

TRENDS IN HEALTHCARE AND MEDICAL INNOVATION

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Global healthcare's significant progress in the last several decades can be attributed to advancements in biological science, which were made possible by innovative medicines, medical devices, and health provider infrastructure. While biotechnology will continue to contribute, due in large part to a combination of genomics, microbiomics, and proteomics, information technology will drive the next wave of healthcare evolution. As a result, healthcare will benefit from rapid advancements in digital technology and artificial intelligence.

The primacy of the electron over the molecule impacts all aspects of health, from helping patients stay healthy to discovering more precise and cost-effective solutions for diagnosis and treatment, and improving outcomes. Furthermore, while the innovations of previous decades disproportionately benefited the developed world, IT-led innovation should give a much-needed boost to providing basic healthcare at a greater scale and reduce significant gaps that exist between developed and developing countries today. That said, the combined innovation in biotechnology and information technology will provide individualized solutions for the developed world by discovering cures and treatments for niche and unmet medical needs.

Drivers of innovation

Five key underlying trends will bring significant change to global healthcare. Of these trends, three are technological and two are related to human behavior and preferences. Many of these trends are reaching maturity in other industries, giving healthcare a chance to leverage those that are best suited for the industry.

1. An information revolution is taking place globally.

Broadband access and smartphone usage are becoming ubiquitous throughout the world, with 90% of the developed world and 41% of the developing world on broadband.¹ Such access enables not only the transmission of information to the patient but also the transmission of data from the patient to the provider, with room for future growth. The availability of smartphones, projected to reach 40% of the global population by 2021, also enables providers to gather patient details and deliver treatment remotely.² In addition to advances in communication, the collection of healthcare data has also exploded. Two examples are the sequencing, storing, and studying of individual genomes—expected to cost US\$1 by 2025³—and the penetration of electronic health records (EHR), which currently exceeds 80% in the developed world.⁴ Both have been driven largely by policy and cost.

2. The healthcare industry is gathering all the ingredients to succeed with artificial intelligence (AI).

In its applications, AI needs rich data on the individual, cross-sectional data across a population, affordable computing, and accurate non-linear models. Prior waves of AI were unremarkable because they were missing some of these key ingredients.⁵ But the information revolution has put all of the pieces into place, making it possible for healthcare practitioners to predict and diagnose diseases earlier and more accurately, select the most effective treatment, and close the loop to nudge human behavior. This will enable AI to serve as a substitute for hard-to-find clinical skills and knowledge, when appropriate.

3. Deeper understanding of science is enabling more targeted treatments. As more genomic data becomes available and our understanding of human biochemistry improves, the push is on to design custom products for biomarker-tagged populations, offering significant efficacy all the way up to a curative therapy. In fact, 73% of the compounds under trial in oncology are associated with biomarkers,⁶ and the future will involve many highly effective—and expensive—niche medicines.⁷

4. Consumerism is on the rise. Particularly in the developed world, healthcare consumers have assumed a larger share of the financial burden, have access to better information for comparisons, and have developed higher expectations of a good experience. Technologies like AI combined with a push for transparency are making it feasible for consumers to demand metrics on provider quality and price. At the same time, the emphasis on experience is encouraging providers and manufacturers to offer better services.

5. Healthcare’s traditional business models are evolving. Over time, the fragmentation of healthcare into different sectors—such as payers, insurers, providers, and manufacturers—has made the healthcare industry inefficient and rife with misaligned incentives. Many of these sectorial distinctions are now beginning to blur in the U.S., with employers getting into health management, insurers investing in care delivery, and providers exploring manufacturing opportunities.⁸ Meanwhile, horizontal consolidation continues as well. Public-private partnerships

are a powerful force here because the public sector has a sense of mission, the power to mandate, and the perspective to set policy for an ecosystem, whereas the private partners have the resources, the technology, and the expertise.

These five drivers are combining to create change, but to what end? The World Health Organization (WHO) defined health in its broader sense as “a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.”⁹ At an individual or population level, this goal can be broken down into four main areas: diagnosis, treatment, outcome, and wellness (see Table 3.1 for a summary of innovations in these four steps). As each of these areas continues to be influenced by the information revolution and technological advancements, we’ll get closer to creating a holistically healthy population.

Diagnosis

To improve the way that patients are diagnosed on a global scale, healthcare providers need to make tests and toolkits available to patients, have the medical skills to administer and interpret the tests, and be able to do so cheaply. Thanks in part to the prevalence of smartphones and broadband, we can tele-diagnose patients and send the data to an interpreter rather than requiring patients to travel to the access point. Technological advancements also are seeking to streamline the ongoing health tracking aspect of diagnosis by making follow-up tests, measurements, and other onerous parts of chronic conditions more convenient and less expensive. Because it’s not enough

TABLE 3.1

Current innovations in the four steps to a healthy planet

Diagnosis	Treatment	Outcome	Wellness
<ul style="list-style-type: none"> • Two-way data transmission from the patient • Wearable tech for monitoring • AI for diagnosis, reducing skill needed • Telehealth, reducing need for proximity 	<ul style="list-style-type: none"> • Focused factories (industrialization) • Digital therapeutics • AI for treatment selection • Data on social determinants of health • Drug discovery in silico • Faster global trials • Cell and gene therapies • Oncology advances • Precision medicine 	<ul style="list-style-type: none"> • Real-world evidence • Value-based care 	<ul style="list-style-type: none"> • Prevention incentives • Interventions for social determinants of health

to produce continuous data if the system cannot consume it, AI-based technologies are stepping in to digest the data. AI, of course, is “always on” and is looking for signals in data in a way that human reasoning might not be able to emulate, potentially making AI-enabled diagnoses more accurate and effective. Moreover, AI-powered diagnoses could take the place of human-driven diagnoses in some cases. An algorithm can detect pneumonia by listening to your cough on the phone,¹⁰ whereas a human would want to listen to your heart through your lungs. This is not just moving the process of diagnosing to a remote location but reducing the need for human expertise altogether.

Treatment

Artificial intelligence can leverage data to select the most effective treatment, though it cannot by itself make that treatment option more affordable. But as business models change, providers are beginning to invest in specialized care—creating focused factories that treat a narrow problem repeatedly and that drive costs down. Examples of this range from the Mayo Clinic in the developed world to Narayana Health in India.¹¹ Vertical integration—especially between payers, providers, and insurers—makes it worthwhile by aligning incentives so that cheaper treatments aren’t equated with revenue losses. Increasingly, social determinants of health, which include attributes that drive 60% of your health and go beyond your genome and medical history,¹² are making the enablement of health and wellness more effective in the long run. For example, food insecurity and loneliness are bigger drivers of morbidity than drugs in the elderly population,¹³ and only a cross-sector entity would have the resources and influence to solve that.

Pharmaceutical drugs are a key aspect of treatment. One trend here is invention efficiency: drug development costs roughly double every 10 years.¹⁴ Can the development be sped up or automated? A third of all AI investments in healthcare are projected to be in drug discovery,¹⁵ specifically using computer simulation to find better molecules faster. Companies are also beginning to leverage AI and data to reduce clinical trial costs and waste, though progress has been slower than desired. The other trend in drug creation is *precision medicine*, which focuses on increasing efficacy by designing treatments for a specific patient population.

Outcome

Pricing pressures in the U.S. and the developing world are necessitating a shift to value- and evidence-based medicine. The overarching question is, are we getting good value for the countries’ total healthcare spending, and at what percentage of GDP is it affordable? The value needs to include the obvious medical metrics such as disease indicators, morbidity, mortality rates, and lifespan. In the developed world, consumers need to be satisfied with the experience and patient-reported outcomes, as patients begin to demand much more than sick care. The shift from cost to value is happening slowly because incentives aren’t well aligned. Healthcare stakeholders need an objective and comprehensive approach to evaluate the impact of treatment in the real world—not in an ideal, clinical trial world. The collection of healthcare data from actual patient treatments

is making this real-world evidence generation possible, and investment and interest in real-world evidence have spiked threefold in the last 10 years.¹⁶

Wellness

We can expect to see continued taming of diseases during the next decade, but the WHO’s broader goal of well-being—and avoiding all of these interventions—is coming into focus in the developed world. Will we soon be able to “predict and prevent” as opposed to “react and revive”? The biggest wellness trends are in addressing social determinants of health—for example, identifying and eliminating food deserts and promoting vaccination penetration—and individual incentives, such as nudges for exercise, proper nutrition, and data collection.¹⁷ Information technology plays a secondary role to the change management challenges that healthcare will face when turning its focus to wellness efforts.

The promise of global health

There is universal dissatisfaction with the healthcare status quo, but the challenges and unmet needs vary widely between the developed and developing worlds. Regardless, an IT-led healthcare innovation trend promises to address the needs of patients across the globe, but in different ways (summarized in Table 3.2).

In the developed world, the rising cost of healthcare has been a prominent subject lately, but other issues such as medical errors, overworked healthcare professionals, and poor patient experiences are equally important. In contrast, the developing world is challenged to provide basic healthcare beyond a small urban segment, with limited government budgets and a severe shortage of healthcare professionals and infrastructure. The contrast is stark. For example, while India and Africa combined share nearly 45% of the global disease burden,¹⁸ they employ less than 5% of the world’s healthcare professionals.

The next wave of healthcare innovation ideally will connect all aspects of individual and population health, including diagnosis, treatment, outcome, and wellness. It will also impact the four main elements of the healthcare delivery system: cost, access, outcome and customer experience. And because health systems have different needs in different parts of the world, the level of impact will vary.

Impact in the developed world

In the developed world, innovation is likely to have the greatest impact on reducing costs, improving outcomes, and moving to targeted and individualized treatment. We’re also likely to see an improvement in the experiences for patient and healthcare professionals.

On the cost front, manual processes and health data silos are some of the key drivers for wasted spending. It is estimated that in the United States of America (U.S.) alone, wasted spending exceeds US\$1 trillion annually.¹⁹ In recent years, there has been

TABLE 3.2

The four elements of the healthcare delivery system will impact the developed and developing worlds differently

Element of the healthcare delivery system	Level of impact and potential solutions	
	Developed world	Developing world
Reduced cost	Impact: high <ul style="list-style-type: none"> • Reduce administrative cost with automation • Reduce waste with diagnostics and more targeted treatment • Reduce drug development cost with drug development in silica and precision medicine 	Impact: high <ul style="list-style-type: none"> • Scale basic healthcare without proportionate increase in cost
Improved healthcare access	Impact: moderate <ul style="list-style-type: none"> • Provide better healthcare support in remote areas and convenience with telemedicine 	Impact: very high <ul style="list-style-type: none"> • Provide platform-based basic healthcare to a large population using a combination of universal electronic health record (EHR) systems and mobile health applications
Health outcome	Impact: high <ul style="list-style-type: none"> • Raise health awareness with wellness applications • Improve diagnosis with AI-based diagnostics and targeted treatments • Move to value-based healthcare where outcome is the new currency of success and focus for healthcare players • Make treatments more targeted and individualized with move to precision medicine 	Impact: moderate <ul style="list-style-type: none"> • Improve health outcomes for the rising middle class
Customer experience	Impact: high <ul style="list-style-type: none"> • Improve consumer experience with reduced wait time, improved long-term engagement 	Impact: low <ul style="list-style-type: none"> • Recognize that customer experience is important to a small percentage of the urban population in a largely cash market

a surge in start-ups promising to reduce inefficiencies using intelligent automation. These range from intelligent scheduling and revenue booking systems to AI-based virtual assistants that can capture patient stories into electronic health records systems. Moreover, two-thirds of doctors would like AI to help with workflow management, administrative assistant tasks, and patient experience analysis.²⁰

The high cost of drug development is also a source of rising healthcare spending. AI can speed up drug discovery (more than a third of AI investment in healthcare is in this space¹⁵), cut R&D costs, decrease failure rates in drug trials, and eventually create better medicines. Artificial intelligence also will help reduce clinical trial costs and timelines by not just predicting trial enrollment and duration, but also making them adaptive.

Remote monitoring can make clinical trials more patient-centric and thereby help to cut a 30% abandonment rate.²¹

Another trend in the developed world is the move from a fee-for-service to a value- or outcome-based care model. As patient data becomes richer and more complete, the ability to measure the outcome has improved significantly. This shift likely will encourage a “holistic” treatment team approach to care in which parties will be paid for providing better care—outcomes and satisfaction—at a lower cost.

The current “react and revive” approach to healthcare is designed to help the sick get better as opposed to the “predict and prevent” approach in which the focus is on helping people stay healthy. A focus on wellness and preventive measures

helps to delay the onset of disease, and self-diagnosis tools help to reduce the dependency on healthcare systems for ongoing health maintenance. More precise diagnosis augmented with automated expertise will significantly reduce onerous tests that are currently conducted to identify and monitor disease conditions.

Care is also likely to move to more customization, as treatments can be targeted for individual genetic profiles and biomarkers. Pharmaceutical companies are making large investments in precision medicine to create more targeted and niche therapies that are angling to replace mass-market medicine.²²

Poor patient experience is another major source of dissatisfaction. In the U.S., patients wait over 24 days for scheduled appointments and have to provide the same information multiple times to different healthcare professionals.²³ Healthcare stakeholders are increasingly using virtual and augmented reality to make the patient experience more engaging and interactive. These technologies are being integrated into patient treatment and engagement efforts, enhancing the ability to improve patient outcomes.

Impact in the developing world

In the developing world, the biggest unmet need is providing basic and affordable healthcare at scale. The last decade has seen a significant increase in government focus on healthcare, including several mobile health, telemedicine, and AI-based initiatives in China, India, and some African countries. China has already edged closer to Europe in leading health indicators, while Africa still lags far behind and India is somewhere in between. As an example, the leading cause of death is moving from infectious diseases to non-communicable diseases (85% in China compared to 61% in India²⁴). The next phase of healthcare evolution in these countries will require universal access to basic healthcare and a way to address the demanding needs of growing middle-class populations.

A platform-based healthcare approach, with an integrated e-health record system powered by mobile health, telemedicine, and AI-based diagnosis and treatment can help developing countries leapfrog ahead on healthcare access at scale without the need to proportionately increase healthcare facilities and professionals.

Mobile devices have become increasingly common in developing countries and, most recently, there has been an emergence of inexpensive smartphones like Reliance Jio in India. The smartphone's applications enable users to schedule appointments and order medicines,²⁵ and to access simple diagnostics and self-monitoring tools. The growing wearable devices market provides mobile devices with an interface designed to capture vital signs. For example, South African start-up Vitals developed a tool that enables healthcare providers to continuously and remotely monitor a patient's pulse, respiration rate, body temperature, sleep, and movement patterns.²⁶ In another example, Khushi Baby developed a program to address an unmet need in rural India with its digital necklace that stores immunization records.²⁷

China is turning to AI-based technologies to provide better healthcare, especially in rural areas where doctors are relying on perceptual senses, like vision and hearing, to gather information about patient health.²⁸ In India, Arvind Eye Care is working with Google Brain to detect signs of diabetes-related eye disease by analyzing photographs.²⁹

To offer platform-based healthcare access at scale, countries will need mobile health, telemedicine, and AI to integrate with universal patient health records. This would help healthcare access evolve from acute diagnosis and treatment to the deployment of preventive measures and the management of chronic diseases. Encouraged by the success of Aadhaar, a biometric-based universal identification system for 1 billion people,³⁰ India is embarking on an ambitious project called Ayushman Bharat to provide health insurance to 100 million families.³¹ One goal of such a program will be to develop a database of EHR records for registered patients. China is embarking on a similar effort with a Precision Medicine Initiative to sequence the genomes of 100 million individuals by 2030. But there are multiple challenges to overcome in building a universal EHR database, and it's likely to be a while before we see material progress in this area.

By focusing on providing healthcare access at scale, developing countries will improve healthcare quality, outcomes, and experiences for their growing middle- and upper-middle-class populations. These populations often pay cash for healthcare and demand a better experience, which is why China and India, in particular, are launching advanced technology-led customer experience initiatives to serve them.

Moving from defining the promise to realizing the promise

A variety of forces, in both the developed and developing worlds, will challenge technology-led changes to healthcare. In developed countries, overcoming legacy issues, such as silos in healthcare data and systems, and leading change management for healthcare professionals and other stakeholders will be the greatest challenges. That said, the enablers for change will include increasing cost pressure and rising consumer power, likely resulting in operational efficiencies through automation and leveraging AI as an assistant—rather than a peer or advisor—to the physician. Government will play an important role in setting up policies and enable an environment where different stakeholder incentives align to drive the intended change.

Meanwhile, developing countries are starting with more of a clean slate, but they are challenged by affordability and the priority that their governments give to healthcare. China is an exception, since its government is likely to drive the change, but elsewhere in the developing world, effective public-private partnerships may be critical to driving progress in platform-based healthcare. To entice the private sector to invest in healthcare, developing countries can leverage well-structured partnerships that mobilize private investment into public service delivery, and that have a risk-sharing agreement built in. In the last few years, public-private partnerships in the health sector have

brought immense benefits to the poor in Africa,³² and the approach to healthcare innovation has been effective in a few countries, including Kenya, Tanzania, and Ghana. As partnerships of this kind are highly complex undertakings, it is important for governments to ensure that project outcomes support larger health system goals and that facilities and services developed by the public-private partnerships are integrated into the broader health system.

We are at the beginning of a significant shift as the primary driver of global healthcare impact switches from biotechnology to information technology. This shift holds considerable promise for healthcare in all parts of the world—developed and developing. The overall impact of this evolution ought to increase life expectancy and quality of life everywhere. But while the promise is exciting and immense, the speed of progress will depend on how the various stakeholders work to find common ground, focus on the right priorities, and find creative models for success through affordable scale.

Notes:

- 1 ITU, 2017.
- 2 Next Conference, 2018.
- 3 Medium, 2017.
- 4 KPMG, 2018; The Office of the National Coordinator for Health Information Technology, 2017.
- 5 Quartz, 2018; Quartz, 2017.
- 6 ThermoFisher Scientific, 2018.
- 7 Genome Biology, 2018; The Conversation, 2018.
- 8 Bailey Southwell & Co., 2018.
- 9 World Health Organization, 2011.
- 10 MedCity News, 2017.
- 11 Advisory Board, 2015; The Commonwealth Fund, 2017.
- 12 Golnvo, 2017.
- 13 NCBI, 2018; BMJ Open, 2017.
- 14 The Library of Economics and Liberty, 2017.
- 15 MarketWatch, 2019.
- 16 Leela Barham Economic Consulting, 2017.
- 17 Healthcare Intelligence Network, 2019.
- 18 NCBI, 2018; BusinessWorld, 2019.
- 19 Health Affairs, 2018.
- 20 The Active Ingredient, 2018.
- 21 CenterWatch, 2016.
- 22 Critical Care, 2017.

- 23 Forbes, 2017.
- 24 World Health Organization, 2015; Times of India, 2017.
- 25 Practo; MedLife.
- 26 Disrupt Africa, 2017.
- 27 Global Citizen, 2018.
- 28 TechWire Asia, 2018.
- 29 VentureBeat, 2019.
- 30 FirstPost, 2017.
- 31 World Health Organization, 2018.
- 32 Health Policy and Planning, 2018.

References:

- Advisory Board. (2015, May 21). How the Mayo clinic improved quality and lowered cost in cardiac surgery. Retrieved from <https://www.advisory.com/research/market-innovation-center/the-growth-channel/2015/05/how-the-mayo-clinic-improved-quality-and-lowered-cost-in-cardiac-surgery>
- Bailey Southwell & Co. (2018, October 3). Chasing the leader: healthcare vertical integration follows optum model. Retrieved from <https://www.baileysouthwell.com/chasing-the-leader-healthcare-vertical-integration-follows-optum-model/>
- BMJ Open. (2017). Reducing social isolation and loneliness in older people: a systematic review protocol. Retrieved from <https://bmjopen.bmj.com/content/7/5/e013778>
- BusinessWorld. (2019, April 12). A thousand-mile journey—India's healthcare roadmap! Retrieved from <http://www.businessworld.in/article/A-Thousand-Mile-Journey-India-s-Healthcare-Roadmap-/07-04-2018-145666/>
- CenterWatch. (2016, June 27). The issue of patient retention in clinical trials. Retrieved from <https://www.centerwatch.com/news-online/2016/06/27/issue-patient-retention-clinical-trials/>
- Critical Care. (2017, October 18). Precision medicine for all? Challenges and opportunities for a precision medicine approach to critical illness. Retrieved from <https://ccforum.biomedcentral.com/articles/10.1186/s13054-017-1836-5>
- Disrupt Africa. (2017, May 19). SA's Vitals secures funding for health wearables. Retrieved from <http://disrupt-africa.com/2017/05/sas-vitals-secures-funding-for-health-wearables/>
- FirstPost. (2017, April 5). How Aadhaar compares to other biometric national identification systems around the world. Retrieved from <https://www.firstpost.com/tech/news-analysis/how-aadhaar-compares-to-other-biometric-national-identification-systems-around-the-world-3700543.html>
- Forbes. (2017, March 19). Doctor wait times soar 30% in major U.S. cities. Retrieved from <https://www.forbes.com/sites/brucejapsen/2017/03/19/doctor-wait-times-soar-amid-trumpcare-debate/#28e9d5132e74>
- Genome Biology. (2018, August 20). Consumer genomics will change your life, whether you get tested or not. Retrieved from <https://genomebiology.biomedcentral.com/articles/10.1186/s13059-018-1506-1>
- Global Citizen. (2018, July 23). This \$1 necklace is helping thousands of Indian kids lead healthier lives. Retrieved from <https://www.globalcitizen.org/en/content/khushi-baby-india-gen-h-johnson-and-johnson/>
- Golnvo. (2017). Determinants of Health. Retrieved from <https://www.golnvo.com/vision/determinants-of-health/>

- Health Policy and Planning. (2018, June 13). Public–private partnerships in practice: collaborating to improve health finance policy in Ghana and Kenya. Retrieved from <https://academic.oup.com/heapol/article/33/7/777/5037236>
- Healthcare Intelligence Network. (2019, April 8). Should ride-sharing be added to a healthcare benefit plan? Retrieved from <http://hin.com/blog/category/sdoh/>
- ITU. (2017, July). ICT facts and figures 2017. Retrieved from <https://www.itu.int/en/ITU-D/Statistics/Documents/facts/ICTFactsFigures2017.pdf>
- KPMG. (2018, October). EHR vendor market. Retrieved from <https://nchica.org/wp-content/uploads/2018/10/Eckert-Puls.pdf>
- Leela Barham Economic Consulting. (2017, March). Real world studies landscape. Retrieved from https://drive.google.com/file/d/0B9Q_esu-wXhr7LV9Vc3RwUDtdU0/view
- MarketWatch. (2019, February 25). Healthcare artificial intelligence market size set to register 10 billion USD by 2024. Retrieved from <https://www.marketwatch.com/press-release/healthcare-artificial-intelligence-market-size-set-to-register-10-billion-usd-by-2024-2019-02-25>
- MedCity News. (2017, January 19). Can a smartphone app to diagnose respiratory diseases rival traditional testing methods? Retrieved from <https://medcitynews.com/2017/01/can-smartphone-diagnostic-app-rival-doctors/?rf=1>
- Medium. (2017, April 27). Forecasting the future of personalized medicine. Retrieved from <https://medium.com/healthfurther/forecasting-the-future-of-personalized-medicine-c88bc55bb668>
- MedLife. Retrieved from <https://shop.medlife.com/?source=app>
- NCBI. (2018, May 12). Reflections on family medicine and primary healthcare in sub-Saharan Africa. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5950631/>
- . (2018, July 12). Food insecurity in older adults: results from the epidemiology of chronic diseases cohort study 3. Retrieved from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6052142/>
- Next conference. (2019, September). How will the end of smartphones look like? Retrieved from <https://nextconf.eu/2018/05/how-will-the-end-of-smartphones-look-like/#gref>
- Practo. Retrieved from <https://www.practo.com/>
- Quartz. (2017, July 10). If you're not a white male, artificial intelligence's use in healthcare could be dangerous. Retrieved from <https://qz.com/1023448/if-youre-not-a-white-male-artificial-intelligences-use-in-healthcare-could-be-dangerous/>
- . (2018, September 6). If AI is going to be the world's doctor, it needs better textbooks. Retrieved from <https://qz.com/1367177/if-ai-is-going-to-be-the-worlds-doctor-it-needs-better-textbooks/>
- TechWire Asia. (2018, June 27). China's quest for better healthcare with AI. Retrieved from <https://techwireasia.com/2018/06/chinas-quest-for-better-healthcare-with-ai/>
- The Active Ingredient. (2018, August 29). How do doctors feel about robots in the exam room? Retrieved from <https://info.zs.com/activeingredient/how-do-doctors-feel-about-robots-in-the-exam-room>
- The Commonwealth Fund. (2017, November 9). Expanding access to low-cost, high-quality tertiary care. Retrieved from <https://www.commonwealthfund.org/publications/case-study/2017/nov/expanding-access-low-cost-high-quality-tertiary-care>
- The Conversation. (2018, October 15). Boyer Lectures: gene therapy is still in its infancy, but the future looks promising. Retrieved from <https://theconversation.com/boyer-lectures-gene-therapy-is-still-in-its-infancy-but-the-future-looks-promising-104558>
- The Library of Economics and Liberty. (2017, August 7). Hooper's law of drug development. Retrieved from <https://www.econlib.org/library/Columns/2017/Hooperdrugdevelopment.html>
- The Office of the National Coordinator for Health Information Technology. (2017). Office-based Physician Electronic Health Record Adoption. Retrieved from <https://dashboard.healthit.gov/quickstats/pages/physician-ehr-adoption-trends.php>
- ThermoFisher Scientific. (2018). The right therapy starts with the right test. European Society for Medical Oncology. Retrieved from <https://www.thermofisher.com/in/en/home/products-and-services/promotions/clinical/ecp-esmo-event-2018/esmo-congress.html>
- Times of India. (2017, September 20). Non-communicable diseases cause 61% of deaths in India: WHO report. Retrieved from <https://timesofindia.indiatimes.com/life-style/health-fitness/health-news/non-communicable-diseases-cause-61-of-deaths-in-india-who-report/articleshow/60761288.cms>
- VentureBeat. (2019, February 25). Google works with Aravind Eye Hospital to deploy AI that can detect eye disease. Retrieved from <https://venturebeat.com/2019/02/25/google-works-with-aravind-eye-hospital-to-deploy-ai-that-can-detect-eye-disease/>
- World Health Organization. (2011, October 7). Designing the road to better health and well-being in Europe. Retrieved from http://www.euro.who.int/__data/assets/pdf_file/0003/152184/RD_Dastein_speech_wellbeing_07Oct.pdf
- . (2015). Noncommunicable diseases. Retrieved from http://www.wpro.who.int/china/topics/noncommunicable_diseases/en/
- . (2018). Ayushman Bharat: An ambitious set of reforms that should benefit millions of India's poor and vulnerable. Retrieved from <http://www.searo.who.int/mediacentre/features/2018/ayushman-bharat-ambitious-set-of-reforms/en/>