Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>overall economy-wide</td>
<td>10.3</td>
</tr>
<tr>
<td>overall private sector</td>
<td>6.2</td>
</tr>
<tr>
<td>healthcare sector</td>
<td>8.8</td>
</tr>
<tr>
<td>food service</td>
<td>3.9</td>
</tr>
<tr>
<td>nursing, psychiatric, &amp; home health aides</td>
<td>8.7</td>
</tr>
<tr>
<td>janitors &amp; cleaners</td>
<td>12.9</td>
</tr>
<tr>
<td>laundry workers</td>
<td>6.1</td>
</tr>
<tr>
<td>licensed practical nurses (LPNs)</td>
<td>10.5</td>
</tr>
<tr>
<td>medical records techs.</td>
<td>6.6</td>
</tr>
<tr>
<td>medical transcriptionists</td>
<td>3.4</td>
</tr>
<tr>
<td>personal care aides</td>
<td>9.3</td>
</tr>
<tr>
<td>registered nurses (RNs)</td>
<td>16.3</td>
</tr>
</tbody>
</table>


Notes: Healthcare sector unionization was calculated after removing the narrow “social assistance” subsector from the Health Care and Social Assistance major sectoral category. The “nursing, psychiatric, and home health aides” category includes nursing assistants and orderlies, as these data cannot be disaggregated any further. Food service includes 2018 Census occupation codes 4000-4150, inclusive.

Fig. 6. Unionization Rates for Selected Health Care Occupations, 2019
Fig. 7. Simplified Map of the U.S. Health Care System
References:


