The Intersection of Technology and Healthcare in Medical Data Processing

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Introduction

With access to healthcare becoming a more important and pressing issue to people worldwide, and technology's global influence growing tremendously, there is so much to come with the growing prominence of technology in the field of healthcare. One of the most basic ways in which technology plays a role in healthcare is that credible information is more accessible on the Internet than it has ever been. This kind of access is crucial to making progress in the healthcare fields and adding new features to the system to make it more efficient than ever. At the moment, there is a lot of information but not a single way agreed upon regarding how to apply said information. Of course, the access to the Internet can also be dangerous due to how much misinformation and lies are spread throughout the information. In addition to access of raw information, social media now make it easier to raise awareness of important health issues. In a sense, the growing influence of technology is helping shed light on the pertinence of healthcare in everyday life.

Thanks to the introduction of modern technology into the healthcare and medicine industry, it is now possible for monitors to read people's health information. There is currently a digital revolution taking place within the healthcare industry. In addition, as technology is an ever-evolving process, wearable technologies are being added to This kind of information shows how much essential information can now be tracked. It is also important to note that the new technology being installed can remotely continuously monitor each heartbeat, the rate and depth of breathing, body temperature, and other important measures of health. It is important to utilize machines created to track health and give the most accurate reporting possible of it.

Challenges

One of the most important facts to keep in mind is that there are many physicians uncomfortable with the technological change in healthcare; thus, just introducing technological changes will not provide any easy solutions that are being sought. Technology does, indeed, have its limits in the healthcare industry and can only go so far; it cannot be treated as infallible or without question. One of the biggest drawbacks about the intersection of technology and healthcare is the compromise of privacy. In recent years, while it has become easier to get essential information across to one's doctor, it is also easier to let out personal information that one may not want to expose. In addition, the costs are astronomically high. Therefore, the risks (both personally and financially) are high, but so are the possibilities for something greater than ever before. Contributor BMO Harris Bank has written an article for *Forbes,* titled "5 Ways Technology Is Transforming Healthcare," in which it informs that "the federal government is also planning to spend up to $29 billion in incentives to encourage hospitals and doctors' offices to digitize healthcare records." (BMO Harris Bank). This goes to show that much of the time and energy that the technology sector currently invests into social media like Facebook and Twitter could go into the health sector and create a healthier, better future for all. The five ways that those specializing in technology are starting to get involved in healthcare are crunching data to offer better diagnosis and treatment, helping doctors communicate with patients, linking doctors with other doctors, connecting doctors and patients, and helping patients stay healthy. One of the ways that the role of technology significantly helps is by helping bridge the gap created by a linguistic divide; there are millions of doctors nationwide in the United States of America (for example) who cannot speak English; this is inevitably a problem for millions of patients, since the majority of Americans do speak English. With language translators (from apps to full-blown devices), along with technological devices that will require little linguistic abilities, there are so

many ways to now combat language barriers. This kind of universal communication can help break down so many barriers that currently stand in the healthcare industry.

Benefits and Importance

Communication

In the article "Use of Information Technology to Improve the Quality of Healthcare in the United States" written for the National Institutes of Health, MDs Eduardo Ortiz and Carolyn M Clancy discuss the benefits and losses when it comes to the use of information technology in the field of healthcare. The MDs explain the following table:

> The lack of evidence was notable especially when compared to the strength of evidence regarding nontechnological safety practices such as prophylaxis for venous thromboembolism, use of sterile barriers during catheter insertion, or use of prophylactic antibiotics during surgery (Ortiz, Clancy).

Item	Patient Safety Program	Patient Safety Practice
1	Venous thromboembolism (VTE)	Appropriate VTE prophylaxis
2	Perioperative cardiac events in patients undergoing noncardiac surgery	Use of perioperative beta-blockers
3	Central venous catheter-related bloodstream infections	Use of maximum sterile barriers during catheter insertion
4	Surgical site infections	Appropriate use of antibiotic prophylaxis
5	Missed, incomplete, or not fully comprehended informed consent	Asking that patients recall and restate what they have been told during informed consent
6	Ventilator-associated pneumonia	Continuous aspiration of subglottic secretions
7	Pressure ulcers	Use of pressure relieving bedding

		materials
8	Morbidity due to central venous catheter insertion	Use of real-time ultrasound guidance during central line insertion
9	Adverse events related to chronic anticoagulation with warfarin	Patient self-management using home monitoring devices
10	Morbidity and mortality in post-surgical and critically ill patients	Various nutritional strategies
11	Central venous catheter-related bloodstream infections	Antibiotic-impregnated catheters

(National Institutes of Health).

Thus, the only conclusion that can be made so far is that there is too much in the technology sector that is not yet well-known or credible. Some steps are now being taken to bring the healthcare industry up to date technologically, such as research using handheld wireless devices and computerized decision support tools. The transmission of information in the healthcare industry through the information technology sector is being put to use through the improvement of healthcare quality. This includes the development and adoption of national standards and the development of a national electronic health information infrastructure. Such recording of data is essential to preventing crucial mistakes from being made in the industry; of course, however, such information is only as good as the information technology worker transmitting the information.

With the world changing so fast, it can be harder to keep track of important information. This is an area where technology comes in handy in the healthcare industry. There are three essentials levels at which the growth of technology in healthcare can help individual patients can take steps to improve their healthcare: using technological devices to manage their own health conditions, sharing information with professionals, and communicating with a trusted community to help look after their health and wellbeing. Improvement in these basic steps is one

of the few surefire mergers of healthcare and technology that is guaranteed to work well; technology in healthcare does not always have to mean complex new ideas that revolutionize the system as we know it, but could simply mean adjustments that make the delivery of healthcare data more efficient. Genetic data processing is just one part of medical data processing and, though the results are currently questionable, the healthcare industry's technological sector lags behind most other industries' technological sectors, which makes it hard for the healthcare industry to deal with modernization. With the world moving at a faster pace than ever before, it is crucial to record all the information that can be recorded, accurately.

Though the information transferred through technology in healthcare may sometimes be erroneous, the quality of healthcare is still massively improved with the prevention of medical errors and reduction of healthcare costs. In addition to such benefits, there would also be decreased paperwork (which is indubitably harder to manage and easier to lose than technologically recorded data is), population management due to earlier detection of infectious diseases, and consistency of healthcare effectiveness. Since the world is rapidly changing, using a means suited perfectly for change (technology) provides effective means of vanquishing the hurdles that stand in the way of accessibility to affordable healthcare. Such easy accessibility also leads to higher patient satisfaction, as patients do not need to make long trips and wait in long lines to schedule appointments with healthcare professionals. Health information technology provides the foundation for Medicaid health system transformation. This is important, as Medicaid is one of the biggest forms of healthcare in the United States. Being that the federal share for United States, healthcare spending tops $5 billion annually, the integration of technology is definitely an opportunity to lower the costs and facilitate exchanges between patients and doctors. Such facilitation leads to a more successful healthcare industry and

healthier, happier patients. As far as recording data, transferring information, and making appointments more affordable and accessible go, the healthcare industry will only improve its weaknesses if it develops a strong information system to handle the processes.

One of the most useful advantages of medical data processing is that, along with making data more accessible for both the patient and healthcare professional, is that recording data online makes editing the data, in case there are any errors, much easier. Oftentimes, the papers that doctors carry have erroneous information that can lead to the patient not getting the appropriate treatment that he or she needs. Electronic health records allow doctors to more easily keep track of integral health information and may even enable them to access information and share it with specialists if there is a problem. Such access of information in turn leads to more immediate addressing of the problems that the patient faces at hand.

Personal health records also help to keep track of important information that one may need in general health endeavors such as fitness. These records can track food intake, exercise, and blood pressure, all of which are essential and crucial information to taking care of one's own wellbeing. This also makes it easier to report progress made to the doctor. Electronic health records also allow doctors to communicate directly with their patients' pharmacy, which makes it easier to go to the pharmacy to pick up medicine without having to bring the paper prescription. This is a major step forward, as patients have complained multiple times in the past that they were treated unfairly because of a lack of paper prescription that was required for them to get the medicine that they needed from the pharmacy. Since these processes are often not executed in a timely fashion, it often takes too long for patients to get the prescription. Thus, they are often not able to attain their prescription drug from their pharmacy as soon as they would like. Now, technological advancements are finally changing all this and making it easier to attain these

prescription drugs. This includes smartphone apps that can help one monitor one's own health as well as to online communities to help and better prescriptions and information data processing with doctors.

Although the healthcare industry lags behind other industries in terms of technological modernization, the growth of technology in the industry is by no means slowing down. Andrew Meola, a contributor to *Business Insider*, writes in his article, "Internet of Things in healthcare: Information technology in health," shares how the role of technology in medical data processing has revolutionized healthcare over the course of a couple years. In 2009, Meola writes, "a mere 16% of U.S. hospitals were using an [electronic health record], but that figure soared to approximately 80% in 2013, according to Becker's Hospital Review" (Meola). For such an increase to occur within only four years shows how important electronic health records have become so quickly; hospitals used to have multiple systems that handled different functions, but electronic health records roll all of those into a single system. Portal technology and home monitoring systems help patients take care of their health by tracking their exercise, heart rate, and other such pertinent information without the doctor's help whenever the doctor is not available to help them.

The Internet of Things is a movement that is starting to weave ultrasounds, thermometers, glucose monitors, and electrocardiograms into connecting patients to monitors so that they can track their health more easily. The Internet of Things also has the power to fix the issue of healthcare patients not taking proper care of themselves when without the doctor's supervision. In other words, this type of technology can inform doctors of any potentially dangerous behaviors in which their patients engage and allow for something to be done to prevent it in time, even for situations when the doctor will not be available or accessible to the patient in time. Such

informative power granted through technological processes in healthcare can reduce so many fatal errors and allow for medical data processing to get done faster and more efficiently.

One of the biggest problems with technology playing an increasing role in the medical healthcare industry is that those who need efficient healthcare the most are the least likely to use the Internet, or any modern technology in general, to enter or access information about their healthcare. Due to weakening and deteriorating condition, old people are generally much more likely to need access to medical information that can help them. Unfortunately, they are far less likely to have access to (and, in turn, trust) modern technology and, thus, use it to report their own personal health information or access information that is beneficial to their health. Susannah Fox, a chief technology officer of the Department of Health and Human Services, has been featured on Wall Street Journal to discuss the role of technology in healthcare, including both the benefits and costs. Fox has pioneered research methods to explore how information technology and social media affect the healthcare industry and the consumer healthcare experience. Laura Landro has written an article for *Wall Street Journal*, titled "Technology and Health Care: The View From HHS," that documents the conversation and Fox's input. When asked about the most significant findings and downsides in this topic, then Fox emphasizes in detail the benefits of easily accessible quality information and the dangers of misinformation and lack of access to quality to information:

> The Internet gives access to information [...] that is crucial unlocking the potential of health and technology, from clinical-trial design to hospital-discharge planning. A recent study showed that people age 65 and older are significantly less likely than the general population to go online for health information. People living with disability are also disproportionately offline in an online world. Discussions about vaccines are daily proof

> that online information, including peer conversations, may not be based on science. It is essential to use the internet to seed the field with facts, to open access to medical journals and clinical-trial results, and to free the data (Landro).

With the elderly and disabled, both groups disproportionately at risk of poor healthcare, so disconnected to the Internet, it is crucial for information to be delivered to them through technological means that can help them or at least provide a younger adult who can assist them. Overall, the worst aspects of making medical data processing more technologically charged are the ease of sharing misinformation and the lack of accessibility for the disabled and senior citizens. As it is, those who are old and disabled but experienced in the intersection of medical data processing and technological innovation can use their expertise to help others who are old and disabled. This would work well alongside the help that doctors and younger, healthier family or friends may provide.

In addition to increasing safety and personalization, technology in healthcare allows can improve physicians' performance and, in some cases, patient outcomes. Such changes may provide the reconciliation needed between physicians and advocates for technology in healthcare, as physicians remain averse to such change in the industry. One of the ways that technology in healthcare saves time and increases safety is by preventing severe mistakes that could be dangerous from occurring. Information technology in general can reduce the rate of errors in three ways: by preventing errors and adverse events, facilitating a more rapid response after an adverse event has occurred, and tracking and providing feedback about adverse events. These errors are important to catch before they are entered and processed as true information. Furthermore, information technology can reduce the frequency of errors of different types and possibly the frequency of associated adverse events. This kind of change brought about by

information technology prevents so many past errors from occurring and lead to a safer, more stable future. It goes to show that the advocates for technological change in healthcare need to consider the costs and benefits, and which one outweighs the other.

Devices

Physicians continue to remain resistant toward technological change in the healthcare sector. Planning for a new health information technology system in healthcare requires identifying the needs of users and what the system is expected to do. In addition, designing the system for a clinic's specific needs, planning the implementation process, and determining how to evaluate how well the system has addressed the identified needs are crucial steps in personalizing the patient's healthcare through the use modern technology (Agency for Healthcare Research and Quality). Such identification and personalization of needs then leads to more accurate data processed medically. Perhaps there has been a disconnect between advocates for information technology in healthcare and physicians, since they differ so vastly in opinion on the matter. Anoj Bhattacherjee and Neset Hikmet have written an informative article for *Researchgate* titled "Physicians' resistance toward healthcare information technology: a theoretical model and empirical test." In this article, they outline physicians' resistance to healthcare and provide a model that could help to reconcile the differences between healthcare insurers. Their research shows an understanding of the subject at hand:

> Physician resistance was identified as the primary barrier to CPOE implementation, with high cost of CPOE implementation and vendor/product immaturity being the other barriers. This study recommended four strategies for overcoming resistance: (1) strong hospital leadership to communicate project vision and commitment, (2) customizing the system extensively to fit physicians' workflow, (3) employing well-respected physicians

to champion change and encourage others to see beyond immediate frustrations, and (4) leveraging house staffs (younger physicians) who were exposed to CPOE as medical students and are comfortable with its usage (Poon et al., 2004).

So far, these are just suggestions on how to make physicians more comfortable with technological change occurring in healthcare. Patients whose cases are more severe and cannot simply conduct every important step through a computer will be able to minimize their struggles by covering online whatever they can. Thus, in turn, will make room in their (and their physicians') schedules to meet with their physicians in person when necessary.

One of the best moves for patients to currently make is to take more initiative in improving their access to information and keeping track of their daily habits and health. Patients need to be assured that they have control and choice over their healthcare information and the means that they use to record data. The ease of access to information for both parties (the doctor and the patient) allows for a healthier relationship between the two and, thus, makes crucial information easier to transmit. In addition, the initiative for the patient to take action toward better health, as well as accessibility for the doctor to make sure that the patient is taking such initiative, needs to be emphasized so that there is better health. Thus, while much of the change needed in healthcare is technologically, much of it is also cultural and needs to start from the patient and doctor.

One of the most important notes to take in such a setting is that there are also negative aspects of technology playing an increasing role in medical data processing. For example, as life expectancy is increasing, so are the costs for healthcare. Even though technology does tend to change for the better, it does so at higher costs. Compared with people 19 to 64 years old, those aged 65 to 74 spend two times as much; those 75 to 84 spend four times as much; and those 85

and older spend six times as much! This is concerning, since the older that one becomes, the more that one needs access to simple and high-quality healthcare; those who need healthcare more than other demographics are consistently likelier to pay much more than younger peers are! In other words, those of the Silent and Greatest generations (the ones who need healthcare the most critically) tend to be much more likely to spend on healthcare than baby boomers and especially Generations X (currently aged 37-51), Y (currently aged 17-36), and Z (currently 16 and younger) do! In fact, the baby boomer generation is so large that, by 2040, there are projected to be 37 Americans over 65 for every 100 working-age American today! In turn, it can be reasonably assumed that, by 2040, spending for healthcare will increase to an even greater disparity between the elderly and younger than already exists. The changing nature of healthcare at the moment, due to technological advances, is contributing to the costly spending.

Despite age contributing to the expenses of healthcare spending, this cost is much more driven by technology. Technological change, after all, is responsible for at least one-third and as much as two-thirds of per capita health care spending growth. This is an alarming rate, since it was not too long ago that healthcare and technology were segregated as fields. After accounting for changes in income and health care coverage, aging alone can account for, at most, only a few percentage points of spending growth. This goes to show that living longer also costs more. That cost, however, is not derived from the long age itself, though, nearly as much as it is from the technological changes that occur each year. Not all of the credit goes to technology; much of the progress made in terms of longevity comes from personal habits outside of the healthcare system, such as higher education attainment and lower smoking rates over the years. As people have generally engaged in both these behaviors, life expectancy has increased significantly.

Another extremely important tactic in dealing with the technological transition of healthcare is the recognition of a need of wearable technologies. They are very much projected to be the next big technology in the market. Wearable technology allows for people not only to wear gadgets as a fashion statement, but much more easily and conveniently plan their schedules due to allowing for smartwatches to schedule meetings, appointments, and other such dates. With fitness becoming a much bigger and more relevant part of people's lives each day, people are turning to health-monitoring applications (such as Samsung's Health application or Fitbit) that allow users to keep track of how many steps they take a day, how much exercise they complete, etc. In 2017 alone, the sales for wearable technologies, such as smartwatches and body-worn cameras, skyrocketed. Year over year, the growth for wearable technologies is projected to rise as high as 16.7%. This is an extremely high rate, as it shows the significance of these devices. It is important to remember that, with time, many trends change. Technology is a huge factor in change because of the fact that it allows for people's entire daily routines to change and evolve with time. With the wearable technologies of today become more significant, users can program their schedules and adjust them on the go! This finding is mindblowing, given that these sources are used so popular in use for people of all ages and backgrounds.

One of the most important pieces of information to keep in mind about medical data processing is that everybody's health needs are different, so a one-size-fits-all program can be very difficult to implement. The use of smartphones has made exchanges in medical data processing much easier and more efficient over time. With health applications that can track one's wellbeing and health, as well as wearable technologies that can monitor heart rates or be used to record pertinent information, patients and doctors have been assisting each other with more efficiency. The use of smart, wearable technology is becoming more commonplace for

doctors, which means that they are now able to perform their jobs more quickly than before and with more accurate results. Without modern technology, healthcare is outdated and not completing the task for which it is made. It is important to note that, while some patients do need in-person meetings with their doctors to occur, there are many patients who do not need such exchange. It is far more convenient for a patient who does not require meeting in person with a doctor to engage in physical therapy sessions at home. This allows for the patient to contact the doctor though a cellphone or laptop rather than meeting in person and wasting time that could go into physical training.

One of the most important, if not the most important, aspects of healthcare is the patient's safety; after all, healthcare's entire purpose is to make sure that patients are safe and healthy. There is no doubt that information technology has increased patients' safety in the healthcare sector. Since many styles of healthcare do not always fit well for everyone, technology has helped to personalize healthcare and increase safety of its use in the industry. Computer retailers, for example, use websites to allow people to purchase computers built to their exact specifications, which can arrive to the consumer as early as two days after the order. This is an important step forward, because healthcare needs are very different depending on the person. More than 600 drugs require adjustment of doses for multiple levels of renal dysfunction. This is an example of a task that is poorly performed by human prescribers without assistance but can be done accurately by computers. From this, it becomes apparent that technology's role in healthcare continues to make personalization (and, thus, efficiency of healthcare delivery) a reality and, in doing so, increase safety as well. Safety is perhaps the most important factor of healthcare, so bringing forth change that can lead to greater safety is a move of pressing significance.

One of the most important parts of improving safety by fixing errors in the system is by improving communication that occurs between doctors and patients. The main benefit of using information systems is that they can rapidly identify such problems and immediately communicate them to clinicians. Allowing technology into the healthcare sector allow for greater efficiency with time, accuracy of information tracked and reported, speed of communication, and safety. Right now, for the groups most resistant to such change, the question to be answered is whether it is a good idea to allow the costs to increase as much as they do when technology is involved.

One of the most important aspects of healthcare is prevention. Having smartphones allows for people to better plan their future, such as what their diet will be and even how many (if any) kids they will have. This, in turn, allows for people in need of healthcare to better focus on their health needs and approach a more personalized system that works well for them. A governmental database called Health and Human Services has been recording important data regarding preventive healthcare. As the database cites, many preventive services include cancer screenings, cholesterol tests, vaccinations, baby visits, and health counseling services. All these tests provide the purpose of preventing lethal infections and diseases from throughout the body (and onto others) by providing the proper preventive treatments in time. Shots in general (whether flu shots or vaccines) prevent diseases and harmful bacteria from entering the body and causing damage. Some of the ways that patients can prevent poor health without relying on technology or on extra spending, the Health and Human Services database lists, are to “be sure to get plenty of vegetables, fruits, whole grains, fat-free or low-fat dairy products seafood, lean meats and poultry, eggs, beans, peas, seeds, and nuts” and “limit salt, added sugars, saturated fats, *trans* fats, and refined grains” (healthfinder.gov). Indeed, such dietary habits taken by

individual patients prevent much long-term health problems such as diabetes, obesity, and other such issues from occurring. The database goes to describe how eating healthy foods and limiting unhealthy ones can reduce risk for “heart disease, type 2 diabetes, high blood pressure, some types of cancer, and osteoporosis” (healthfinder.gov). Hence, serious health problems can be prevented by taking little steps.

Indeed, the steps needed to prevent extraneous healthcare spending and technological programming are not utilized nearly as much as they could be. The Center for Disease Control and Prevention cites that, at least as far as one nation in concerned, “Americans use preventive services at about half the recommended rate” (cdc.gov). This shows that patients do not use the resources available to them for better health as easily as they could. Even though chronic diseases can be generally prevented through close partnership with one’s healthcare team, or detected through appropriate screenings, they are responsible for 7 of every 10 deaths among Americans each year and account for 75% of the nation’s health spending! This is troubling, as it shows how much is being invested into the development of healthcare, both financially and technology, yet how little is actually produced in results. The five leading causes of death (at least in the United States) according to this database are “heart disease, cancer, chronic lower respiratory disease, stroke, and unintentional injuries” (cdc.gov). Proper tracking and planning of health diets and processes (such as exercise) onto a computer, online database shared with the doctor and patient, or any other such easily accessible technological device, is essential to preventing lethal incidents from occurring.

Data Processing

While such preventive measures can vastly reduce the need for the investment of even more money and time into healthcare, they still cannot solve critical issues such as medical

emergencies. Technological advancements in the technology sector allow for greater personalization, more accurate information recorded at quicker speeds, and more effective treatment for the problems at hand. It is important to note that advanced technology cannot be given only to the figure of authority in charge of healthcare but must also involve the people being treated so that they can have control and choice over their healthcare problems. Connective technologies that involve both patients and doctors allow for better interaction in lesser time between the two, leading to a healthier and more productive relationship between the two parties.

Unfortunately, as is the case with preventive healthcare, many patients underscore the importance of healthcare's and technology's intersection. According to the Centers for Disease Control, only 38% of office-based physicians used electronic health records until the federal government passed regulations that provided incentive for physicians to adopt electronic health records. By 2013, 78% of physicians used electronic health records. Still, costs are a major problem with the introduction of advanced technology into the healthcare sector. Unfortunately, the fact still stands that greater use of technology in the American healthcare industry has led to the country spending more on healthcare than other industrialized countries, and still yielding an ineffective system. Despite the United States being relatively new to integrating technology and healthcare, other countries have been shown to spent between one-third and two-thirds as much as the United States does. While the U.S. performs well on breast and colorectal cancer survival rates, it has among the highest rates of potentially preventable deaths from asthma and amputations due to diabetes. This goes to show that, as bitter as it may be to swallow, much of the United States' spending is unnecessary. It also brings about the question of how much technology will really help or change. Furthermore, the only advancement that the United States

has made in healthcare is higher breast cancer survival rate than other groups, but that is minimal compared to its lag behind the other countries in terms of healthcare efficiency.

One of the ways to combat the rising cost of technology-infused healthcare is, of course, raising money. In Silicon Valley, there are many causes currently raising money for better quality of healthcare and spending. Some large companies in California are working with the government to provide better technology and healthcare. Though those in power are the ones raising money, there is still concern that so much money needs to be raised in the healthcare sector. Silicon Valley startup Clover Health has helped raise money for better technology in healthcare. Clover has put in almost $300 million and has 19,000 members whose data-driven approach to health care could substantially bring down what Americans spend annually. Thus, if companies with the power to raise money can do so, then this will assist with working around the issue of the high costs of high quality technology incorporated into healthcare.

Healthcare is a heavily regulated industry, but for health companies to work with the government to improve technology in healthcare and raise the money to do so can bring forth the benefits of technology while also tackling the issue of cost. There is a lot of work to be done, but better healthcare can be brought about without the worry of costs if companies take the initiative to raise such money.

One of the ways for those in power to raise money for better technology in healthcare is for large, influential companies in both sectors to work together. This has been happening more recently, with technology and health related companies working together to raise such money. In addition to the earlier cited example of Samsung creating an app that allows for heart rate to be measured, Apple has also been trying to get customers to wear health-tracking hardware so that people can take better care of themselves. In his article for *Technology Review*, "Amazon May

Be the Next Tech Giant Muscling Into Health Care," associate editor Jamie Condliffe writes of the merging and collaboration taking place between technology and healthcare companies. He notes that even though "Apple and Google are already trying to use existing or available hardware for health purposes [it is worth to note] that has a key advantage over other firms, with its sophisticated retail and distribution network [and therefore] may hope to offer a more comprehensive service than Apple or Google could right now" (Condliffe). Thus, it seems that there is now competition within the technology industry to raise better technology for healthcare. Raising such money, therefore, may help not only the customers who need better healthcare, but also the free market by creating more competition and jobs.

What would happen to the workers in the healthcare and technology industries as the two start to intersect? Will there be more harm than good? There is a variety of options to come from such a growth of industries. The database for Rasmussen College lists the entry-level position of medical records and health information technician, which includes 74,939 job postings of positions such as medical coding, medical records analyst, health information technician and clinical documentation and has an average salary of $34,160 per year. This is just one example of how many promising, lucrative jobs are being made available, even at the entry level, due to the intersection of technology and healthcare. Medical coding is one of the most important aspects of medical data processing and such a job is in high demand. Almost all the jobs provided by this intersection call for medical coding skills, which are essential to the future of medical data processing.

As previously discussed, the relationship with physicians and advocates for technology in healthcare is complicated. Also complicated is the future of physicians with the growing influence of technology in the healthcare sector. Jonathan P. Weiner, Susan Yeh, and David

Blumenthal discuss the future of physicians under this intersection in their article, “The Impact of Health Information Technology And e-Health On The Future Demand For Physician Services” for the a governmental database for Michigan called michigan.gov. They bear the unfortunate conclusion that if health information technology were “fully implemented in 30 percent of community-based physicians’ offices, [then] the demand for physicians would be reduced by about 4–9 percent” (Weiner). Such statistics contribute largely to physicians’ cold attitude toward technology becoming prominent in healthcare.

One important fact about the current healthcare system is that different forms of health need to be considered as different systems. For example, cardiovascular health is a different department from mental health and, therefore, requires different treatment and consideration when it comes to adding electronic health records and other forms of technology. Thus, the challenge of personalization still persists, as there is a lot of work to be done so that individual needs can be met for people in healthcare.

One of the most important factors of determining quality in healthcare is the satisfaction of both the doctor and patient. Unfortunately, many physicians so far have not had a good experience with electronic health records. Some of the problems with electronic health records include poor usability, time-consuming data entry, interference with face-to-face patient care, and inefficient and less fulfilling work content. Allowing for physicians to achieve more autonomy and control of the situation allows for a more productive environment. In turn, this can be an effective solution to the problems that physicians currently experience with electronic health records.

This goes back to the point of including experience with computers in physicians’ training that they receive in college and medical school. It is important to note that physicians

who report higher levels of autonomy and control at are likelier to report greater satisfaction and lower rates of turnover. This means that giving physicians more autonomy is another way to improve the healthcare system. They also need to be treated as they are getting the respect that they deserve as healthcare professionals - meaning a high salary for the work that they put in; studies show that employees who achieve high salaries, especially for putting in hard work, end up being more productive and capable of yielding effective, positive results. Another important factor is a good relationship between the doctor and patient; physicians who perceive good working relationships with other physicians (including perceptions of teamwork), as well as with staff in their practices, are also likelier to report being satisfied with their jobs and their overall career than were those who do not share such positivity. This, in turns, means that patients need to also perceive their doctor as attentive and their healthcare as of good quality, with patients improving in their health and receiving the results for which they aim. Electronic health records and technological means of communications will be able to alleviate some of the issues that exist with electronic health records and allow for patients and doctors to have more efficient, easy communication.

One way that information technology has become more relevant within the realm of healthcare is that well-known technologically based corporations have become more likely to take initiative for working on healthcare issues. In his article “The Real Reason Apple Made the Apple Watch” for *Time*, technology consultant and analyst Tim Bajarin discusses this case in depth and outlines Apple’s endeavor to expand to healthcare. Barajin states that “Apple was looking at ways to deliver on Jobs’ goal of making their customers healthier by using technology to help monitor and track health related data points” (Bajarin). Similar to Samsung’s health app, this device for Apple allows for users to keep themselves more fit and use technology to record

their health updates so that they can keep track of the progress that they have made. Fitness is an important part of people's everyday lives, and technology has become one, too. This kind of addition into the company shows a different direction than one of technology merging with healthcare; it shows, instead, the introduction of healthcare systems and jobs into a technology-heavy company. With Samsung's own health monitoring application for the smartphone, as well as Apple's addition of medical monitors, full-time nurses, and facilities, there is much to anticipate for the future of healthcare and technology.

One of the benefits of increasing the use of technology within the field of healthcare is that it may lead to less problems with quality for those who cannot afford something of high quality. The main point of technology being introduced into healthcare is its transformative power; technology really has the power to change healthcare and, thus, its quality altogether. One of the most important skills for both patients and doctors to learn is to adapt to the technological change in the workplace. With so many practices, such as 3D printing, becoming more prominent within the technology sector, it is important for knowledge and awareness of technology to become more accessible so that the transition brought about by technology can be smooth and comfortable for all.

In his article, "Innovation Is the Key to Health Care Reform," for *Reason* Magazine, health economics professor Robert F. Graboyes discusses ways to improve healthcare through the use of technology. Graboyes outlines the many different technologies being developed currently and on their way to gaining prominence, such as "designed for a single individual's DNA; 3D printed transplantable organs made from a recipient's own cells (no need for donors or rejection); nanobots to repair a patient's damaged genes; wearable telemetry to continuously monitor a patient's biometrics; vastly expanded capabilities for telemedicine; better detection,

treatment, and prevention of illness via social media and state-of-the-art data mining; and—less sexy but no less important—lean production methods to squeeze more care and more health out of a given quantity of resources" (Graboyes). This shows that there is a lot of room for improvement in the healthcare sector to be made before healthcare can be affordable for all. The mechanisms of these technologies need to be learned so that information can freely flow between doctors and patients. So far, technology has shown to improve the transfer of information and bring about accuracy, which is essential to a successful healthcare experience. With more time to develop the technologies in healthcare and for information to be transferred freely, there will be much more success to come.

Risks

Disruption of the status quo

So far, the data present a paradox: the free flow of accurate, high-quality information is increasing, but so are the costs with it. Still, how much of this is actually known by doctors and patients alike remains a matter of further investigation. While electronic medical records are certainly a major step in the technological revolution of medical data processing, how helpful are they really? Though most physicians have adopted electronic medical records for their professions, this is not the case with the majority of hospitals in general. Cost is unsurprisingly the primary source of resistance of the use of electronic medical records in the hospitals. Even though physicians have largely started to use electronic medical records, only 1.5 percent have adopted a comprehensive system of electronic records that includes physicians' notes and orders and decision support systems. Such systems alert doctors of potential drug interactions or other problems that might result from their intended orders. This problem is driven by skyrocketing costs that make simultaneously cutting healthcare and improving information technology within

healthcare nearly impossible to do. There is so much to take into account with the speedy transfer of information and changes in how it is being transferred.

The Human Element: the good, the bad, the ugly

While many doctors remain resistant to technological change taking place in their workplaces, differences in such views are pronounced among generations. While many doctors are old and unlikely to retire anytime soon, many are also young and ready for change and a smooth transition in the free flow of information. The older doctors, unsurprisingly, tend to be more resistant to technological updates taking place in the healthcare industry, but younger doctors tend to be far more enthusiastic and welcoming of it. This makes sense, as younger doctors are far more likely to be connected with technology and therefore familiar with it. They use smartphones for everything, from texting and calling to finding information at the whim of a Google search. They are also far more open to the idea of an understanding of medical technology being mandated in their training in medical school, as college and postgraduate students and aspiring doctors. In her article “Career Source: Millennial Physicians' Must-Haves: Location, Computerized EDs, Guaranteed Income” for *Emergency Medicine News*, Dr. Barbara Katz discusses how open millennials (currently the youngest generation in the workforce, of the cohort of babies born from 1981-2000) actually are to having technology used in their professions as doctors. She discusses how the vast majority of information that millennials receive is from online sources rather than through manual papers and books. Even though most doctors overall remain resistant to technological updates with which they cannot keep, 79 percent of [millennials] preferred using electronic medical records for charting and documentation. Fifteen percent preferred dictation, and five percent like to use scribes. This is important to know

since technology is a very significant part of the change currently taking place in the world in general (not just the healthcare industry), and millennials are all for it.

Still, however, a majority of millennial physicians prefer not to work with a computerized healthcare system. Thus, it is important to note that, though many generational changes do occur, many trends remain throughout the generations. Millennials' ambivalence toward technological changes in the healthcare sector, along with large technology corporations like Apple taking initiative to capitalize on healthcare, is a promising sign that information technology will develop more of a role within the healthcare industry as time goes on.

Regardless of the potential risks posed by large corporations, competition and new ideas are arising at high rates, giving way to innovation. Competing to develop jerseys, shoes, and bras loaded with sensors and wireless circuitry. Thus, the very style of fashion may be revolutionized with the rise of wearable technology. Of course, the problem of battery life still remains; if this is not worked on and addressed, then there will still be problems facing the wearable technology industry. Unlike smartphones and many other new technologies, wearable technology has a great amount of appeal for young adults, parents, and the middle aged rather than just for teenagers and young adults. One type of wearable technology that is extremely intriguing is the development of devices that track children's locations if they get lost or wander off too far. This is something that could seriously garner a great deal of support with parents whose children wander off too often and create extra tasks that consume time and energy.

The age-old conundrum of technological process is the compromise of human communication. With smartphones and wearable technology, it is hard to tell whether the technological devices hinder human interaction or communication, or actually make people more connected. It is a question with many different factors that need to be taken into account in order

to form a comprehensive, honest answer. The truth is that people become so immersed on catching up with what is going on (which they find about directly from their phones) that they indeed become less involved in the physical world around them. However, the use of smartwatches helps people schedule their appointments better so that they can make wise use of their time. In addition, the GPS system used to track children that have gone missing is a wearable technology that definitely uses its power to make itself more accessible and available to people of all different backgrounds.

The extent to which this new technology may go is both exciting and frightening. For example, the article notes that Walt Disney has started working on a wristband that will be used to get on rides, pay for food and enter hotel rooms when in Walt Disney. The technology is convenient for guests, but a great risk that comes from this is that it allows for the large company to collect a lot of crucial information about their whereabouts and personal familial information. It is definitely that crosses some lines in terms of boundaries. This, of course, is very concerning, as it allows for the company to obtain information over the people even if they are not ready for such information. Furthermore, the car company Hyundai has started working on apps that will let people unlock and start their cars with their watches and phones! This is something that can either give us something greater than ever before or become a huge risk. There is no doubt that it is a topic of controversy and confusion. This kind of power with smartphones and smartwatches can definitely be a good thing, as it allows for greater personalization and access. However, it can also be incredibly risky, as the smartphone and smartwatch are both devices that can be very easily lost, compromised, or stolen. The problem with smartphones is that they can easily be taken into the wrong person’s head and then used to unlock the car.

Costs

Human learning

As far as the issue of higher costs with better technology in healthcare goes, will this ever be resolved? There needs to be solid scientific research, as well as application of said science, done to ensure that there is a safe healthcare plan when it is carried out. The relationship between science and technology is that of theory and application; one gives the data acquired from extensive research, whereas the other applies the data garnered. This is a major reason why it is crucial for doctors, scientists, and those working in the healthcare and technology sectors to have just as much contact and accessibility er as it is for doctors to have with patients.

The Less Certain Uses

What lies beyond the challenges of increased costs when technology is added onto healthcare? 3D printing is one of the most interesting and stimulating topics currently discussed in the matter of technology intersecting with medical data processing. One form of 3D printing allows for children to be designed prenatally. This is 3D immersive visualization of unborn babies. Many are afraid of this type of technology being implemented in medical data processing, since they see it as a threat to a newborn baby's humanity and differences as a person. In the *Science Daily* article, "Realistic 3D immersive visualization of unborn babies," the effects of a designer baby are discussed in great detail. The article discusses how similar the 3D designs of the baby are to the actual makeup of the baby when born. It lists more benefits of technology in the healthcare sector, stating that such "technology has numerous potential applications, including assessment of fetal airway patency [and coordination of] care with multidisciplinary teams and provide better visual information to parents to help them understand malformations and treatment decisions" (ScienceDaily). This shows a lot of promise and

potential for the future of 3D printing but leaves many people on a noose, pondering in fear what this will bring about. It is something that needs time and consideration.

Conclusion

Interestingly, physicians are actually more open and receptive to this type of technological change within the healthcare sector, since they are more familiar with the blueprint behind the design of the baby. This kind of confidence comes from the free exchange between physicians and computer scientists as they find out more crucial information and deliver it to each other in times of need. It is important that this medical information stay accessible to those working in the different sectors and honestly communicated so that it can be improved for all. With a collaborative workforce among the medical, scientific, and technological sectors, there is so much that can be accomplished. Such information systems lead to a more efficient system for an industry that is already severely behind in terms of technological modernization. This, like the trend of technological firms now taking their own initiative regarding healthcare, shows a promising future when it comes to technology being incorporated into medical data processing.

Even though smartwatches are less prone to physical security threats, they are still risky in that their short battery life can make it very hard to know for sure if they will last long enough to lock and unlock the car whenever it is needed. In addition, these easy ways to decode and unlock systems with the use of smartwatches make it easier for cybercriminals to perform hacks and carry out any destructive agenda that they please. One of the other biggest problems is inaccuracy, as well as a one-size-fits all program. In reality, this kind of system is inefficient and problematic since it does not take into account how different two people’s needs can be from each other. These issues can lead to a lot of problems and a failure to help the majority of patients’ needs. In an industry as related to people’s lives as healthcare, it is important that

medical data are processed accurately so that patients can receive the correct treatment that they need; misinformation entered leads to miscommunication and the wrong step being taken by the doctors on whom the patients depend.

There are many different challenges and benefits that arise from the intersection of technology and healthcare. At the moment, an extensive amount of research is being performed in the field so that there can be more safety and certainty as technology grows within healthcare. Luckily, many large, influential technology corporations such as Apple and Samsung are already working on a better healthcare system that will be implemented into the corporations themselves and, thus, better able to work with those in the technology sector. Physicians continue to remain resistant to the technological changes posing a threat of replacing their jobs, but this can be fixed with better training regarding the technology in both medical school and the workplace. In addition to preparing physicians for a changing system, technology education may also give them the the power to teach their students how to use technological devices when it comes to tracking crucial information regarding their health and recording medical data. Thus, proper training and familiarization of technological changes in the healthcare industry to which physicians are currently averse, may actually lead to the adverse effect of what they are anticipating. One of the biggest problems also remains the cost of adding technology into healthcare. For years, healthcare insurers have advocated for healthcare information technologies as the means to lower healthcare costs (which has actually had the adverse effect), improve the quality of healthcare delivery, and reduce medical errors.

Many doctors and patients may have different preferred methods of communication and reporting, and many patients are often shy to share their information. In fact, one of the reasons why the rate of owned electronic health records is so low with psychiatrists is that many patients

are nervous to report information on their mental health since it may cause for information that they do not want exposed to be exposed. Another factor to consider if whether technology is an important factor for all departments of healthcare. Many agree that, for fitness training and disease prevention, it is an important feature to install, but when it comes to mental health provisions, then meeting in person is still the preferred method of communication and receiving treatment. Therefore, personalization of healthcare depends not only on the individual patient but also on the specific type of healthcare service being received.

The rise of wearable technology gives way to both greater technological innovation and greater risk. It raises both irresistible opportunities and unavoidable threats. Interestingly, the growing role of technology is causing a major upset in the medical industry, as many of the professional workers in the life sciences are hesitant to it. This is understandable, being that many changes are now also made possible in regards of altering one's health. There is much to reform before knowing the extent to which technology and healthcare can work together.

Many of the costs that come with better technology in healthcare are starting to be addressed by large corporations such as Samsung and Apple, which take it upon themselves to create a better healthcare system. Younger doctors show much more openness and enthusiasm to technology becoming a major part of their work, due to their extensive experience with it. There is much to anticipate as technology comes closer to healthcare, and whether the costs are worth it is still highly debated. Still, there is much to look forward to and it will be interesting to see where the future goes regarding these changes. With so much potential and so many experts in both medicine and technology working together, the future of technology and healthcare as partners is a highly anticipated one.

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