

The Rise of the Data-Driven Physician



Foreword from Dean Minor

Since its inception, the Stanford Medicine Health Trends Report has examined the most consequential developments and technologies that are changing health care delivery. Our 2020 report describes a health care sector that is undergoing seismic shifts, fueled by a maturing digital health market, new health laws that accelerate data sharing, and regulatory traction for artificial intelligence in medicine.

In 2020 and beyond, these trends have enormous implications for patients, influencing how they will experience health care as well as the services they may soon have access to. But to truly understand how this future is taking shape for patients, we felt it was critical to start by asking those who will be directing their care.

As a proxy for the health care delivery system, Stanford Medicine conducted a national survey of physicians, residents, and medical students to understand how key health care trends will manifest themselves in the doctor's office over the next decade.

What we found boils down to one central idea: physicians expect new technology to transform patient care in the near term, and they are actively preparing to integrate health data—and the technologies that harness it—into the clinical setting. In other words, we are witnessing the Rise of the Data-Driven Physician.

Physicians and medical students now pursue supplemental education in data-oriented subjects such as advanced statistics, coding, and population health. And they express openness to using novel datasets,

including those from health apps and wearables, as part of routine care. These developments have significant potential to advance patient care and empower tomorrow's health care providers to predict, prevent, and cure disease—precisely.

And yet, the promise of this future is not assured. Among those surveyed, few feel “very prepared” to implement emerging technologies in clinical practice, especially for innovations that physicians and students say have the greatest potential benefit for patients. This Transformation Gap represents both a major challenge and opportunity for health care stakeholders. Certainly, we will need to heighten our focus on providing physicians and clinicians with adequate training. But we must also account for other issues.

From our survey, we see a future health care workforce that today is grappling with high levels of student debt, poor work-life balance, and administrative distractions—issues that are influencing career choices, including whether to remain in medicine. Educators, health administrators, government officials, and the private sector—now enmeshed in health care delivery—all have distinct opportunities to alleviate these burdens.

The findings presented in this report are just the beginning of an important conversation. As we embark on a new decade, there is no better time to have a discussion about how we can prepare and support tomorrow's health care providers to rise to their fullest potential.



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Introduction

The 2020 Stanford Medicine Health Trends Report identifies the Rise of the Data-Driven Physician as one of the industry's most consequential developments—one that has significant implications for patients. To understand this trend, there are four factors to appreciate:

- 1. An industry under transformation.** In 2020, it is clear that the health care sector is being profoundly altered by a number of trends, from technology advancements, to consumer adoption of novel health services, to policy and regulatory developments. Taken together, these trends place a high premium on new skills that fall outside the traditional domain of health care delivery.
- 2. Health care providers awake to new developments.** The next generation of physicians is developing a broader skillset. Our research found that nearly three-quarters of all medical students and nearly half of all physicians are planning to pursue additional education in data-oriented such as advanced statistics and data science.
- 3. A transformation gap in health care.** Currently, physicians and medical students report low levels of readiness to implement the technologies they believe have the most transformative potential for health care and their patients. While physicians recognize the benefits of many new technologies, education and training currently lag in fully preparing them for these new developments.
- 4. Under pressure.** Even with a new skillset, tomorrow's physicians face significant practice pressures today that are influencing their decision-making, including which specialties they choose and even whether they will remain in medical practice. Moreover, issues such as private industry getting involved in health care loom over the medical profession. How these trends play out will ultimately determine the future success of the Data-Driven Physician.

These trends and developments present important challenges and considerations for health care stakeholders. What's clear is that, if they can be successfully navigated, we will witness a revolution in health care, one that will bring significant innovation and data-driven insights to patient care.

Methodology

In addition to conducting a secondary review of news articles, white papers, and peer-review research for the 2020 Health Trends Report, Stanford Medicine worked with Brunswick Insight to conduct a comprehensive survey of 523 U.S. physicians and 210 medical students and residents.

(The student and resident sample included 77 current medical students and 133 medical residents.) Respondents were contacted through a list of American Medical Association (AMA) verified physicians and survey sample panels of medical professionals. Respondents were compensated for their involvement in the survey and were informed that their responses will be used to inform public-facing research. Respondents were given the opportunity to opt-out of any and all questions in the survey. Respondents were contacted between September and October of 2019. Percentages are rounded up to the nearest whole number when calculating totals.



Findings

1. Transformation of Health Care

The Rise of the Data-Driven Physician is the direct consequence of data and technology transforming the health care sector

The Rise of the Data-Driven Physician is a sign that the entire health care market is now grappling with the practical application of data and new technologies. Specific developments that are driving these changes include:

- The maturation of the digital health care market
- The availability of data
- Artificial intelligence moving from theory to practice

The Digital Health Market Is Maturing

The digital health market is showing signs of maturity as it moves from a realm of ambitious early-stage start-ups to more established companies with validated products. In part, this helped to fuel several high-profile IPOs of digital health companies in 2019. Last year, we also saw major corporations make multi-billion-dollar offers to acquire digital health companies that have, over time, amassed a significant consumer following.

Notable health care companies that went public in 2019 include Livongo and Health Catalyst, which both entered the market with billion-dollar valuations.ⁱ Also prominent was Google's announcement to acquire Fitbit for \$2.1 billion dollars.ⁱⁱ

Analysis from Rock Health indicates that investments in digital health care in 2019 are keeping pace with

investments that were made in 2018. While the total number of deals seems likely to stay consistent with 2018, the average size of the deals has increased.ⁱⁱⁱ

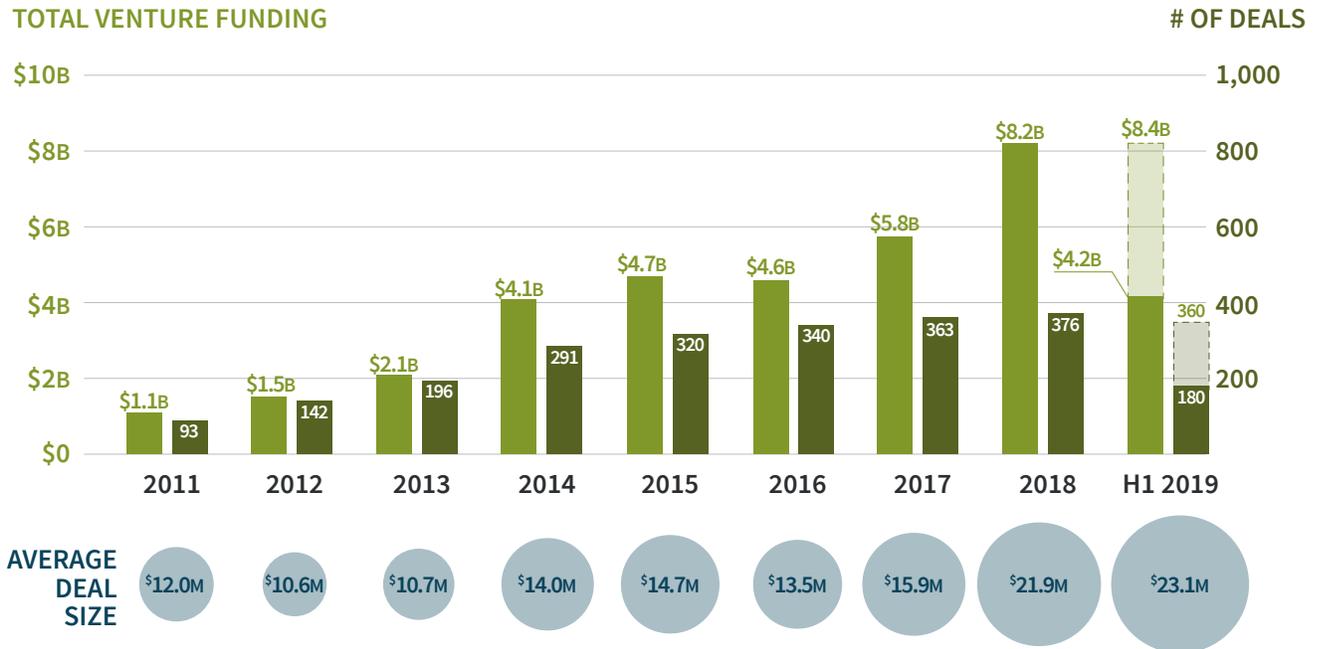
Consumer behavior also demonstrates a growing maturation of digital health care. Analysis from Rock Health shows an increase in the use of digital health tools by consumers over time, including wearable health-tracking tools and provider reviews.^{iv}

Data Sharing Is Increasing

Landmark legislation and regulatory priorities are pushing the health care sector to make data sharing a priority. The 21st Century Cures Act, passed in December 2016, has led to new data sharing rules for Electronic Health Record (EHR) systems—the technology now used by most medical practices to digitally document patient care.

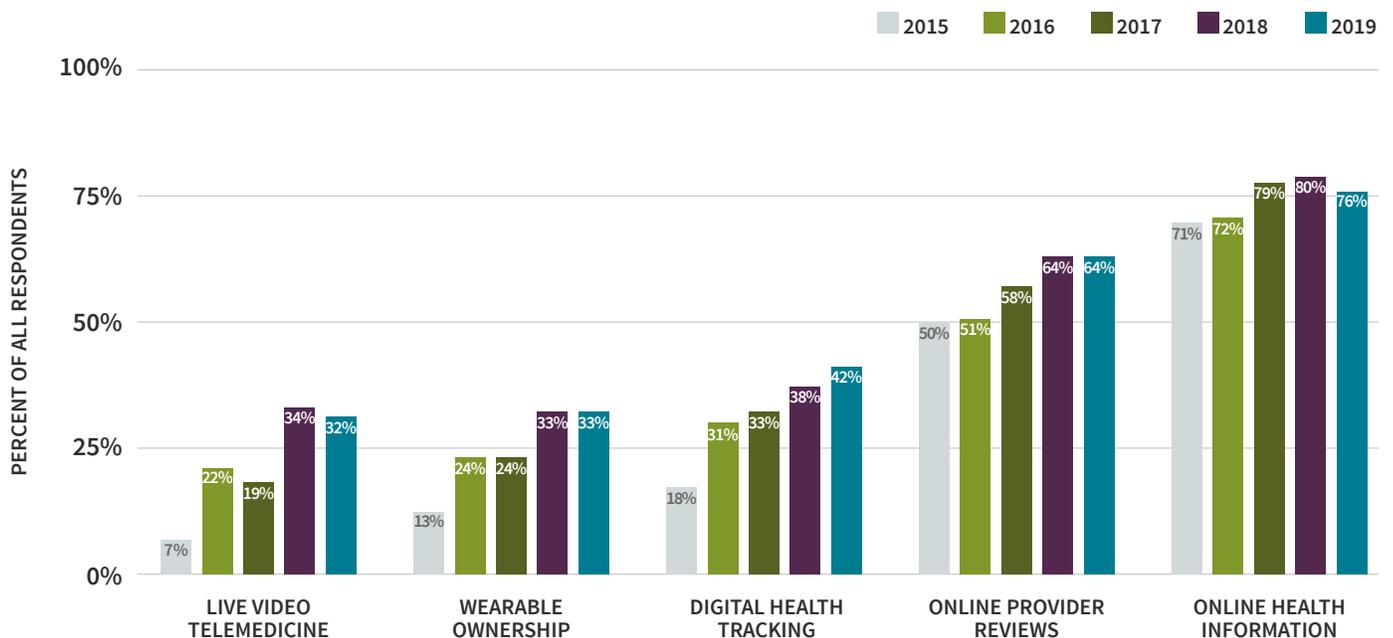
The rules, which are now under final review with the U.S. Office of Management and Budget, define and limit information blocking practices, greatly expand patients' access to their own medical records, and promote standardized language and application programming interfaces (APIs) that encourage technical interoperability across EHR systems.

Digital Health Funding 2011-H1 2019



Source: Rock Health (2019). 2019 Midyear Digital Health Market Update: Exits are heating up.

Adoption of Digital Health Tools 2015-2019



Source: Rock Health (2019). Digital Health Consumer Adoption Report 2019.

For an industry that has long struggled with low levels of information sharing and poor interoperability across its technology systems, in 2020 we expect to see the final rules create a seismic shift in how health care stakeholders share and interact with digital medical records.

Writing for Health Affairs in June 2018, Don Rucker, the National Coordinator for Health Information Technology at the U.S. Department of Health and Human Services, explained the potential of using open APIs to encourage greater EHR data sharing, particularly on health care outcomes, to ultimately improve treatment for patients:^v

The Cures Act builds on the 2015 Edition of ONC's health IT certification criteria by calling for the development of modern APIs that do not require "special effort" to access and use. APIs are technology that allow one software program to access the services provided by another software program.

...

Today, payers and employers who purchase care have little information on health outcomes. Often times, contracts between providers and payers are negotiated on reputation of the provider rather than on quality care. Providers should compete on the entire scope of the quality and value of care they provide, not on how exclusively they can craft their networks. Outcome data will allow payers to apply machine learning and artificial intelligence to have better insight on the value of the care they purchase. Population-level data transfer that is aligned with HIPAA

is also central to having a learning health care system, advancing many research priorities and use cases, and modernizing public health reporting.

Artificial Intelligence Moves from Theory to Practice

The medical community is keenly aware of the power of artificial intelligence (AI). Our survey shows that almost 40% of physicians, students, and residents see the potential for AI to transform health care in the next five years.

While technology developments in AI are a significant part of this story, an equally important component is the regulatory traction that AI has made in medical treatment.

According to an analysis conducted by The Medical Futurist Institute, approval of medical algorithms by the FDA has seen rapid growth over the past several years. In a report released in June of 2019, the Institute found that the FDA had approved a total of 46 algorithms up to that point:^{vi}

| Year | Total Number of FDA Approved Algorithms |
|--------------------------------|---|
| 2014 | 1 |
| 2015 | 0 |
| 2016 | 4 |
| 2017 | 8 |
| 2018 | 25 |
| 2019 (as of June) | 8 |
| Total (as of June 2019) | 46 |

Source: The Medical Futurist (6 June 2019) FDA Approvals For Smart Algorithms In Medicine In One Giant Infographic.

The algorithms approved cover a broad spectrum of treatments and diagnoses. A common form consists of imaging algorithms designed to analyze medical scans and images to identify potential cancer and tumors. Examples include:

- AmCAD-US evaluates thyroid nodules and categorizes nodule characteristics.
- Arterys' algorithm is able to spot cancerous lesions in liver and lungs on CT and MR images.
- iCAD classifies breast density and detects breast cancer as accurately as radiologists.
- ScreenPoint Medical assists radiologists with the reading of screening mammograms.

However, current AI applications extend far beyond the domain of medical imaging. Increasingly, AI is being explored as a tool to support clinical workflows, including in the Intensive Care Unit (ICU). A recent study looked at how AI could be used to track patients while they are being treated in an ICU to potentially improve care efficacy and outcomes down the road:^{vii}

The study is the result of a six-year collaboration between AI researchers and medical professionals at Stanford University and Intermountain LDS Hospital in Salt Lake City, Utah. It used machine vision to continuously monitor ICU patients during day-to-day tasks. The goal was to test the feasibility of passively tracking how often they moved and for how long. Early studies of ICU patients have shown that movement can accelerate healing, reduce delirium, and prevent muscle atrophy, but the scope of those studies has been limited by the challenges of monitoring patients at scale.

Depth sensors were installed in seven individual patient rooms and collected three-dimensional silhouette data 24 hours a day over the course of two months. The researchers then developed algorithms to analyze the footage—helping them detect when patients climbed into and out of bed or got into and out of a chair, as well as the number of staff involved in each activity.

The results showed preliminary success: on average, the algorithm for detecting mobility activities correctly identified the activities a patient was performing 87% of the time. The algorithm for tracking the number of personnel fared less well, reaching 68% accuracy. The researchers say that both measures would probably be improved by using multiple sensors in each room, to compensate for people blocking one another from a single sensor's view.

The demonstration suggests how these systems might augment the work of hospital staff. If algorithms can track when a patient has fallen or even anticipate when someone is starting to have trouble, they can alert the staff that help is required. This could spare nurses the worry provoked by leaving one patient alone as they go on to care for another.

As AI makes its way into the clinic, it is sure to have a significant impact on the medical profession. Tomorrow's clinicians not only need to be prepared to use AI, but they must also be ready to shape the technology's future development. There are still many outstanding questions about the technology, including what role AI should have in the patient-doctor relationship, ethical considerations, and, more practically, how it can best alleviate clinical practice burdens. Having a basic fluency in AI will be important for clinicians to engage in these critical discussions going forward.

With these significant changes driving the future of patient care, a fundamental question presents itself: how ready is the medical community for these developments?

Tomorrow's clinicians not only need to be prepared to use AI, but they must also be ready to shape the technology's future development.

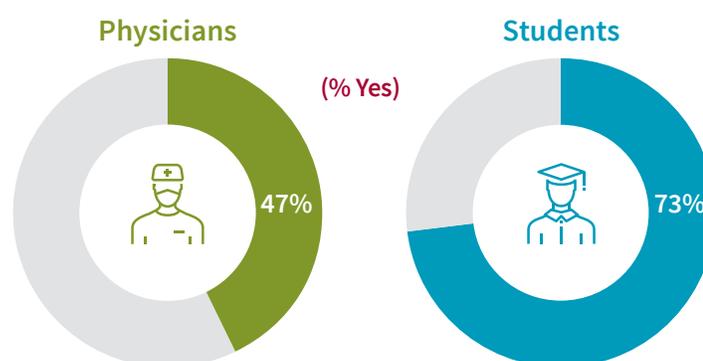
2. The Rise of the Data-Driven Physician

The next generation of physicians is actively preparing to use data and emerging technologies in patient care

A rapidly changing health care industry will require physicians to learn many new skills. Our survey data indicates that physicians and medical students recognize this reality. **Nearly half of all physicians (47%) and three-quarters of medical students (73%) said that they are currently seeking out additional training or classes to better prepare themselves for innovations in health care.**

Survey data sheds light on the specific classes, topics, and subject areas on which physicians and students are focusing.

Are you currently seeking out additional training or classes to better prepare yourself for innovations in health care?

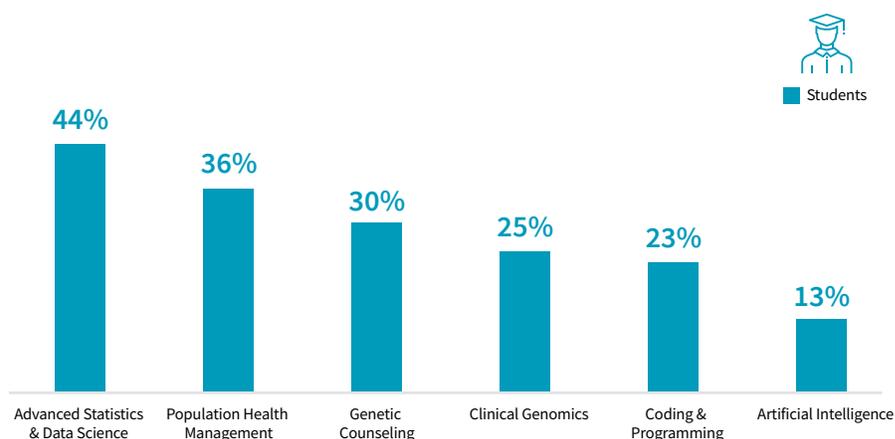


The Next Generation Of Physicians Is Diving Deep Into Data

Among medical students who decide to take additional classes to prepare for new developments in health care, many show a significant interest in data-oriented subjects.

Do you plan to take classes that focus on any of the following topics to better prepare yourself for new trends?

(Among Students Taking Additional Classes)



Among students, 44% have taken or plan to take classes about advanced statistics and 36% are interested in population health.

The Stanford Center for Population Health Sciences describes the multi-disciplinary nature of population health and its goal of bringing together diverse sources of data to reach medical conclusions:^{viii}

Population health research examines the relationships between myriad determinants and resulting health outcomes in large populations. It sits at the intersection of medicine and public health, between the biologic and the social sciences, enabling integrated research that encompasses virtually every domain of life and society.

Effective population health research requires rich and diverse data with opportunities for potential linkage and long-term follow-up. Stanford PHS offers access to a growing portfolio of population-level data to Stanford researchers and affiliates.

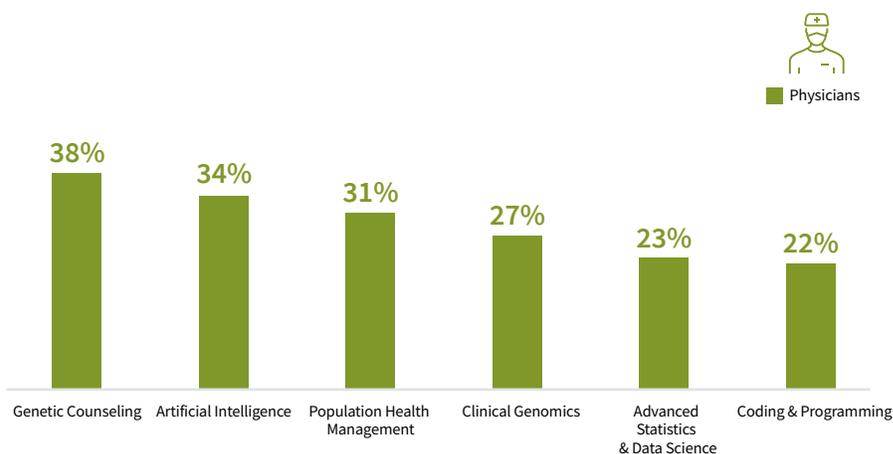
Students appear to be learning not just how to work with and interpret large datasets, but also how to apply social determinants data to gain a greater understanding of patients and underlying issues that may influence their health.

Genetic Counseling And AI Are Physician Priorities

As DNA testing becomes more commonplace, physicians are seeking additional training in genetic counseling to confidently interpret test results and discuss them with patients.

Do you plan to take classes that focus on any of the following topics to better prepare yourself for new trends?

(Among Physicians Taking Additional Classes)



Physicians

Even so, the complexity of this field presents a steep learning curve and will likely require physicians to pursue ongoing education. Organizations such as the National Society of Genetic Counselors have indicated that, even after receiving training, many clinicians still struggle to understand, interpret, and ultimately provide counsel based on the results of a genetic test:^{xi}

Even after taking educational courses, clinicians struggle with interpreting genetic testing results, according to a new study presented this week at the National Society of Genetic Counselors' annual meeting ...

In a new analysis, they examined how well clinicians fared on quizzes assessing their grasp of certain key cancer genetic testing concepts after they completed one of the Jackson Lab courses. Most of the nearly 800 individuals who took

a post-course quiz understood how to deal with positive genetic testing results, but they had difficulties interpreting negative results and variants of uncertain significance.

Not far behind genetic counseling is a relatively high interest from physicians to better understand how to apply and use artificial intelligence (AI) in their practice. This interest in AI may reflect a broader anxiety about the impact that AI could have on jobs and the future of the economy. Academic research paper headlines such as “Could machines using artificial intelligence make doctors obsolete?”^x and “The medical AI insurgency: what physicians must know about data to practice with intelligent machines” help to capture some of these concerns as well as the imminence of AI that many practitioners feel.^{xi}

The Future Physician's Toolkit

Not surprisingly, a majority of physicians expect to make use of electronic health records (EHRs) in their practice (87%). This high figure reflects a concerted effort by the U.S. government to push for EHR use through legislation and financial incentives.^{xii}

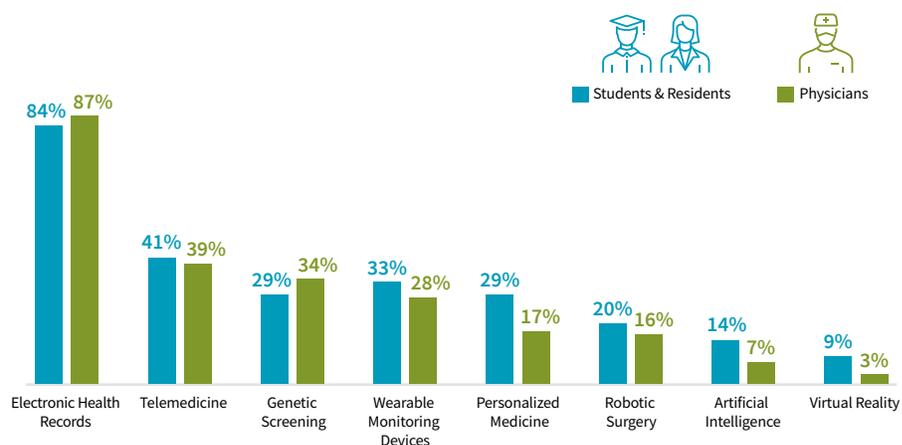
Moreover, roughly eight out of 10 physicians, students, and residents feel ready to use EHRs in their practice. However, high readiness for EHRs does not correlate with physician satisfaction with the technology. An assessment conducted by the Stanford WellMD Center, which compared the usability of EHRs with other common technologies, underscores the issue:^{xiii}

The results from the 870 physicians who completed this assessment showed EHRs with a poor ranking of 45 -- out of 100 -- on the System Usability Scale (SUS), a standard assessment used to evaluate the usability of technology. This was far below Google's SUS score of 93 and well below Excel's ranking of 57 right on the low end of the scale.

Among this same group of 870 physicians, 865 also completed a separate burnout survey. The results revealed a strong correlation between how doctors ranked EHR usability and burnout. Wide variation in EHR usability was observed by specialty. Certain medical specialties, such as dermatology, orthopedic surgery, and general surgery, ranked the usability of EHRs particularly poorly.

Relative to expected EHR use, all other technologies scored significantly lower,

Which of the following innovations do you [expect to use - Students and Residents / personally use - Physicians] in your practice?



with telemedicine (39%) and genetic screening (34%) ranking behind EHRs. Of note, this difference in expected use may reflect gaps in medical training (covered later in the report), as well as lower overall exposure to emerging technologies when compared to EHRs. As of 2017, EHRs were used by nearly nine in 10 (86%) U.S. office-based physicians.^{xiv}

Data-Driven Physicians Are Using Wearables to Understand Their Own Health

Over the past decade, digital health wearables have gone mainstream, gaining wide consumer adoption. Fitbit, for example, claims to have approximately 25 million active users.^{xv} In addition, recent clinical studies have started to validate wearables as a tool to conduct various kinds of health screenings:

Last year, a collaboration between Stanford Medicine and Apple sought

to determine Apple Watch's ability to predict a medical condition called atrial fibrillation. Ultimately, the study's key findings indicate that wearable technology can safely identify heart rate irregularities, highlighting the potential role that wearable devices and other digital technologies can play in achieving better health outcomes for patients.^{xvi}

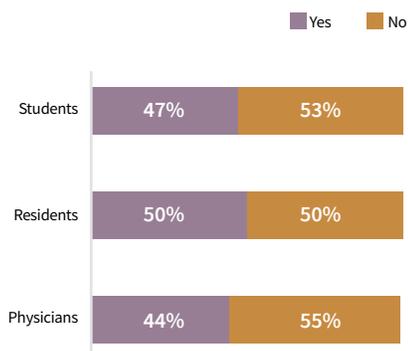
Moreover, roughly eight out of 10 physicians, students, and residents feel ready to use EHRs in their practice. However, high readiness for EHRs does not correlate with physician satisfaction with the technology.

Within this climate, what are physician attitudes—and behaviors—with regard to wearables and novel sources of

health data? And how do they view them when it comes their patients?

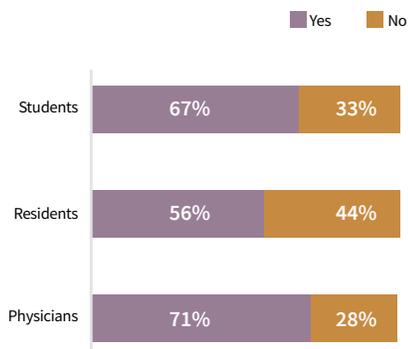
Survey results indicate that almost half of physicians, students, and residents use a wearable health monitoring device:

Do you use a wearable health monitoring device, such as a Fitbit or other similar product?



Importantly, among those who use wearables, a majority use the data they receive from their devices to inform personal health care decisions:

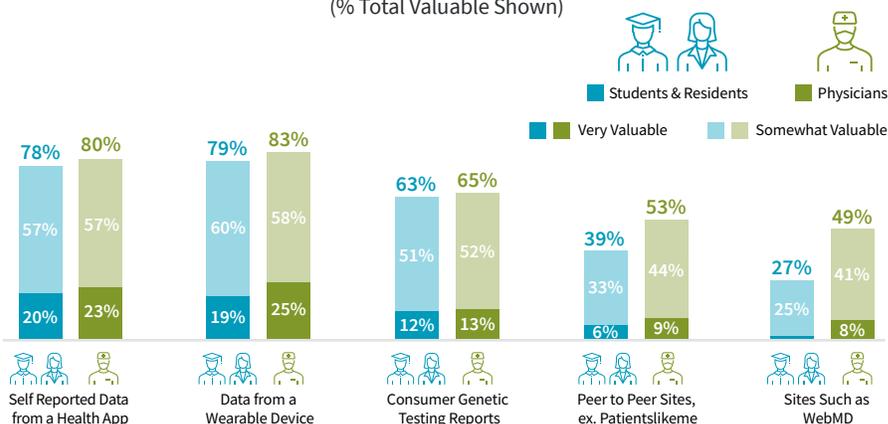
Do you use the results or data from your own wearable device to help inform your personal health care decisions?



Beyond their personal use of health data from wearables, physicians and medical students also attribute some clinical value to this data when it comes to their patients. Among various “alternative” sources of health data, physicians and medical students see the greatest value in wearable devices and health apps:

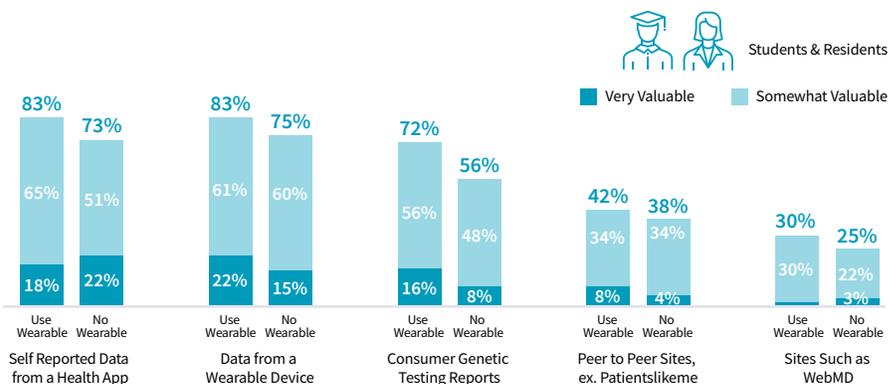
The next generation of Data-Driven Physicians understand that valuable data can come from many different sources, including apps and wearable devices

If a patient provided you with the following sources of information, how much clinical value do you believe it would provide? (% Total Valuable Shown)



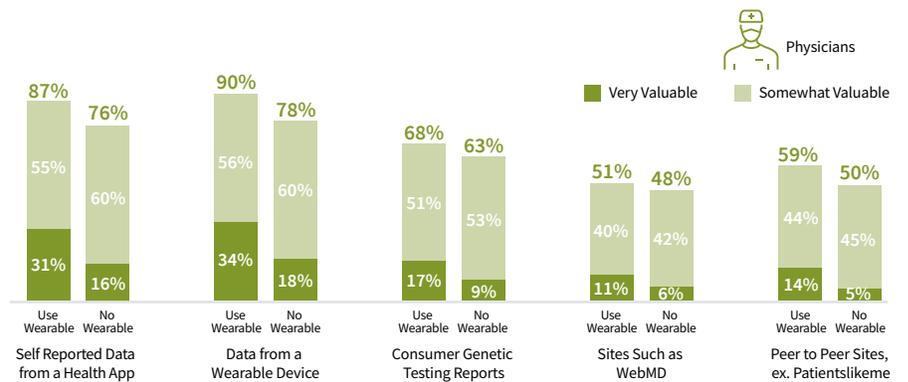
What’s more, our survey findings show that medical professionals who use wearables have a higher level of trust in other novel sources of health data:

If a patient provided you with the following sources of information, how much clinical value do you believe it would provide? (% Total Valuable Shown Among Students and Residents)



Beyond their personal use of health data from wearables, physicians and medical students also attribute some clinical value to this data when it comes to their patients.

If a patient provided you with the following sources of information, how much clinical value do you believe it would provide?
(% Total Valuable Shown Among Physicians)



3. The “Transformation Gap”

Most physicians, residents, and students do not feel “very prepared” to implement the innovations they say have the greatest potential benefit for patients

The Innovations Expected To Transform Health Care In Five Years

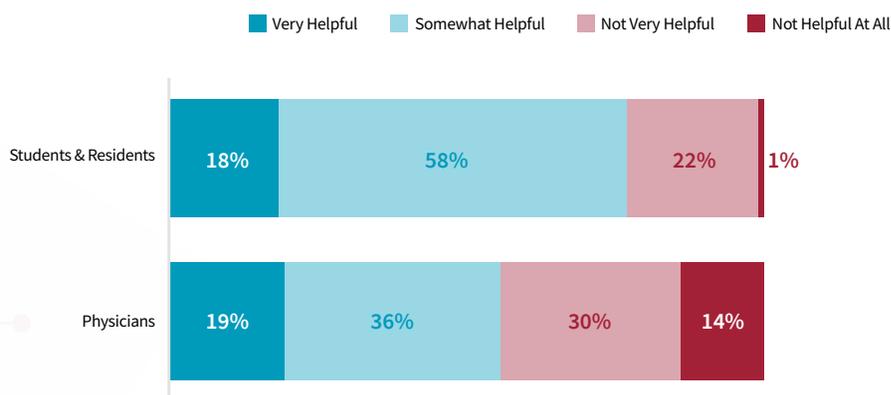
There is significant agreement among physicians, residents, and students that personalized medicine and telemedicine have the greatest potential to transform health care in the near-term. They also see potential in developments such as artificial intelligence, genetic screening, and wearables.

However, when asked to rate the effectiveness of their education to prepare them for these developments, only 18% of medical students and residents have said that their education was “very helpful” in preparing them. Forty-four percent of physicians said that their education was either “not very helpful” or “not helpful at all.”

Which of the following innovations do think have the most potential to transform the health care sector in the next five years?

| | Students & Residents | Physicians |
|---|----------------------|------------|
| Personalized Medicine | 64% | 61% |
| Telemedicine | 58% | 52% |
| Artificial Intelligence | 40% | 42% |
| Wearable Consumer Health Monitoring Devices | 41% | 40% |
| Genetic Screening for Health Risks | 33% | 43% |
| Electronic Health Records | 32% | 23% |
| Robotic Surgery | 16% | 19% |
| Virtual Reality | 15% | 12% |

How helpful has your education been in preparing you for new technologies in healthcare?



The Transformation Gap

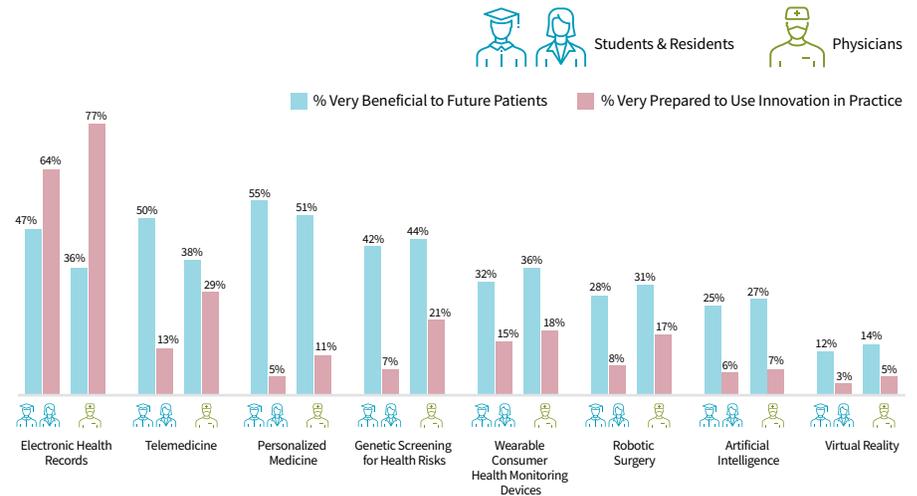
From these survey responses and others, we see a “transformation gap” emerge: a sharp divergence between the innovations that health providers recognize as important, but for which they feel insufficiently prepared.

Most starkly, we see this gap with innovations that physicians, residents, and medical students believe will benefit their patients the most.

For example, more than half of those surveyed see significant potential for the application of personalized medicine, but few physicians and students (11% and 5%, respectively) feel “very prepared” to implement it in practice.

Ultimately, those providing education and training to future medical professionals will need to consider these gaps as they continue modernizing their curricula to reflect the new realities of medical practice. Putting EHRs aside, a technology that is already ubiquitous in medicine, should even a few of these innovations reach scale over the next five years, care providers will be contending with a significant learning curve.

Perceived Benefit to Patients and Preparedness to Use



4. Under Pressure

The future depends on more than training. Equal attention must be focused on addressing medical practice burdens that have downstream consequences for patients

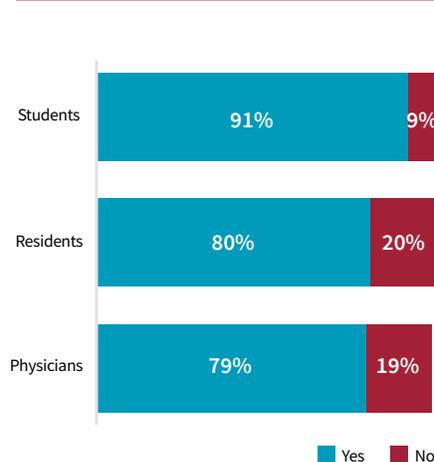
Practice Pressures And Work/Life Integration

Adequate training and a heightened skillset are not enough to prepare tomorrow's clinicians for the future, not if they are buckling under the weight of medical practice burdens. Results from our survey capture a key issue facing the medical community:

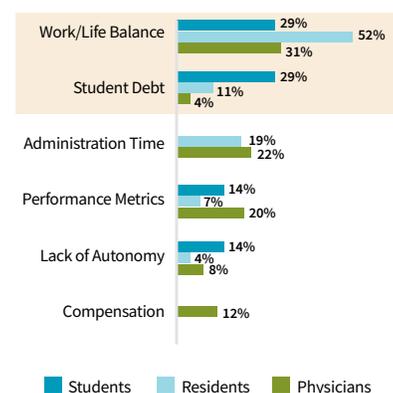
Among physicians and residents surveyed, nearly one in five would change their career path if they were given the opportunity to do so.

For physicians, this desire to change careers can be traced to a wide variety of factors, including increased time spent on administration, the burden of performance metrics, and difficulty achieving work-life balance. For residents, **52% cite challenges with work-life balance as the most significant reason to consider leaving medical practice, making it their most significant challenge.**

If you could redo your career, would you still pursue a career in medicine?



Top reason for not pursuing a career in medicine



The struggle to achieve work-life integration is not new. Previous research conducted by the American Medical Association (AMA) found that one-third of medical residents expressed concerns about work-life balance, and that this was the most common concern of residents.^{xvii}

One in three residents considers work-life balance the biggest challenge they face during their graduate medical education, according to a recently published survey report. This marks the third consecutive year in which survey respondents listed work-life balance as their biggest challenge.

Moreover, nationally, professional burnout among physicians remains a concerning trend. Published in 2019,

a study by Stanford Medicine, the Mayo Clinic, and the AMA found that roughly 44% of physicians reported at least one symptom of burnout in 2017.^{xviii}

Among physicians and residents surveyed, one in five would change their career path if they were given the opportunity to do so.

Though this represents a slight improvement from 2014, the last time period for which this study was conducted, physicians remain at increased risk for burnout relative to workers in other fields.

The Role Of Technology In Physician Well-Being

Today, primary care physicians spend more time interacting with their electronic health record systems than with patients, an issue they say significantly impacts their professional job satisfaction.^{xix}

This underscores the opportunity for future technology developers. Advancing technologies that are capable of automating and offloading administrative and clerical tasks from physicians would go a long way toward alleviating their most commonly expressed pain points.

Indeed, according to our survey, physicians, residents, and students estimate that, in the future, as much as one-third of their work could be automated by technology.

One example of such an effort is a pilot study between Stanford Medicine and Google Research called “Digital Scribe.” The pilot is evaluating the potential of speech-recognition and machine learning tools to automatically enter information into physicians’ EHR notes as they interact with patients who opt-in to the study. If successful, it has significant potential to not only free-up physicians, but benefit patients as well, who would regain the full attention of their doctors.^{xx}

Automation, however, can only go so far. Given the poor usability that physicians attribute to their EHR systems, broader solutions will be needed. This has been the central focus of a national symposium hosted by Stanford Medicine, which, for the last two years, has convened experts from health care, technology, and

Estimated % of Work That Will Be Automated:



government to improve EHRs and reduce their burdens on clinicians. Solutions discussed at these past two events can be found at: <http://med.stanford.edu/ehr.html>.

Beyond technology, academic medical centers, hospitals, health systems, health plans, and other stakeholder groups must take action, both at an institutional-level and in coordination with one another, to address the systemic causes of physician burnout. For health care organizations, commitment from leadership is an important first step.^{xxi}

In 2017, Stanford Medicine appointed Tait Shanafelt, MD, as Associate Dean and Chief Wellness Officer—the first academic medical center in the U.S. to create this position. At Stanford, Dr. Shanafelt directs The WellMD Center, whose mission is “To advance the well-being of physicians and those they serve.” The WellMD Center, in conjunction with the Physician Wellness Committee, conducts an annual Physician Wellness Survey to measure the impact of its health and wellness initiatives and validate evolving measures of physician burnout, professional fulfillment, and wellness at Stanford.

Will The Private Industry’s Foray Into Health Care Help Fix Things?

Extensively documented in our last Health Trends Report, companies that have long operated outside of health care are now entering the fold. With this shift, a significant amount of innovation is now being driven by partnerships between health providers and so called “non-traditional” entities, including major consumer technology companies.

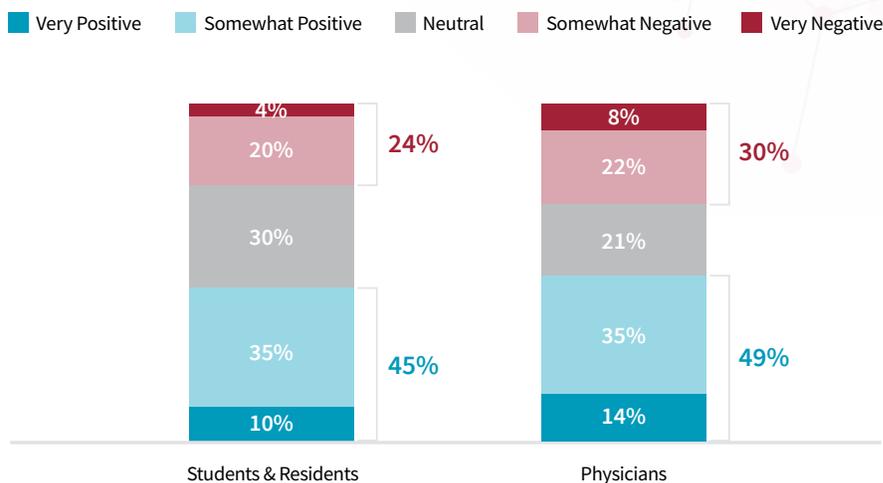
However, physicians, residents, and students have mixed views about the impact that these companies will have on health care. Notably, a large share of respondents (30% of students and residents and 21% of physicians) are still undecided.

When probed further, a complicated picture emerges:

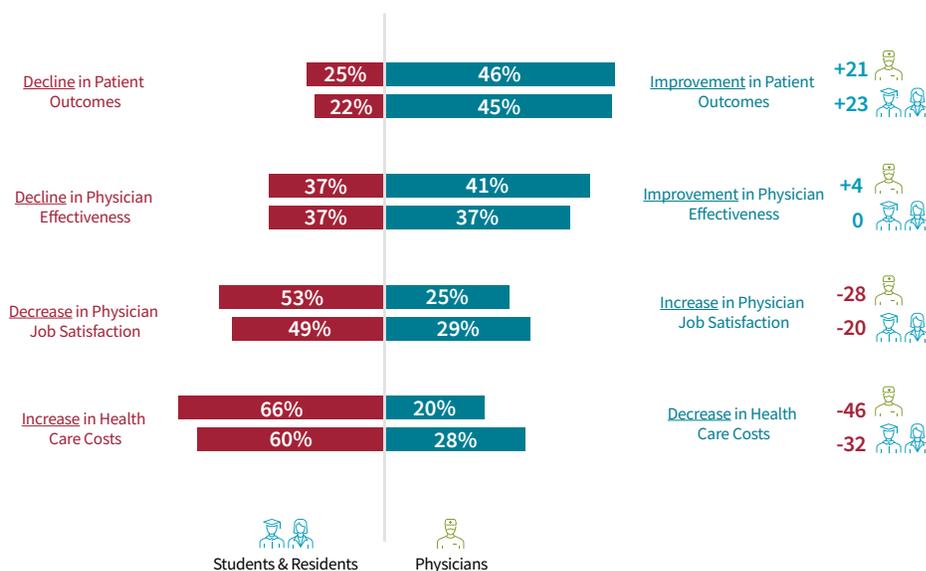
- Patient outcomes are likely to improve
- Respondents are divided on whether physician effectiveness will improve
- Physician job satisfaction will likely decrease
- Health care costs will likely increase

Though feelings are mixed, what is indisputable is that tomorrow’s medical workforce will look very different from that of today. In 2020 and beyond, we expect to see employers, health plans, and the private sector increasingly involved in health care delivery. Physicians will need to learn how to operate effectively in a larger health care ecosystem. Just as new market entrants must learn how to adapt to the cultural differences of medicine and navigate the stringent rules and regulations that exist to protect patients if they are to make a positive impact.

How do you feel about consumer technology companies and other non-traditional players entering the health care market?



What will be the impact the increase in corporations getting involved in health services?



Student Debt

Second to work-life balance issues, medical students who said they would rethink a career in medicine cited education debt as a primary factor influencing this decision. The survey indicates that a large majority of students and residents have taken on debt or loans in order to pursue their medical education.^{xxii}

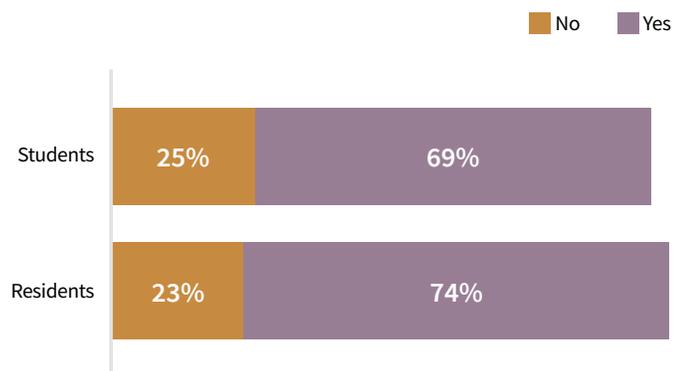
The survey results align with other publicly available data about the size of the student debt issue and the burden it places on students and residents. According to the Association of American Medical Colleges:^{xxiv}

Seventy-five percent of medical school students in the class of 2018 graduated with student debt, according to the AAMC.

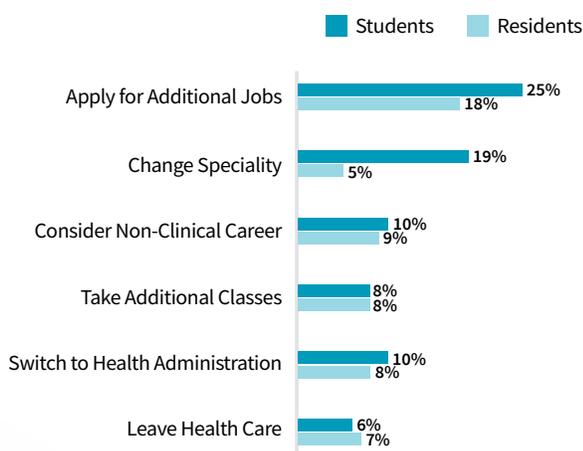
Among those graduates, the average student loan debt was \$196,520, up from \$190,694 in 2017. Those figures include debt from medical school, undergraduate studies and other higher education.

Student debt doesn't just take a financial toll on students and residents. Our survey also uncovered important ways that student behavior and lifestyles are influenced by their debt burden.

Have you taken on debt or loans in order to pursue your medical education?



45% of Students and 33% of Residents have done one of the following:



Forty-five percent of students and a third of residents (33%) have taken a variety of actions in response to the burden of their student debt. This includes looking for additional work (25% and 18%, respectively), changing medical specialties (19% among students), or pursuing a career path that is either administrative or non-clinical in nature.

These figures show that education debt can have a significant influence over students' career plans—decisions that have downstream effects for patients, potentially negative ones. Going forward, it will be critical for medical institutions to consider strategies for alleviating medical education debt for future physicians—particularly for those with the greatest financial needs.

Conclusion

The Rise of the Data-Driven Physician is an unprecedented opportunity to transform medicine and improve patient outcomes. And we are encouraged to see current and future physicians taking steps to actively prepare for this new era of data and digital health.

However, as it stands today, few feel sufficiently prepared to bring these new developments into the clinic. Moreover, issues such as poor work-life balance and student debt may ultimately push promising medical talent away from their passions or, worse yet, from the industry altogether. At the end of the day, we are all patients, and we all stand to lose when this is the case.

Addressing these challenges won't be easy, but given the stakes, the need to take action has never been more apparent. There is no "silver bullet" to do what is necessary; multiple actions, by many stakeholders, are needed.

Medical training and education will need to be continuously modernized to keep pace with new practice trends. Leaders across health care, government, technology, and other groups will need to engage in constructive ways to tackle physician concerns, including practice burdens that lead to professional distress and disillusionment. While the issues are manifold, we believe that those with a stake in the future have both a strong incentive to act and the capacity to do so.

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