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AI IN THE HEALTH CARE SECTOR

ENHANCING CARE, EFFICIENCY, AND INNOVATION

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AUTHORS' NOTE

Martin Baily led the work on this case study. These case studies were written as part of a joint project with David M. Byrne and Paul E. Soto of the Federal Reserve Board. We are indebted to them for assistance and helpful comments. We would also like to thank Eli Schrag for his factchecking.

1. Introduction

Much of the interest in the use of AI in the health care field is that it can be used to improve patient care by reading scans, improving diagnoses, suggesting treatment protocols, discovering new drugs, and providing better service to patients.[1] AI also has the potential to make more mundane but perhaps equally valuable contributions by reducing the burden of paperwork and reducing burnout among practitioners.[2] Health care spending in the United States was 17.6% of GDP in 2023, far above the level of other countries, imposing a severe burden on household and government budgets (Martin et al. 2025). To the extent that AI will be able to lower the cost of health care, or slow its increase, while sustaining or even improving the quality of care, that would be a huge benefit.

Efforts to reduce health care costs in the past have not been very successful.[3] Americans do not use more health care than those in other advanced economies, rather they pay much more for the services of providers, and even efforts by large companies to reduce benefit costs lack the power to reduce these payments (Blumenthal 2021; Wager and Cox 2024). The Affordable Care Act included provisions to control costs using the huge market power of Medicare and Medicaid, and costs were held down somewhat (Buntin and Graves 2020). Even if AI can come up with new technology able to improve productivity substantially, it will have to be accepted by the health care providers that operate and largely control the system.

Another barrier to the adoption of AI technology within health care is the issue of trust. Famously, generative AI is prone to hallucinations and making errors. Machine learning and predictive AI, used to read scans, for example, can also make mistakes (Greenstein et al. 2024). Both patients and doctors are naturally reluctant to use a new technology that might make errors that could be harmful. Combining AI with human analysis does not always do better than humans alone—a study of AI use in radiology showed some doctors defer to the AI too much, some dismiss it too much (Agarwal et al. 2023).

Another impediment to usage relates to "data custody" and "data security." For large-scale AI models to run, the patients' data needs to be readily available so that it can be used in the model training process. This could create apprehension if patients feel that this information is not fully secure and could be leaked or reverse engineered.

Despite the barriers to the adoption of AI in health care, there is a tremendous amount of interest in developing health care AI programs. The size of health care spending makes it a target for companies developing programs. The payoff to successful developers can be substantial, and the payoff to society could be substantial as well. A team made up of leading Harvard health economist David Cutler and three consultants from McKinsey & Company have estimated that AI could raise health care productivity by 5-10%, representing savings of $200 to $360 billion (in 2019 dollars) over the next 5 years (Sahni et al. 2024).

This review of AI in the health care sector illustrates the enormous potential of the technology but also the barriers to widespread adoption. There is a need for further advances in the underlying technology to make it more reliable. And user-friendly applications are needed, so that medical staff can use AI even if they have limited technical skills. In addition, the resistance to change in this sector is strong, suggesting that it may take many years to realize the full potential of AI.

2. Potential contributions of AI to health care

The areas of health care that have been highlighted for contributions from AI are the following, according to the Mayo Clinic Press Editors (2024) and McKinsey & Company (Spatharou et al. 2020):

- Improving patient outcomes by using AI algorithms to examine large amounts of medical data to help clinical personnel make diagnoses and identify problems that may otherwise have been missed.
- Taking on administrative tasks, such as data entry, scheduling patient visits, and billing. By allowing medical personnel to concentrate on clinical treatment, this can reduce costs and alleviate labor shortages.
- Optimizing resource allocation to reduce costs.
- Anticipating health care problems in patients showing early symptoms so that preventive care can be given to avoid more severe (and more expensive) problems in the future.
- Accelerating the pace of new drug development by suggesting chemicals that might be therapeutic, analyzing biological data, and suggesting new uses for existing medications.

Two additional applications of AI have been suggested but will not be covered in this paper (Daley 2025):

- Managing health care data.
- Using AI to improve robotic surgery.

Both of these topics are important, but we decided to limit the analysis here because we cannot cover everything. In particular, this project on AI has not looked in detail at the expanded use of robots, given the improvements in AI capabilities. This is a topic for our future research.

2.1. UTILIZING LARGE AMOUNTS OF DATA TO IMPROVE TREATMENT

A very important aspect of health care involves data analysis. The human body is an extraordinarily complex organism, and doctors are required to memorize a detailed picture of human anatomy as well as gain an encyclopedic knowledge of all the diseases and problems from which a patient may suffer. The medical record on any given patient will contain perhaps hundreds of separate pieces of information including routine measurements such as blood pressure and temperature as well as scans, genetic information, and verbal interviews, including a list of symptoms. Most patients will have been treated or tested over many years. Because of time pressure, doctors may have only a few minutes to read a patient's record before a consultation. Even without a time constraint, the record available to a doctor will be incomplete because different providers do not communicate with one other or because they have

incompatible data systems. This challenge for doctors is also an illustration of a broader difficulty with AI: It needs to access data that in many situations are found in different silos (Davenport and Mittal 2023).

Medical research and treatment have developed over many years, and medical knowledge is global. A 2005 paper reported that at least 560,000 new medical articles are published each year (Glasziou and Haynes 2005). For a complex illness such as cancer, there are hundreds of different drugs available to treat patients as well as surgery and radiation ("Cancer Drugs" n.d.). This means that the combination of different patient characteristics and different available treatments is far too large for any doctor to memorize (Newton 2024). Most cases a doctor sees are routine, of course, but cases that seem simple can turn out to be difficult to treat. Medical errors are always a danger, especially for providers that are under heavy time pressure, but even if there is not a specific error, the treatment provided may not be the optimal one. AI has the potential to assist providers by suggesting diagnoses and treatment protocols. Analyzing large data sets is something that AI is very good at; looking at a lengthy medical record and matching a patient's need against a range of possible treatments is something these programs can do. Modern AI models perform particularly well with unstructured text data that, so far, the health care industry has not been able to leverage to assist treatment. Of course, the doctor or other provider will have to maintain control over the treatment that is given to the patient, making the final decision on the treatment to make sure the AI program is not making a mistake.

Example of improved care with AI: "in polycystic kidney disease (PKD), researchers discovered that the size of the kidneys—specifically, an attribute known as total kidney volume—correlated with how rapidly kidney function was going to decline in the future. But assessing total kidney volume, though incredibly informative, involves analyzing dozens of kidney images, one slide after another—a laborious process that can take about 45 minutes per patient. With the innovations developed at the PKD Center at Mayo Clinic, researchers now use artificial intelligence (AI) to automate the process, generating results in a matter of seconds" (Mayo Clinic Press Editors 2024).

While there are demonstrable benefits to the use of AI in the health care setting, there are significant barriers to adoption. For one, hospital budget committees may be concerned about the cost of these technologies and whether they will generate enough new revenue to justify the cost. Further, even if hospitals do invest in these technologies, it is up to doctors to actually use them, and they may be reluctant to adopt technology that was seemingly designed to replace them, although the companies developing this technology would argue that isn't their goal.[4]

The concern about medical staff and administrators disagreeing about AI's application is illustrated in an August 2023 Washington Post article headlined "Hospital bosses love AI. Doctors and Nurses are worried" (Verma 2023). The actual article is more balanced than the headline suggests, but it does report some sharp differences of opinion among different groups of health care workers, specifically skepticism from a nurses union representative about the evidence that AI improves patient care.

Another source of resistance to new technologies comes from skepticism among health care personnel around the benefits of past digital technology that was supposed to raise efficiency. Nirav Shah, a doctor and medical researcher at Stanford was quoted in a recent article saying (Columbus 2024), "It used to take me 45 minutes to admit a patient in the paper-based world, and now, thanks to electronic health records, it takes me an hour and 45 minutes."

These barriers to the use of generative AI do not mean the new technology will never be used. If some progressive hospitals or clinics find that it works effectively to make doctors, nurse practitioners, radiologists, and other staff more productive, then hospital administrators and doctors will be able to save money or handle more patients with the same staffing levels. At that point, the use of the technology will likely spread

quickly. Insurance reimbursement schedules will build in an expectation of using cost-saving techniques, applying pressure for their adoption.

The Mayo Clinic is using AI in its work and is researching new ways that AI can improve care and streamline paperwork. As a very large provider, it has access to patient data to train AI programs and has the financial resources to invest in development.[5] AI can do a first pass on radiology scans, saving doctors and radiologists time. It can provide patient risk assessments, identify colon polyps, and keep doctors up to date on research developments. It is also being developed to write clinical notes and fill out forms, reducing the paperwork burden.

2.2. DIAGNOSTIC ERRORS

Diagnostic errors did not start with the arrival of AI. These errors have been around for as long as patients have been treated. A committee convened by the National Academies of Science to look at the incidence of diagnostic errors in 2015 declined to give a number for the frequency of errors in the era before the use of AI (Committee on Diagnostic Error in Health Care 2015). The Agency for Health care Research and Quality (part of Health and Human Services) is not as reticent. They find that medical errors have contributed to 10% of patient deaths in the United States (Kavanagh 2023). The British Medical Journal Quality and Safety made the estimate that 795,000 patients a year in the United States suffer serious harm from diagnostic errors (Newman-Toker 2024).

There is a difference between errors made by humans and those made by computers. Each year thousands die in automobile accidents because of human driving errors. Although there are efforts to reduce the toll of such accidents, most people are willing to accept the accidents in return for the benefit of easy mobility. When computer-controlled vehicles have accidents, however, this leads to headlines and demands for stiffer regulation. That is understandable, since it is unnerving to hear about a car that cannot recognize a pedestrian crossing the road or a parked emergency vehicle. Similarly, patients are willing to take their chances with a human doctor, especially if that person has a good bedside manner. If they learn that a computer system harmed them with a faulty diagnosis, there would be complaints and possibly a lawsuit filed against either the doctor or the provider of the AI program or both. Since AI is so new, there is little in the way of regulation and insurance to protect AI companies, so they are more vulnerable.

To shield patients from AI-based diagnostic errors (and AI companies and hospitals from potential lawsuits), for now AI should be seen as a diagnostic tool for doctors to use, not as a substitute diagnostician. The AI programs can suggest options to the doctor but not override their decision. An important element in the use of AI in health care is that the information it provides should at times be discarded. As the technology progresses, AI programs are becoming more helpful and less mistake-prone. For example, new Large Language Models (LLMs) have a chain-of-thought process imbedded in them that can explain the reasoning for why it chose a particular diagnosis, helping providers make the right decisions.

2.3. FINDING AND DEVELOPING NEW PHARMACEUTICALS

Increasing productivity in finding and producing pharmaceuticals is much needed. The Bureau of Labor Statistics provides a productivity measure for pharmaceutical and medicine manufacturing, which is the production of the medications. These data show a low rate of growth since 1987, which turned negative in recent years.

These data are of interest, but the manufacturing part of new drug production is not the most important. Over time new drugs have become more complex; rather than a simple pill, new drugs are now often biologics that are much more costly to manufacture. Also, a lot of drugs are manufactured overseas, leaving more specialized product manufacturing to the United States.

It is research and development (R&D) and the productivity of R&D that is more important to both health care costs and outcomes than the manufacturing cost.

TABLE 1

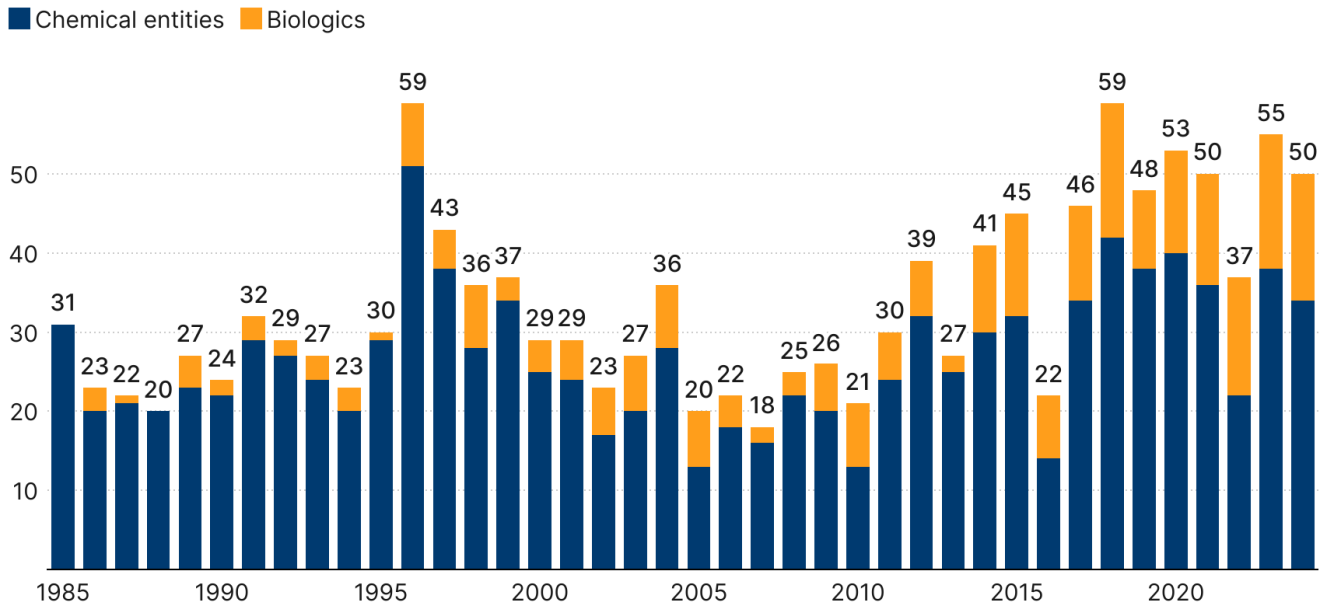
Output per hour worked, pharmaceutical and medicine manufacturing, annualized growth, percent per year

1987-1995	1.12%
1995-2007	0.44%
2007-2018	-3.41%
2018-2023	-0.37%

SOURCE: Bureau of Labor Statistics, Office of Productivity and Technology (2025)

FIGURE 1

Number of new drugs approved by the Food and Drug Administration, 1985-2024



Source: De La Torre and Albericio (2024), using data from the Food and Drug Administration

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Figure 1 shows the number of new drugs approved by the FDA from 1985-2024, indicating the number of new chemical entities and the number of biologics.

The cost of drugs is an important contributor to overall health care costs, representing about 9% of total costs (Hughes 2023). Today, most of the drugs prescribed are off-patent and are generally cheap, but new drugs are increasingly costly to develop, and some are priced at very high levels indeed, which either places a burden on insurance companies or makes the drug unaffordable for patients without comprehensive coverage.

A 2021 report by the Congressional Budget Office (Austin and Hayford 2021) reviewed the current cost situation and cited a study that found that development costs for new drugs rose at about 8.5% per year for more than a decade from the 1990s to early 2010s (DiMasi et al. 2016) An OECD report finds that the average real cost per new drug approved in the United States was around $2 billion 2016-20, having come down from $2.5 billion after 2011 with the development of CRISPR and other technologies (OECD 2023). If AI can reduce further the cost of developing new

drugs and increase the number of effective new drugs available, it could help both reduce overall health care costs and increase the quality of care.

According to the Organization for Economic Cooperation and Development study (OECD 2023), AI is helping drug discovery in the following ways.

- Understanding how proteins fold. DeepMind's Alphafold2 program allows researchers to understand the three-dimensional structure of proteins. The way proteins fold is as important to their function in the body as the chemical structure of the protein, and until now, researchers did not know how most proteins in the body fold. Soon after this program was developed, it became possible to predict the structures of all proteins in the human body.
- The next step is to find out which protein is the one to target for the specific disease under investigation. There are several AI companies that are looking at alternative ways to approach this problem using a variety of different datasets, but there is no clear winning approach as yet. Researchers rely on prior knowledge of the way diseases impact the body.
- Identifying the molecule that could be used to target the disease is the next step and the full range of possibilities is endless, because there are 10^{60} possible molecules. This number is reduced to a more manageable size using commercially available screening platforms, given the disease or research area studied. AI programs are then used to suggest possible molecules to attack the specific disease. These are already valuable in suggesting options but are not yet able to predict accurately the right chemical to use in treatment (see, for example, Tranchero 2024).
- Once a promising initial molecule has been suggested, a further refining process is gone through to identify a molecule called a lead, which has better therapeutic properties and lower toxicity than the original molecule. Once the lead has been identified, animal experiments are tried to see whether the molecule is effective against the disease and the nature of any toxicity.

The continued interest in using AI for drug discovery is illustrated by the recent launch of Xaira, which is backed by $1 billion in venture capital funding (Xaira Therapeutics 2024). The impetus for Xaira came from the lab of David Baker at the University of Washington, who has been using AI models for several years to generate new therapeutic molecules using deep learning models on structured quantitative data. The new company has a very distinguished senior staff and board, including a Nobel prizewinner.

A positive view of the use of AI in new drug development comes from Sandra Barbosu (2024) in a study for the Information Technology & Innovation Foundation. She argues that AI has the "potential to boost the efficiency of drug development, accelerating the delivery of new therapies and fostering competition" (Barbosu 2024, 1). She notes that the use of AI is still in its early stages, but Barbosu identifies companies or research entities reporting that AI has improved efficiency in several stages of the drug development process, including not only identifying chemical compounds but also streamlining clinical trial protocols and optimizing trial design.

So far there has not been a flood of new pharmaceuticals appearing from the use of AI. What is the holdup? Bender and Cortés-Ciriano (2021) discuss the reasons for this in an article that notes that using computers to aid drug development is hardly a new idea. They point to a cover article in Fortune Magazine from 1981 titled "The Next Industrial Revolution: Designing Drugs by Computer at Merck." This point highlights the fact that in assessing the future contribution of AI to raising productivity, we should be looking at its additional (or marginal) contribution, not the whole history of computerization. Another argument of Bender and Cortés-Ciriano (2021) is that while chemistry is amenable to analysis using computerized approaches, biology is not. They say: "more complex biology, such as receptor conformational changes, equilibria and biased signaling, is much more difficult to understand already, and it only gets more difficult if one moves to events further downstream, such as changes in gene

expression or protein modifications, especially when it comes to modelling changes spatially and over time" (Bender and Cortés-Ciriano 2021, 513). They go on to suggest that techniques currently being used to improve patient selection and clinical trials are being labelled as AI when in fact they have little to do with AI. In their conclusions, they argue that a reason why it is an ongoing struggle to use AI in drug development is that the right kind of data is not being collected or codified in a way that that can be used to train AI.

3. Conclusions

In the first section of this case study we quoted the study by Sahni et al. (2024) that found AI could lead to an increase in health care productivity of 5-10% within 5 years, a very substantial saving of resources. This look at the potential impacts of AI in health care suggests that indeed improvements of this magnitude are possible. Where we would differ is over the time horizon required to achieve savings of this magnitude. Many applications of AI in this area are promising but remain at an early stage. Changing clinical practice is very hard indeed, especially in a system like that in the U.S. where providers exercise so much control over methods and approaches.

Baily and Garber (1997) wrote about a study of health care productivity that compared disease treatments in the U.S., Germany, and the U.K., and it was striking to find that protocols for disease treatment were different across the countries in ways related to the differing financial incentives on the providers. If it were possible to provide strong incentives to health care providers, it might be possible to utilize AI to achieve the potential of 5-10% cost saving within 5 years, but the current health care system is likely to be much slower to achieve gains of this size. In addition, the technology is still developing. In an interview with James Manyika of Google, he stressed that AI has been around for some time, longer than the latest developments in generative AI (Manyika 2024). Nevertheless, the technologies are still new, and it will take some time for them to prove their value in a field such as health care where life and death issues are at stake and market forces do not operate in straightforward ways.

How does this review of AI in health care fit with earlier discussions of AI as a general purpose technology? Assuming Sahni et al. (2024) are correct in their estimation of the impact of AI on health care productivity, this can be seen as the "neoclassical effect," the one-time upward movement in productivity from applying the new technology. Of course, the one-time impact on the level of productivity also causes a temporary increase in productivity growth. These authors do not try to estimate the impact of AI beyond their 5-10-year time-horizon, but if it turns out that there is follow-on, complementary innovation of the kind seen in prior general-purpose technologies, it could lead to ongoing increases in productivity.

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Endnotes

1 Stern (2022) explores the regulation AI in the medical area and the characteristics of AI devices. Allen et al. (2021) report that 30% of radiographers were using AI to enhance interpretations of scans. Khan et al. (2023) examine the use of AI for diagnosis. DeepMind Google (Saab et al. 2024) developed AlphaFold using Machine Learning to understand the folding of proteins and they have recently released Alphafold2 that can apply to a broader class of proteomes.

2 The American Medical Association reported the results of a survey from 2021-22 showing that 40% of doctors were considering leaving their organizations within two years (Berg 2023).

3 For example, Amazon, JPMorgan Chase, and Berkshire Hathaway formed a coalition called Haven to reduce costs; it failed and has been disbanded (Blumenthal 2021).

4 This was based on an extensive interview by Baily with the representative of a medical AI company that sells scanning software in the U.S. market, as well as other AI products. The company preferred to be anonymous.

5 See Davenport and Bean (2024) and Mayo Clinic Press Editors (2024).