



Investment Thesis Report: Generative AI in Healthcare

July 2023

Abstract

An aging population, public health crises (most recently the Coronavirus pandemic), skilled labor shortages, escalating healthcare costs, and ongoing issues related to medical errors highlight the need for technological solutions for many challenges in the healthcare system. Problems including patient management, data processing, physician burnout, and accessibility of care present obstacles that generative AI has shown the capability of solving in other industries. Various advanced Large Language Models (LLMs) such as OpenAI's GPT-4, Google's Bard, and IBM's Watson, address similar efficiency problems within many other industries. Deployment of targeted AI technologies can redefine the healthcare landscape through the reduction of medical and pharmacological errors, improvement of diagnostic efficiency, and an increase in early intervention. These language models have the potential to allow healthcare organizations to deal more effectively with a larger patient base as well as allow professionals to devote their time to direct patient care rather than administrative tasks.

Across the healthcare industry, both incumbent giants and budding startups are realizing the power of AI. Microsoft, in partnership with Nuance, and alongside other leading organizations such as Ada Health and Doximity, is integrating AI into its operations, demonstrating the versatility of AI technologies in healthcare. These applications range from automating administrative tasks and reducing the burden on healthcare professionals to offering personalized health coaching and providing instant responses to patient queries, ultimately enhancing the patient experience.

The healthcare regulatory system has also seen the potential of AI. FDA Commissioner Robert Califf has highlighted the potential of LLMs in healthcare, expressing the vision of an efficient

communication paradigm where clinical note-taking is less cumbersome and patient queries are addressed in a tailored, timely manner.¹ Recent technological innovations, such as Apple's AI features in its smartwatch that checks for unusually high or low heart rates in the background, display the potential of AI in improving individualized patient monitoring and enhancing accessibility of care. The generative AI in this technology also allows patients to clearly understand complex medical data through the use of natural language processing (NLP), the process of interaction between humans and computers. This highlights the need and efficacy of consumer-driven retail healthcare readily available to patients, as it is crucial we enable the identification of potential health issues remotely.

While these developments promise a transformative future for healthcare, it is imperative to balance this rapid integration of AI with thoughtful regulation and ethical consideration.

Healthcare is an industry where accuracy is mandatory. There can be no margin of error where miscues may affect the life of a patient. Although these LLMs are highly promising, they have yet to fully address problems such as algorithmic bias, privacy concerns, and the need for continuous adjustments for accuracy. These issues underscore the complexity of the path ahead.

The increasing attention of AI in corporate communications and rising public interest make clear that AI in healthcare is not just a transient trend but a necessity for a more efficient, personalized, and accessible future. As AI becomes integrated into more healthcare processes, it is critical to maintain a focus on patient safety by creating regulatory policies to maintain integrity and ensure accurate data.

Current Trends and Problem Identification

Analysis of Challenges and Opportunities of AI Integration in Healthcare

Prominence of Legacy Systems

One of the most significant hurdles to the adoption of AI in healthcare is the persistence of legacy systems. The adoption of AI in healthcare has not been as rapid as expected given the potential for this technology to revolutionize the industry. Outdated technologies, although dependable and familiar, are not equipped to take advantage of the benefits of AI.

Legacy systems in healthcare include everything from older Electronic Health Record (EHR) platforms to traditional diagnostic and treatment methodologies. These technologies are built on outdated technological infrastructure and lack the capacity required to incorporate AI solutions. They may also be incompatible with modern data formats, making it challenging to use AI models that rely heavily on access to diverse, high-quality datasets.

As of 2021, 73% of healthcare providers still relied heavily on such legacy systems.² This reliance creates a significant roadblock to implementing more sophisticated AI technologies.

Without systems that synergize with AI technologies, healthcare providers risk the possibility of incorrect data negatively affecting patients. These systems have been deeply ingrained into healthcare practices, procedures, and workflows for decades, making the transition toward newer technologies a complex endeavor.

Historically, novel technologies in healthcare have faced lengthy adoption curves. For instance, the EHR technology, which is now widely used, took years to be accepted by the medical

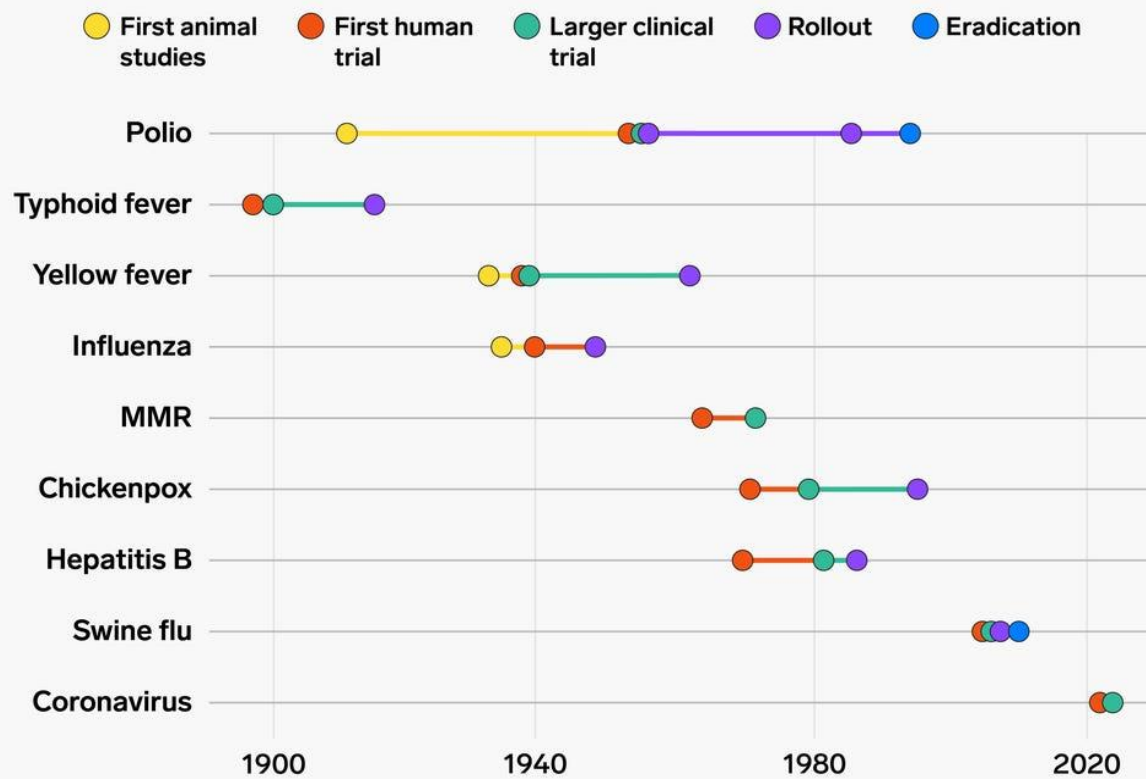
community. Initially, physicians resisted using EHRs because they felt these systems were time-consuming and interfered with patient care. Over time, however, regulatory pressure (such as the Health Information Technology for Economic and Clinical Health Act in the U.S.) and the demonstrated benefits of digital records led to the broad adoption of EHRs.³ Regulatory pressure is not always a perfect solution, however, a survey by healthcare communication platform TigerConnect found that 89% of healthcare organizations still rely on the use of fax machines and 39% still use pagers.⁴

The process of replacing or upgrading legacy systems can also be a substantial financial burden for many healthcare providers. This is particularly true for smaller practices and those in low-resource settings, who may find the costs of purchasing, implementing, and maintaining AI technologies prohibitive. Due to this, adoption will require providers to take on more expenses with the expectation that the implementation of AI will lead to greater future profits through increased efficiency and greater service offerings.

Regulatory challenges also pose a significant hurdle. The healthcare industry is heavily regulated to ensure patient safety and data privacy. As a result, any new technology must undergo rigorous testing and approval processes before it can be widely adopted.

Despite these obstacles, there's a growing recognition of the limitations of traditional systems and an increasing interest in adopting AI-driven digital tools. The COVID-19 pandemic has especially highlighted the need for a more aggressive adoption of a streamlined, efficient, and digital approach to healthcare delivery. The Coronavirus vaccine was developed and approved within a year, showing the possibility of rapid change in times of need.

Comparing vaccine development throughout history



Sources: The College of Physicians of Philadelphia; WHO; CDC; National Institutes of Health; Business Insider

BUSINESS INSIDER

Although AI may not seem as pressing as the COVID-19 pandemic, it has the same potential to change the healthcare landscape in a positive way. As the industry continues to evolve, overcoming the legacy system hurdle will be crucial to unlocking the full potential of AI in healthcare.

Interoperability and Standardization of Data

The adoption and effectiveness of AI in healthcare critically depend on access to large amounts of high-quality, standardized data. However, a considerable challenge lies in the lack of standardized and interoperable health data, a factor that hampers the broader implementation of

AI in the sector. Interoperability refers to the ability of different information systems to exchange and cooperatively use data in a coordinated manner. It is crucial to ensure a seamless flow of health information to enhance the quality and continuity of patient care. The dominance of legacy systems has made it difficult to ensure the correct interpretation of data between new and old technologies. In machine learning this is highly inefficient. Interoperability requires significantly more memory and processing power to work with outdated and varied datasets. In the long run, this will result in a longer process to fully integrate AI into existing systems as well as higher costs.

Standardization involves the use of uniform formats for data and consistent health information terminologies. This ensures that data is consistently recorded and interpreted across different systems, enhancing its usability and utility, particularly for AI applications that depend on large, diverse datasets. By implementing standardization methods of preparing data for machine learning training in organizations, AI teams can reduce up to 30% of infrastructure costs, according to the Forbes Technology Council (2021).⁵ AI will most likely be used in conjunction with legacy systems if implemented, risking the possibility of inaccuracies if databases are not significantly standardized.

Even though these factors are clearly important, as of 2017 only about 30% of healthcare providers have fully interoperable health data.⁶ This limitation means that a significant proportion of healthcare data remains inconsistently formatted, reducing its usability for advanced AI algorithms as they need highly standardized information to output accurate results.

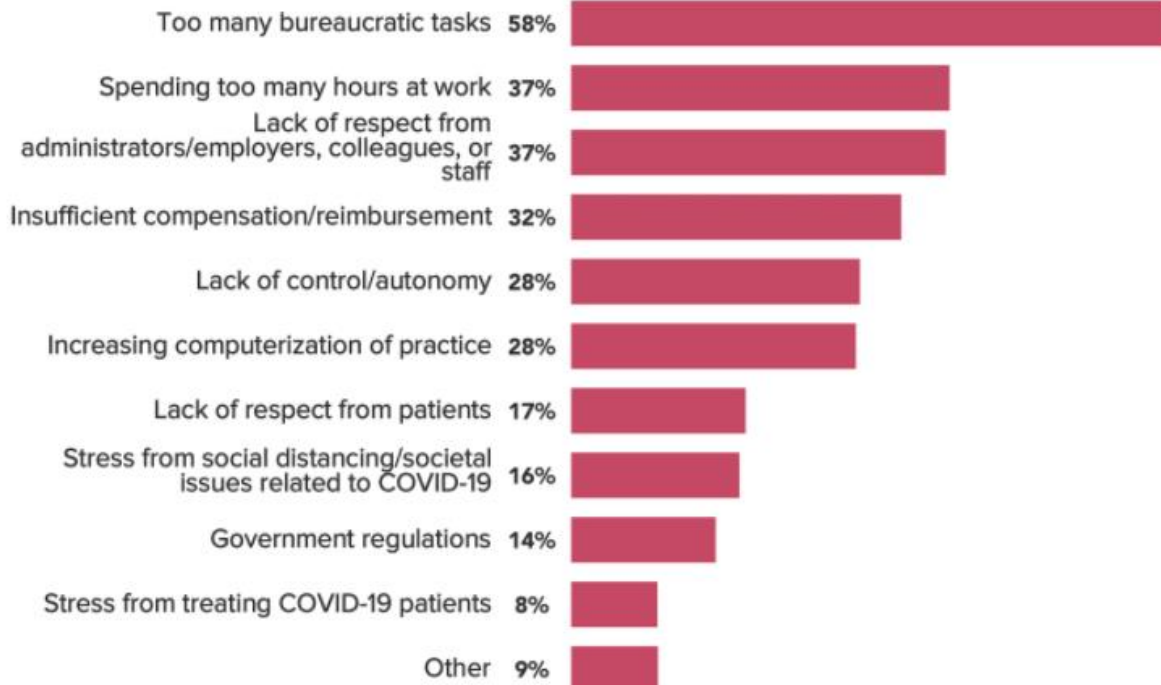
Enhancing interoperability and standardization is an ongoing process that requires concerted efforts from stakeholders across the healthcare sector. Without standardized data formatting and

cross-device compatibility, AI implementation will take much more time and expense. Further risk lies in inaccurate answers due to disorganized data. Initiatives thus far have shown promise, and as efforts continue, generative AI may have the opportunity to reach its full potential in healthcare.

Industry-wide Burnout

Due to long hours and difficult workloads, organizations have been challenged with physician burnout. Burnout can occur in any role, but the repetitive stress medical professionals face through their daily responsibilities causes a high level of mental exhaustion, with the pandemic only worsening the issue. A Medscape report in 2022 showed an increase in burnout rates among physicians increasing from 36% pre-pandemic to 42% today.⁷ This escalating trend signifies the urgency in leveraging AI to shoulder administrative tasks and alleviate some of the burdens on physicians.

What Contributes Most to Your Burnout?



Source: Prosperous Life MD (prosperouslifemd.com)

While the majority of physicians' efforts are spent evaluating patients, a significant source of burnout stems from the added workflow attributed to administrative tasks. Physicians must diligently take notes on each patient, hence EHR documentation takes a significant amount of time.

Affected Suppliers

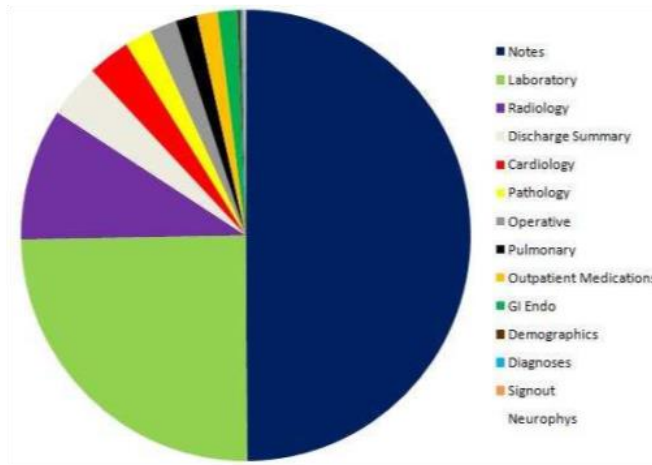
Primary Healthcare Providers

Primary healthcare providers, including general practitioners and family practices, have dealt with an increasing and unsustainable amount of administrative duties in recent years. Due to the smaller size of many practices and increasing demand, providers have been struggling to keep up largely due to the seemingly never-ending list of administrative work required for each patient.

According to a 2017 study, during a typical 11.4 hour work day, primary care doctors spend 4.5 hours on EHR-related tasks during office hours and an additional 1.4 hours after work.⁸ This equates to over half of a doctor's day dedicated to administrative work, significantly reducing the time available for direct patient care.

The technological advancements within medicine have clearly helped reduce the problems with paper-based documentation, however, they still pose a challenge for physicians themselves as the data entry is extremely detailed. Doctors must spend time documenting everything from patient notes to treatment plans.

The average percent of time that physicians spent in each section of the EHR.



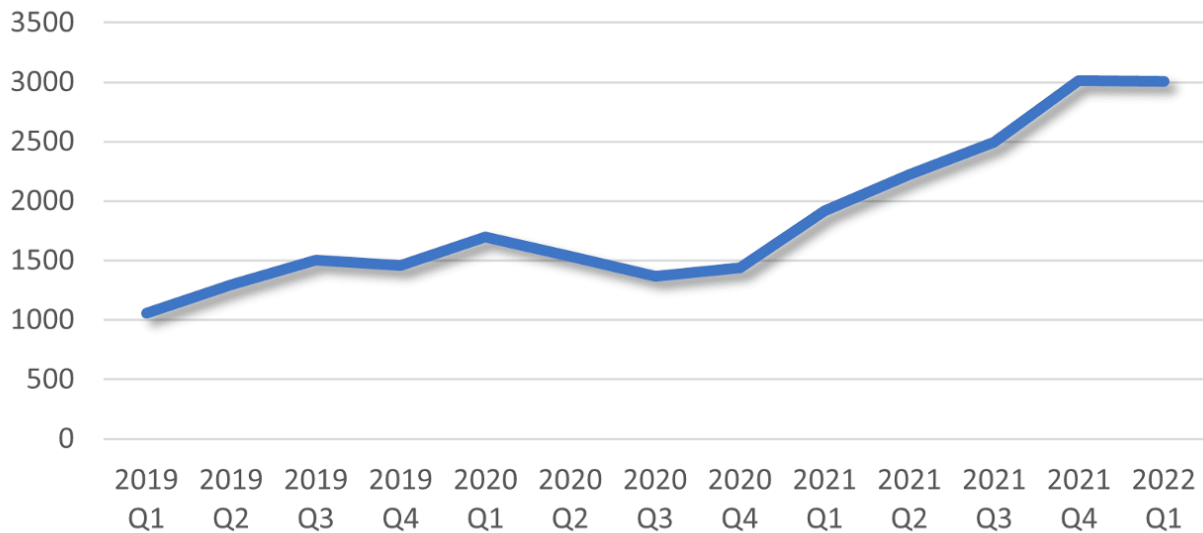
Source: Cognitive Analysis of the Summarization of Longitudinal Patient Records ([researchgate.net](https://www.researchgate.net))

Notes are particularly difficult to manage as they take about half of a physician's day.⁹ This process is due to both pre-appointment research and post-appointment documentation. This cumbersome process can be greatly altered in a way that is beneficial for both doctors and patients using generative AI as an EHR assistant.

Radiology

Radiology is an extremely difficult field of medicine due to the constant inflow of cases and the necessary accuracy involved. Increasing usage of technology including X-rays, CAT scans, and MRIs has raised the workload of radiologists as they read anywhere from 20-100 cases per day, each containing potentially thousands of images.¹⁰ As demand for imaging services and specialists has increased in recent years, the number of radiologist trainees have been steadily decreasing.

Figure 1.1
New Radiology Job Postings
ACR Job Board, By Quarter



Source: vRad analysis of ACR job board data, 2019-2022

Because of the growing shortage of radiologists in the United States, each specialist is tasked with a greater workload leading to burnout and possible diagnostic mistakes due to fatigue and stress. As of 2023, more than one in three physicians have had a medical liability lawsuit filed against them at some point in their career.¹¹

While generative AI is still too early-stage to independently diagnose from images, it can be used in a variety of ways to assist radiologists. Further, it can allow healthcare facilities to decrease funding toward risk management by using the technology to catch potential mistakes before reports are given to the patients.

Biopharma

Pharmaceutical companies struggle with both high research and development costs and an ever-increasing amount of published research to analyze. A report from Deloitte states that the average time to bring a molecule from discovery to launch is 10-12 years. This timeline makes it extremely costly. The R&D process at the top 12 biopharma companies has increased from \$1.188B in 2010 to \$2.168B in 2022 (2022). This results in the average ROI of drug development over this time frame declining from 10.1% to 1.9%.¹²

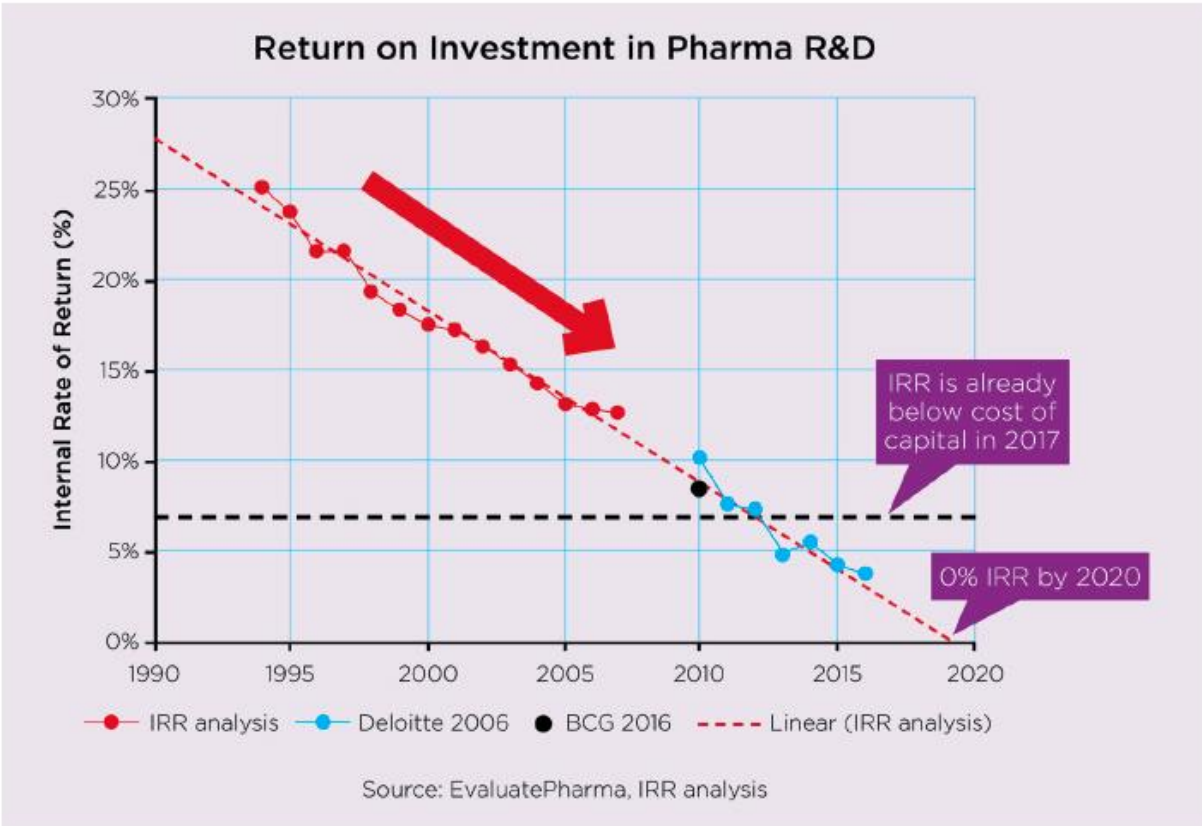


Figure 2: Internal Rate of Return in R&D Investments

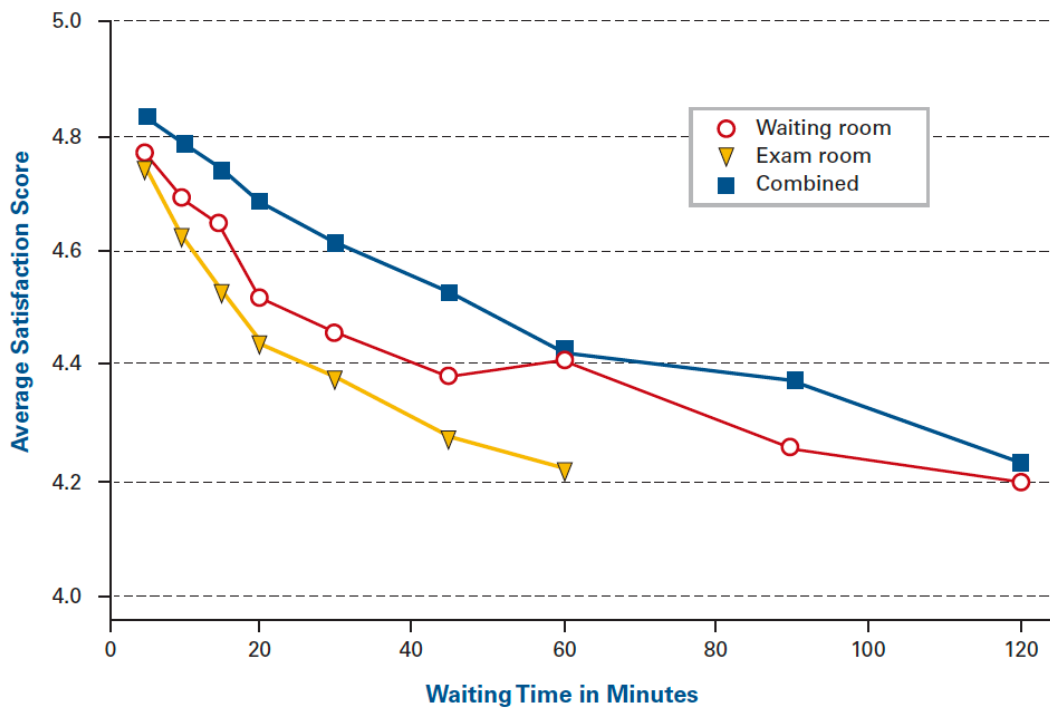
The lengthy and expensive process may cause biopharma companies to be more hesitant to research new drugs, leading to less innovation throughout healthcare. McKinsey reports that generative AI can boost R&D efficiency in biopharma by 10-15% through generative design, the process of taking different inputs to create possible results.¹³ By analyzing vast swathes of biological and chemical data to quickly identify high-potential drug candidates, predict their effectiveness, and optimize their design, researchers do not have to start from scratch and can eliminate possible inefficiencies in the timeline.

Further, the analysis of data is extremely time-consuming as researchers must sift through past reports to understand what works and what does not. Generative AI can also impact this side of

research by organizing and summarizing relevant data ultimately helping bio pharmacists to be more efficient.

Patients

Due to the many deficiencies in the healthcare industry, mentioned above, patients are extremely unhappy with their experience in hospitals due to wait time and transparency. According to TechTarget, the time to schedule an appointment has gone up by 24% since 2004 and 8% since 2017, up to 26 days.¹⁴ Furthermore, in urgent care facilities, patients wait over two hours on average to see a doctor, when time is vital due to immediate concerns.¹⁵ This disorganized process can impact hospitals, too, as patients may take their business elsewhere in the hopes of shorter wait times. It also affects patients' overall satisfaction and in turn possible referrals and retention rates.



Source: American Journal of Managed Care (2015)

The deficiencies in healthcare mentioned earlier also affect the patient. Misdiagnosis, burnout, and transparency are key factors healthcare providers need to improve. Transparency with billing is vitally important as many patients do not understand where fees are coming from and why hospital bills are so high. Generative AI has the potential to assist with many of these challenges by helping physicians' workflow, scheduling, and documentation in order to give patients the care they deserve.

Investment Areas

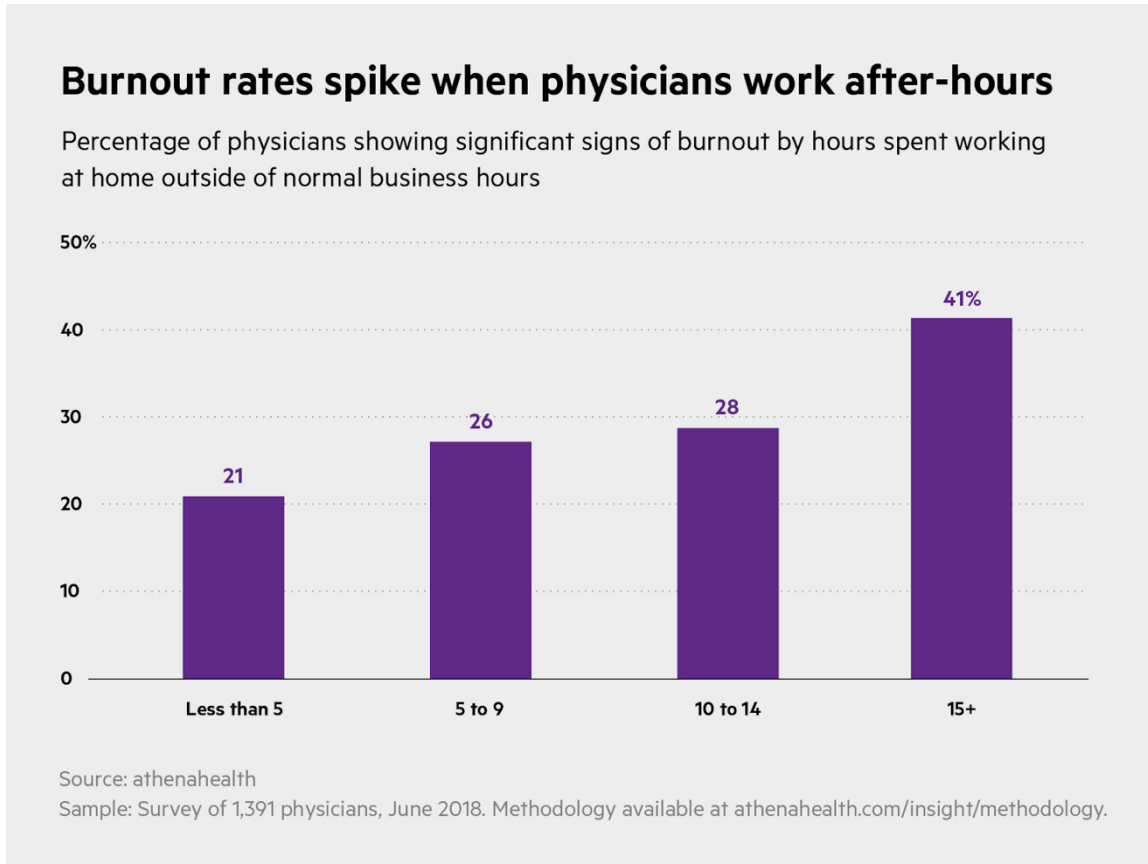
Clinical Documentation

Clinical documentation is a highly important, time-consuming part of every physician's daily workload. Whether providers are communicating patient information amongst each other or taking notes during a patient visit, physicians must keep comprehensive and accurate records of a patient's medical history such as diagnostic information, treatments, and services provided.

While technological advancements have reduced burdens for professionals in other industries, the process of clinical documentation has become significantly more burdensome to healthcare professionals in recent years.

According to an American Medical Association study, physicians spend almost two hours on EHRs and administrative desk work for every hour they spend with patients, with administrative work continuing after office hours.¹⁶ Further, when healthcare professionals have a patient visit, much of their focus is on taking notes rather than direct patient interaction. Many physicians go into medicine with the sole goal of helping patients, so when most of their time and attention goes toward note-taking, burnout becomes much more likely. Over time this increasing physician burnout, and subsequent shortage, will cause strains on healthcare providers and severely impact

the patient experience. To combat this some companies have begun leveraging generative AI to lessen the burden and time commitment of clinical documentation and note-taking.

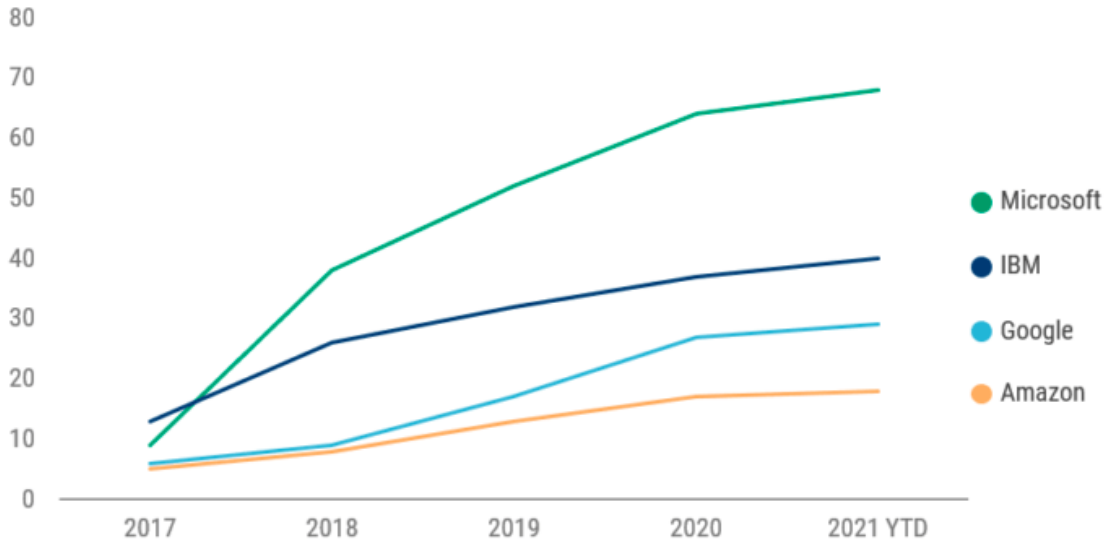


Nuance, a subsidiary of Microsoft, uses ChatGPT-4 and ambient AI in their Dragon Ambient eXperience (DAX) Express. Microsoft acquired Nuance in 2021, in what was its second-largest acquisition behind LinkedIn, showing the potential seen in Nuance’s healthcare AI solutions.¹⁷ Microsoft has led other companies in total healthcare partnerships allowing for the unique offering of integrating different technology between companies. This opportunity with Microsoft will help Nuance to grow its existing technology through a significant source of funding, while also enhancing Microsoft’s expertise within the healthcare industry.



Microsoft leads in total healthcare partnerships

Cumulative healthcare partnerships announced, 2017 – 2021 YTD (4/12/21)



Source: CB Insights ([link](#))

DAX uses AI to create fully automated clinical documentation allowing physicians to stay entirely focused on the patients during visits while notes are being taken in the background. Notes are generated immediately after visits allowing physicians to make any necessary corrections following the appointment. As of 2022, Nuance's technology is used by over 55% of physicians and 77% of hospitals in the United States, allowing for seamless integration of DAX into a platform that many healthcare professionals are already familiar with.¹⁸ If Nuance's newest application reaches the success it promises, it will significantly improve physicians' work-life balance and attention toward patients.

As the prevalence of telehealth has increased following the COVID pandemic, Nabla has developed a tool to transcribe video conversations. Similar to Nuance, Nabla's Copilot alleviates the administrative burden on physicians by creating a visit summary they can edit after the appointment. According to Nabla's data, Copilot usage has resulted in saving two hours and 50%

of clinical documentation time as well as seeing three more patients per day.¹⁹ Copilot was launched in March 2023 using GPT-3, however, Nabla's goal is to eventually create its own LLM. To train the LLM, Nabla has allowed for a data sharing opt-in, where if patients agree, the AI can learn. Copilot, like DAX, does not provide diagnostics but rather creates documentation of the visit, and leaves diagnostics to the physician.

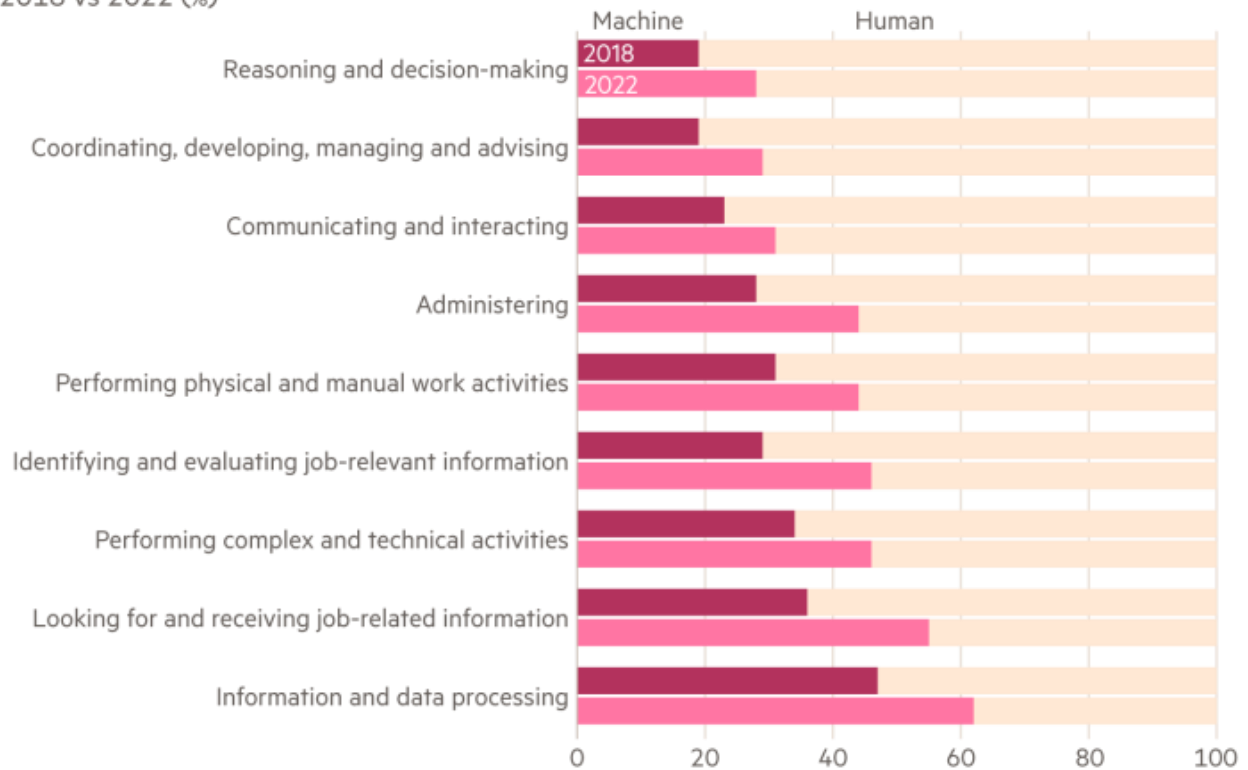
With applications such as DAX and Copilot, healthcare providers' time spent on administrative tasks can decrease significantly. While these AI applications enhance the role of the provider, they do not replace them. Tasks such as patient diagnosis, assessment, and interaction require a human component to improve patient satisfaction. Data security has also remained a focus in creating these technologies. DAX and Copilot are HIPAA and GDPR-compliant, allowing for general public and governmental acceptance. While clinical documentation is not the only current issue plaguing the healthcare industry, these AI tools address a very important challenge facing healthcare professionals and have the potential to stop an increasingly likely physician shortage.

Pre-visit Preparation

One of the reasons physicians spend so much time on EHRs is pre-visit preparation. Physicians must understand the reason for the patient coming in as well as what type of appointment it is. This process is extremely important for treatment as physicians understand what to look for during the visit. At present, however, it is far too time-consuming to sift through the massive amount of information in the EHR, and physicians may be rushed going from patient to patient.

Human-machine working hours

2018 vs 2022 (%)



Source: Future of Jobs Survey 2018, World Economic Forum
© FT

This is where AI-powered assistants can alleviate the pressure physicians face. Navina has created an assistant to extract insights from historical patient data and distill the data into a “patient portrait.” This allows physicians to get all the necessary information about a patient at the point of care. According to a report by the AAFP, the AI assistant reduces pre-appointment preparation for physicians by 61% and increases diagnosis accuracy.²⁰

Another company using ambient AI to auto-generate clinician notes, like that previously described, is Suki. The company’s CEO, Punit Soni, describes their technology, Suki Assistant, as a Siri for doctors. Physicians can set the application to ambient or dictation mode depending on if they want to dictate notes post-visit or generate notes during the visit. Soni mentions in

interviews that data shows 80% of physicians would not recommend the career path to their children, largely due to the administrative burden many face.²¹ In terms of pre-appointment preparation, Suki Assistant summarizes patients' EHR data through integration into platforms such as Epic, Athenahealth, Cerner, and Elation, allowing physicians to quickly receive updates on the most relevant information about a patient before visits. Family Physicians using Suki reported a 62% decrease in documentation time per patient and a 70% decrease in after-hours charting in the EHR.²² This feature ensures that physicians will be prepared for visits, ultimately improving patients' experience and quality of care. Suki Assistant can also create personalized templates based on each physician's style and needs, allowing patients to keep the vital element of individualized care. In the future, the goal is for Suki to act as an assistant for doctors to help keep them organized and more efficient.

Medical Information Analysis

Technology has become increasingly prevalent in the healthcare sector overall, creating a massive stockpile of information updated immediately after each patient visit, diagnosis, and treatment plan. Furthermore, as new research papers and experimental drug treatments are released, it makes it almost impossible for medical professionals to stay up-to-date and make informed decisions for their patients. The organization of healthcare data is also an issue, as most is unstructured, meaning that it does not fit into traditional row and column databases. As of 2019, unstructured data comprises around 80% of all healthcare data²³. This makes it extremely difficult for physicians to interpret and analyze the massive quantity of information as it is not all formatted in the same way.

The vast amounts of publicly available data are not just an issue for physicians, though, as patients attempt to sift through the internet in an effort to self-diagnose. This issue can lead to health problems worsening as patients incorrectly self-treat and have unnecessary concerns about a medical issue that they do not actually have. Moreover, without some sort of algorithm or application to efficiently and accurately summarize for the layman, the data is extremely difficult to comprehend. For both groups, patients and healthcare professionals, generative AI is beginning to create solutions for medical information analysis.

Google’s Med-PaLM 2 model has been specifically trained on medical data in order to sift through and analyze the vast amounts of information. This training has clearly helped as Med-PaLM 2 has improved immensely since Google’s first iteration.

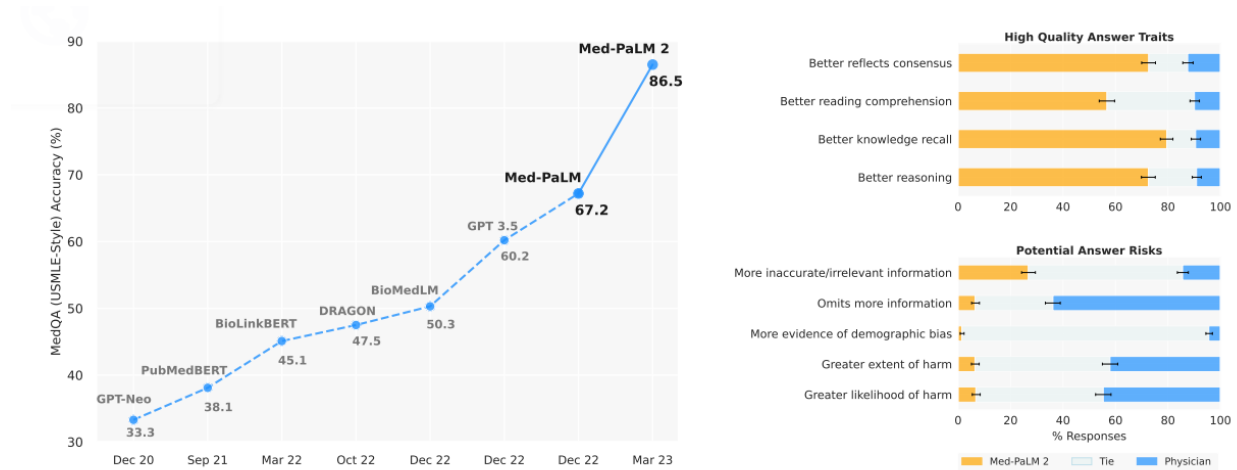


Figure 1 | Med-PaLM 2 performance on MultiMedQA Left: Med-PaLM 2 achieved an accuracy of 86.5% on USMLE-style questions in the MedQA dataset. Right: In a pairwise ranking study on 1066 consumer medical questions, Med-PaLM 2 answers were preferred over physician answers by a panel of physicians across eight of nine axes in our evaluation framework.

Currently, Med-PaLM 2 is not aimed toward patient-facing use cases. Instead, it can be used in hospitals helping physicians to diagnose rare diseases and fill out patient records. When tested on the United States Medical Licensing Examination (USMLE), Med-PaLM 2 scored an 85.4% which corresponds to an expert level physician. This product can help healthcare professionals

immensely as it can rapidly extract relevant insights from unstructured medical data, including clinical notes and research papers. This reduces the burden on physicians of constantly learning about new studies and information and allows them to stay easily updated. It also improves the patient experience by providing the best current treatment plans that up until now may have flown under the radar for many physicians.

Similarly, Hippocratic AI is an LLM currently being built and trained with the goal of creating a model safe enough for clinical diagnoses. Rendering accurate and specific diagnoses may significantly reduce doctors’ risk of misdiagnoses. With this technology used as a backup, checking medical professionals’ findings, healthcare organizations will not need to spend as much on risk management. The model has already outperformed GPT-4 on 105 out of 114 tests and certifications, by a margin of at least 5% on 74 and at least 10% on 43.

Name	LLM #1	LLM #2	GPT-4	Hippocratic AI
North American Pharmacist Licensure Examination (NAPLEX)	51.0%	0.0%	70.9%	91.1%
Registered Nurse (NCLEX-RN)	58.8%	25.8%	76.2%	88.6%
Certified Professional Coder	54.7%	50.0%	65.3%	71.0%
American Board of Obstetrics and Gynecology Licensing Exam (ABOG)	44.0%	24.0%	80.3%	92.3%
Hospital Safety Training Compliance Quiz	39.4%	27.3%	48.5%	72.7%
Registered Dietician	57.1%	46.9%	71.4%	83.7%

Source: Hippocratic AI

The biggest difference between Med-PaLM 2 and Hippocratic AI is the information being used to train the AI. While Med-PaLM 2 is using all publicly available medical information, Hippocratic AI has invested heavily into acquiring evidence-based healthcare content rather than using the entire internet. As the technology continues to be trained, medical professionals from every area of healthcare have been selected to review it, and the commercial release will not happen until they deem the model safe. Another difference between Hippocratic and Google's model is the base it is aimed at. Hippocratic AI is physician as well as patient-facing, while Med-PaLM 2 is purely physician-facing. The goal of the model is to help patients see more transparency in healthcare by explaining benefits and billing, providing dietary advice and medication reminders, answering pre-op questions, onboarding patients, and delivering test results. Medication reminders are extremely important for patients. According to a National Library of Medicine study, only 55% of patients not using a reminder intervention adhere to medication schedules.²⁴ Due to the patient-facing goal, Hippocratic AI has been trained in bedside manner. Studies show that bedside manner impacts emotional well-being and quality of health outcomes, so it has been a point of emphasis for the model.

Name	LLM #1	GPT-4	Hippocratic AI
Shows empathy	30.0%	68.3%	75.0%
Shows care and compassion	43.3%	75.0%	85.0%
Makes patient feel at ease	5.0%	29.2%	57.5%
Takes a personal interest in patient's life	33.3%	63.3%	70.0%
Helps patient take control	35.0%	61.7%	65.0%

Source: Hippocratic AI

Another company working in the healthcare data and information space is Ferma.ai. This product, created by the life sciences consulting firm ZoomRx, is aimed at professionals in the pharmaceutical, biotech, and medical device sectors. Ferma.ai allows these professionals to get immediate and accurate answers to their life science questions. The model has combined GPT-4 with specific pharma and clinical datasets and has been trained to include hyperlink citations in order to alleviate any concerns about hallucinated information. The model has access to over four million scientific publications, 190,000 clinical trials, 30,000 SEC reports, 10,000 earnings call transcripts, and 105,000 press releases, allowing it a wide range of information to answer questions. It also allows professionals to learn about the subject and ensure the answer makes sense by including step-by-step reasoning in every output. The model allows life science professionals to improve decision-making efficiency by accelerating access to important

information, which in time may significantly increase the pace and quality of innovation in the sector.

Similar to Ferma.ai, Atlanta-based startup, InpharmD is a digital platform that connects medical providers to answers for specific questions. The average hospital based clinical pharmacist spends 8 hours per week researching clinical questions, which InpharmD hopes to decrease. The common process of consulting references with drug questions at the point of care is increasingly slow. Tools are not up-to-date and therefore lack the ability to answer new and complex questions. With InpharmD, providers can submit any medical question and it is immediately answered through a combination of generative AI summarized studies and remote clinical pharmacists to verify accuracy. As of Q3 2023, the company currently works with some the country's top health systems including Mount Sinai, BayCare, Saint Francis, Dartmouth Health, Wellstar, and more. With this technology, the role of pharmacists is enhanced, time is saved, and patients are given the most effective drugs for their specific health problems in a timely manner.

These four companies enable rapid, accurate, and comprehensive analysis of medical data. Physicians do not have to spend as much time sifting through and analyzing data in order to figure out the best treatment plan or stay updated on the most recent methods. Patients can be more prepared for appointments, surgeries, and treatments by simply asking the AI questions instead of researching different sources from different places on the internet. Lastly, researchers can see a comprehensive summary of all relevant data in their sector helping them to identify pre-existing trends and relationships, eventually leading to quicker drug discoveries and treatments.

Administrative Automation

Clinical documentation is not the only administrative task that creates a burden for healthcare providers. Appointment scheduling, insurance claims processing, and billing are all inefficient and time-consuming processes as professionals must communicate with insurance providers and patients before knowing which entity to charge for the visit. This process is further exacerbated due to the use of fax machines as the primary means of communication for healthcare providers. Faxing makes what is already a difficult process even more time-consuming and inefficient.

Currently, most appointments are scheduled manually, leading to double bookings and in most cases long wait times. Generative AI has a massive opportunity to impact this aspect of the healthcare space by considering factors such as the patient's condition, the urgency of the case, and specific physician's past visit times. Over time the technology can learn from past patterns within the hospital to predict future demands, thereby optimizing the schedule. Moreover, by learning each physician's typical visit time scheduling can be made to decrease the wait time for patients dramatically. New York-based Urban Health Plan (UHP) integrated eClinicalMessenger's generative AI technology to target patients most likely to miss scheduled appointments. Since January the pilot program has had a 24% increase in the likelihood to make an appointment for the high-risk no-shows group and an 8% increase for those with moderate risk. Further, UHP was also able to increase access to virtual care, extending hours to 89 per week through the new system.²⁵

Assort Health is another company in the space using a voice AI tool to handle calls with patients. The technology handles a multitude of administrative tasks such as appointment scheduling, insurance checks, prior authorization, and claim status. Assort Health improves the patient experience by allowing callers to talk with an AI assistant that understands their needs, instead of

waiting on hold. Healthcare providers benefit from replacing costly call center operations with a cheaper, more efficient alternative. The technology has already driven a 5x decrease in call drop rate and 3x decrease in cost per call. This highlights the ability of AI solutions to both improve the patient experience and decrease costs for hospitals. By integrating into the EHR for other administrative tasks, Assort Health also helps to alleviate staffing shortages and overworked healthcare professionals.

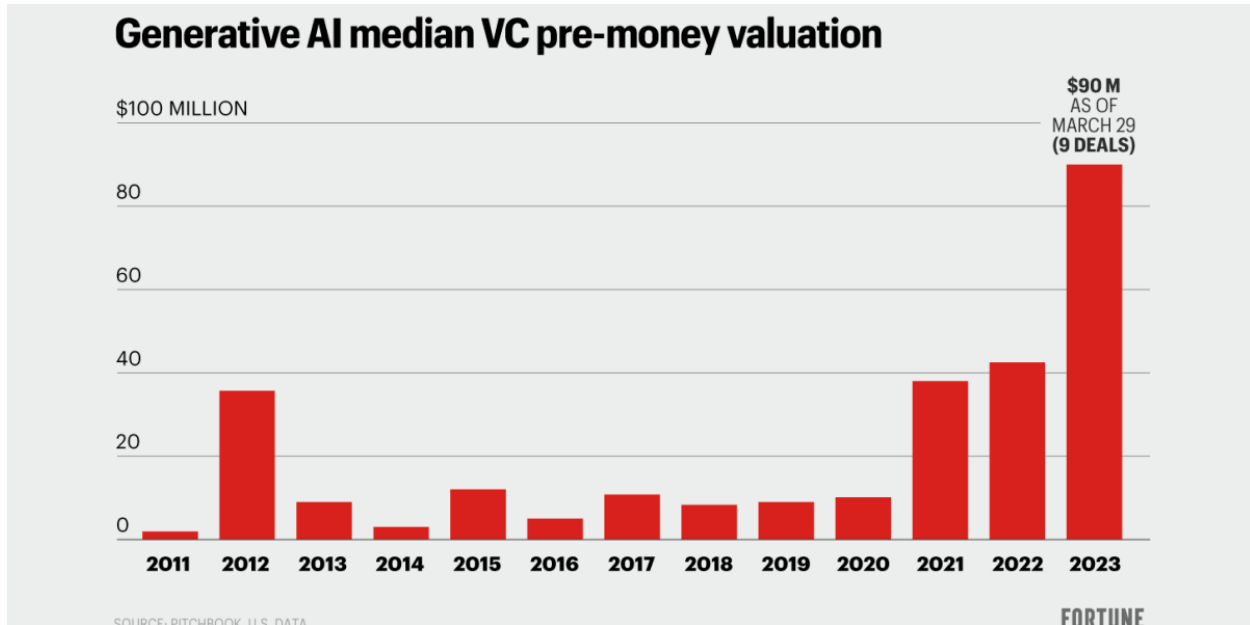
Doximity has partnered with ChatGPT to automate this process by preparing referrals and authorization requests. The AI writing assistant can draft and fax preauthorization and appeal letters to insurers helping healthcare providers' workload. These documents are drafted and then copied over to a HIPAA-compliant portal where professionals can correct any false information before faxing. Over 80% of doctors are already on Doximity's network, allowing for ease of use as well as a large network for healthcare professionals to connect with peers, transfer patient files, access research relevant to their specialties, and conduct telemedicine visits.²⁶

This technology allows providers to streamline processes and cut costs, while focusing more on patient care. Additionally, implementation also allows for improved data accuracy, accelerated availability of information, and increased organization, which are all vital for decreasing the administrative burden on healthcare providers.

Startup Landscape

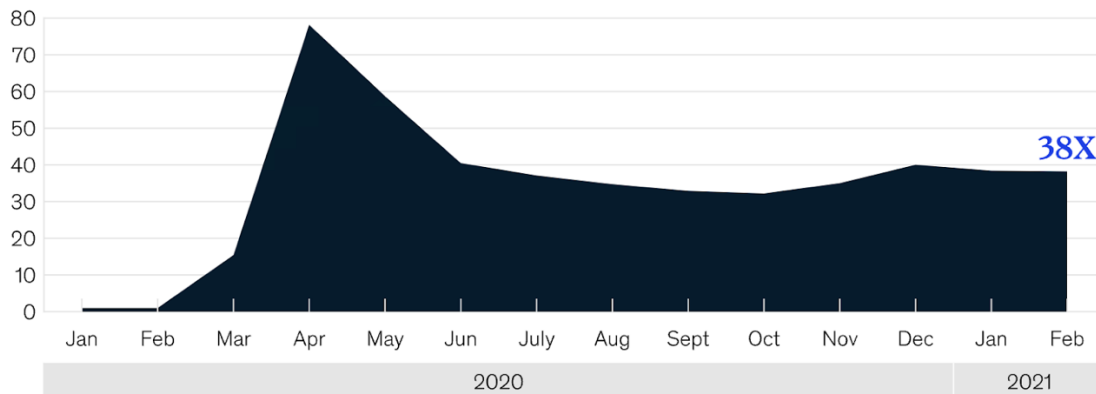
The market for generative AI has seen rapid growth largely driven by Microsoft's \$10 billion investment in Open.ai. Companies have observed both a sharp increase in efficiency and a

decrease in costs when implementing generative AI into their existing infrastructure. Due to this, funding is pouring into startups at unprecedented valuations.



The healthcare industry has seen similar growth in deal activity and valuations over time within the generative AI sector. The widespread adoption of new technology in hospitals has led to a surge of partnerships between providers and generative AI companies. The 2020 pandemic has shown providers the potential of new technologies, such as telehealth.

Telehealth claims volumes, compared to pre-Covid-19 levels (February 2020 = 1)¹



Source: McKinsey & Company ([link](#))

Even with lockdowns decreasing steadily through the end of 2020 into the beginning of 2021, hospitals continued to heavily rely on telemedicine to conduct appointments. Physicians were able to meet with a greater number of patients as no-shows and wait times decreased, and patients were able to meet in the comfort of their homes. While telemedicine usage has declined as the COVID concerns have decreased it remains far above pre-pandemic levels. As of Q3 2022, around 23% of patients use telemedicine compared to the 27% 2021 levels.²⁸ Even with the gradual decrease of telehealth usage, it has still proved itself as a necessary and effective advancement. This technology is just one type that the healthcare industry has seen revolutionize historical norms and highlights the need for increased adoption of new technology.

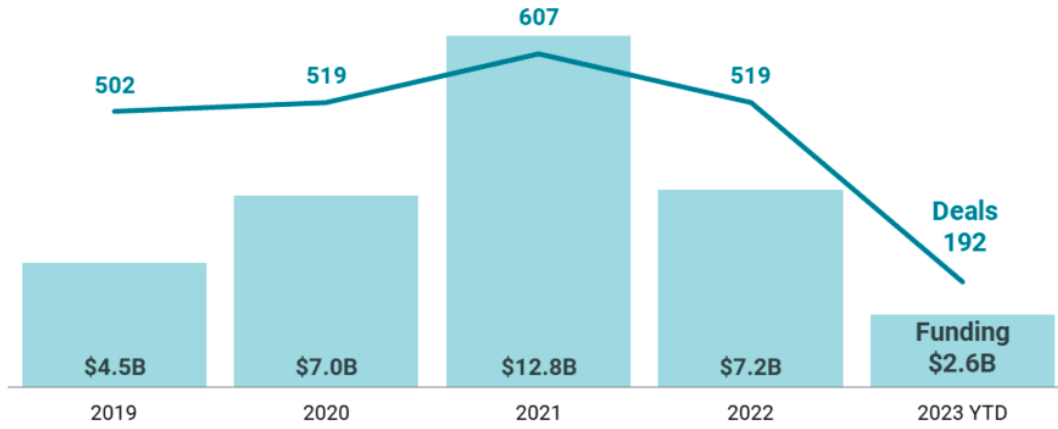
Due to the earlier mentioned challenges regarding physician burnout, the generative AI in healthcare market is expected to reach \$17.2 billion by 2032 with a CAGR of 37.0%.²⁷

Companies have already figured out many use cases for the technology and with the need for more streamlined operations within hospitals for physicians and patients, generative AI will only become more necessary.



Healthcare AI funding and deals slow down in 2023

Disclosed equity funding & deals (as of Q2'23)



CBINSIGHTS

Even so, economic downturns and a slowdown in venture dealmaking have led to less funding toward both generative AI in healthcare and in the broader market. Even with lower deal activity, generative AI technology has not decreased in valuation, so as future startups in the space find new use cases, funding should increase. Further, as the technology becomes more intelligent it will impact hospitals at a greater scale and dramatically increase in effectiveness. Without worries of incorrect outputs, providers can use AI for more tasks and enable even greater assistance to physicians. As healthcare companies learn more about generative AI, more use cases for integration will be discovered. Companies that embrace the technology gain a clear competitive advantage by enhancing patient care and physician workload, driving outsized financial growth.



Founded: 2022

Size: 6 Employees



Generative AI assistant to personalize the consumer experience with increased visibility around cost and quality of care. Helps healthcare companies and patients to gain better transparency on billing.



Assists patients by summarizing and comparing public hospital and insurance pricing data. First company to use client-specific data and AI to optimize treatment and insurance decision-making.



\$1.7 Million led by AlleyCorp



Location: Bellevue, WA

Website: cascadehealth.ai

⚡ GenHealth.ai

Founded: 2023

Size: 10 Employees



Predicts the future outcome of patients using generative AI and millions of patients' encoded claims and clinical data. Can simulate pharma clinical trials and create more personalized life and health insurance plans.



Current evidence based medicine requires single-use hypotheses. With predicted future outcomes, Genhealth lowers costs and allows more rapid innovation. Goal is to expand use cases to assist more healthcare decisions.



\$13 Million led by Craft Venture and Obvious Ventures



Location: Boston, MA

Website: genhealth.ai

CODAMETRIX

Founded: 2019

Size: 104 Employees



Leading AI technology platform assisting healthcare revenue cycle management. Utilizes AI for medical coding to assist with medical billing challenges. Current billing processes cause a massive cost and time burden.



Hospitals face a shortage of employees in revenue cycle management and billing departments. This technology automates billing in order to eliminate delayed payments, claim denials, coder shortages, and high costs.



\$55 Million led by SignalFire



Location: Boston, MA

Website: codamatrix.com



Rad AI

Founded: 2018

Size: 83 Employees



Automatically generates an impression from the findings in scans. Learns from radiologist's language to create more personalized reports. Communicates patient outcomes to ensure treatment is followed.



Automates repetitive tasks for radiologists, saving time and decreasing burnout. Saves radiologists an average of 60 minutes per day. Helps professionals to create reports more efficiently through image pattern recognition.



\$25 Million led by ARTIS Ventures



Location: San Francisco, CA

Website: radai.com



Founded: 2017

Size: 72 Employees



Provider of collection, analysis, and insights into clinical data. Enhances the data collection and analysis of registries by recording patients' diagnosis, treatment, outcome, and more.



Decreases time spent in EHR by extracting data from medical records and populating clinical registries. Automates patient databases and helps physicians to better focus on direct patient interaction.



\$25 Million led by Paramark Ventures and Frist Cressey Ventures



Location: San Francisco, CA

Website: carta.healthcare



Founded: 2020

Size: 10 Employees



Generative AI platform that both helps past stroke survivors recover and identifies warning signs of strokes early-on to create prevention plans.



Eight out of ten strokes are preventable, yet they are the leading cause of disability worldwide. By detecting high risk patients, expert-level preventative care can be delivered to those in need.



\$10 Million led by Nate Ramanathan



Location: Charlottesville, VA

Website: syntrillo.com

Deepflare*

Founded: 2020

Size: 8 Employees



Uses generative AI and machine learning prediction models to boost the development of mRNA vaccines and drugs against viral diseases.



During the COVID-19 pandemic mRNA vaccines became widely adopted. This technology seeks to accelerate the process of developing mRNA vaccines targeting other deadly pathogens to prevent another possible pandemic.



\$1.53 Million led by Sunfish Partners



Location: Poland

Website: deepflare.ai

Birch AI

Founded: 2020

Size: 13 Employees



Leading AI platform for healthcare customer support. Automates customer support by summarizing, classifying, and analyzing customer calls. Reduces average duration of customer interaction by up to 35%.



Healthcare industry calls are costly and time intensive due to significant documentation requirements. Focus is on complex calls which generate over \$10 billion in annual costs to the healthcare system per year.



\$3.1 Million led by Radical Ventures



Location: Seattle, WA

Website: birch.ai

Moving Forward

The integration of generative AI in healthcare has the potential to reshape the industry. The technology has already shown its capabilities in multiple sectors including disease prevention, personalized treatment, drug discovery, and administrative automation. The technology has already begun helping doctors reduce diagnostic errors and be more efficient in reading cases, leading to improved patient outcomes. Furthermore, the long-standing administrative processes which have proven far too time consuming have been made much more efficient and effective from scheduling and optimizing wait times to summarizing pre-visit preparation. Generative AI has also made massive strides in the drug discovery by speeding up the drug development pipeline and reducing associated costs. In addition to these realized use cases, AI has the power to enhance many other areas of healthcare, allowing for a better patient experience and decreased physician workload.

The market is rapidly moving towards generative AI as the technology is seeing massive advancements. While healthcare systems must be wary of the investment into AI integration, this area has already garnered tremendous interest from large private investors to continue developing the tech and proving its use case. There is massive opportunity for both healthcare providers and investors in this sector as more companies find solutions to existing processes using AI. While generative AI is not a universal solution to all the inefficiencies within the healthcare industry, organizations that embrace the technology gain a clear competitive edge over competitors.

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