AI Applications in Health Care

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Overview

Artificial intelligence (AI) is creating a new paradigm in health care, enabling transformative applications in patient care while potentially reducing both systemic cost and overburdening.

AI is transforming health care by improving disease detection, precision medicine, drug development and patient monitoring, while also enabling telemedicine, reducing administrative burdens and predicting public health needs. Beyond task application, AI is additionally beginning to shape medical education and professional training as well.

While AI's application in the medical field forges ahead, public confidence about its use in health care remains low, with 79.4% of respondents in a recent survey conducted by Heartland Forward stating that they do not trust AI to provide accurate information about health care. To advance public acceptance of AI in the medical field, rigorous validation of the efficacy of AI-driven solutions is required. Ethical frameworks and regulatory standards are essential to address algorithmic biases, guarantee patient privacy and ensure equitable health care delivery, and the public needs to be made aware of and understand these regulatory guidelines if public trust in AI is to be improved. The health care sector stands to be meaningfully and substantially impacted by the incorporation of AI into its work and must play a leading role in educating the public and policymakers on the improvements to care that stand to be made by this revolutionary technology.

Diagnostics and Disease Detection

As part of its early disease detection work, AI-powered systems can identify behavioral risk factors that, with the proper intervention, can help patients avoid potential health conditions and impacts. Outside of behavior, AI's data analysis abilities additionally allow it to analyze medical images, lab results and patient records to improve diagnostic and longer-term patient outcomes.

- **The Whole Health Approach and Preventative Medicine**: AI's ability to evaluate and recommend modifications to patient behavior stands to potentially improve patient outcomes.
- **Medical Imaging**: Tools like IBM Watson Health or Google's DeepMind deploy deep learning to detect tumors, fractures, or organ anomalies from MRI, CT and X-ray scans.
- **Early Disease Screening**: AI can spot subtle patterns in data that precede clinical symptoms, enabling early interventions.
- **Pathology**: AI models analyze tissue samples to identify cancerous cells at an earlier stage and optimize treatment options as well as patient outcomes.

Preventing disease is almost always preferable to treating it after diagnosis, when interventions can be invasive, taxing and disruptive to daily life. Preventive medicine shifts the focus from reactive care to proactive health management, where clinicians work alongside individuals to reduce risks before illness takes hold. AI enhances this approach by identifying genetic predispositions and other risk factors, then guiding personalized behavioral and lifestyle adjustments that can help safeguard long-term health.

One prominent example of AI's application to improve health outcomes is vaccinations. AI has the ability to further strengthen vaccine strategies by identifying individuals who may be more susceptible to adverse reactions and by designing personalized interventions—such as tailored nutrition programs—that reduce vulnerability to disease and promote overall resilience."

Beyond vaccinations, AI is being integrated in medical imaging in a significant way to identify cell mutations that lead to cancers and other tumors at earlier stages where less invasive treatment options are available and tend to result in more favorable patient outcomes. Radiological imaging, including MRIs, CT scans and X-rays, have complex features that can be analyzed and identified by sophisticated AI algorithms developed by machine learning more effectively than highly trained medical technicians. AI can isolate minute variations and patterns that are not discernible to the human eye and vastly enhance diagnostic capabilities. Outside of cancer, significant advances in the early detection of specific neurological conditions such as multiple sclerosis, migraines, epilepsy, Parkinson's disease and traumatic brain injury are being witnessed. [ii]

Outside of disease detection, IBM's Watson Health and Google's DeepMind and many other AI-derived health applications are utilizing deep learning to improve testing accuracy. This is particularly evident in the decrease of false positives in digital mammograms demonstrated by AI-based computer-aided design software. When compared to FDA-approved software AI maintains an identical level of sensitivity in identifying breast cancers and many other types of cancers[iii], but AI does provide earlier detection for a variety of cardiovascular diseases. These better detection methods, coupled with personalized treatment plans, result in improved patient outcomes while reducing health care costs and strain on the health care system as a whole.

Taken together, these advances illustrate how AI is reshaping the very foundations of Whole Health and preventive medicine—moving health care from a system that reacts to illness toward one that anticipates and averts it. By enhancing the precision of diagnostics, optimizing preventive strategies like vaccination, and tailoring care to individual risk factors, AI has the potential to extend healthier years of life while alleviating the burdens on patients, providers and health systems alike. As these technologies continue to mature, they offer not only earlier interventions and better outcomes but also a more sustainable, proactive model of care for the future.

2. Personalized Treatment, Clinical Decision Making and Precision Medicine

AI is revolutionizing personalized medicine by enabling treatments precisely tailored to individual patients.

- **Drug Matching**: Algorithms recommend the most effective medication based on a patient's genome and medical history.
- **Treatment Optimization**: Predictive models help doctors adjust dosages and treatment plans in real time.
- **Cancer Therapy Guidance**: AI platforms suggest targeted therapies for specific tumor mutations.

One of the most promising applications of AI in medicine lies in its ability to transform treatment planning through precision and personalization. AI can analyze personal electronic health records to assist health care professionals in tailoring patient care to their health and genetic profiles. This improves treatment effectiveness and lessens the likelihood that patients will be prescribed medications that do not effectively work with their health profile and medical history.

Collaboration between clinicians and AI-driven systems ensures that treatment plans remain aligned with the most current medical knowledge while being finely tuned to each patient's unique needs. By providing rapid, data-informed feedback, AI allows physicians to adjust dosages and therapies in real time, strengthening the promise of truly personalized care. [v] These tools are already shaping clinical decision-making—for instance, guiding the selection of anticoagulants for patients with atrial fibrillation, optimizing anti-platelet therapy after coronary interventions and advancing pharmacologic applications. [vi] Taken together, such innovations signal a paradigm shift toward precision medicine, particularly in the field of cardiovascular care.

Oncology is another field benefiting from the deployment of AI-powered personalized medicine. IBM Watson for Oncology is assisting oncologists in developing individualized treatment plans for cancer patients. Watson synthesizes medical literature, clinical trial data and patient records to generate evidence-based treatment plans—and in one comprehensive study, its oncology recommendations aligned with those of leading specialists in 96% of cases. [vii]

The application of AI-based predictive analytic tools has shown impact at Mount Sinai Health System ICU in New York City. The AI tool analyzes real-time patient data to predict potential complications such as heart failure or sepsis, prior to occurrence. This predictive approach was associated with a 20% decline in ICU mortality rates and vastly improved patient outcomes. [viii]

Together, these advances illustrate how AI is fundamentally reshaping modern medicine by enabling more precise, proactive and personalized care. From tailoring drug therapies and guiding cardiovascular treatments to optimizing oncology protocols and predicting critical complications in real time, AI empowers clinicians to make data-driven decisions that improve outcomes and reduce risk. As these technologies continue to evolve and integrate into clinical practice, they promise not only greater treatment effectiveness but also a transformation of health care toward a model that anticipates disease, minimizes harm and delivers truly individualized care.

3. Drug Discovery and Development

Outside of direct patient care, AI can drastically speed up the drug R&D process by predicting molecule interactions and identifying promising compounds.

- **Virtual Drug Screening**: AI predicts which compounds will work against a target disease.
- **Clinical Trial Optimization**: AI models identify suitable participants, forecast trial outcomes and reduce costs.
- **Repurposing Existing Drugs**: AI finds new uses for drugs that have already been approved by the Food and Drug Administration (FDA), shortening the approval timeline.

AI is poised to potentially upend the traditional drug discovery process, transforming what was once a decade-long, high-risk endeavor into a faster, more precise and potentially far more cost-effective pursuit with huge implications for patient outcomes. Historically, trial-and-error approaches have been used to identify promising molecular entities, shepherded through the clinical trial process to eventually receive FDA approval and introduction to the market.

Previously, scientists have been required to manually analyze vast volumes of biological data, a process marked by high failure rates and inefficiencies. In recent years, developing a new drug has taken more than a decade on average and cost upwards of $2 billion [ix], with phase 3 clinical trials—encompassing hundreds of participants and prolonged review cycles—contributing significantly to these costs. The cumulative expense of failed candidates passed onto the few successful drugs made this traditional model increasingly unsustainable.

The AI-assisted discovery process is revolutionizing the field by shortening timelines and lowering costs. By utilizing AI algorithms, researchers can simulate and predict interactions between targeted proteins and potential drugs. These capabilities have the ability to accelerate general drug development—yielding tangible breakthroughs in areas such as oncology and neurodegenerative diseases. AI is demonstrating effectiveness in advancing cancer therapies, with one study training an AI algorithm on a large dataset of preidentified cancer-related compounds and their biological influences. This process produced compounds that could be used in the development of new cancer therapies. [x]

Additionally, AI has assisted finding potential cures for Alzheimer's disease when it was deployed to aid in the identification of inhibitors of beta secretase, a protein associated with Alzheimer's.[xi] This, and other experiments, have led biopharmaceutical companies to announce partnerships with AI firms to aid in identifying novel drug targets and develop vaccines.

Additionally, AI is demonstrating high proficiency in finding additional therapeutic indications for repurposing drugs that have already been approved for other treatments. Many FDA-approved drugs for specific diseases have demonstrated efficacy in other applications. And potential therapies that have failed previous clinical trials can be identified by AI with the promise of treating non-identified illnesses such as rare and infectious diseases.

Together, these advances illustrate how AI can transform every stage of drug discovery and development—from early target identification to clinical trial optimization and drug repurposing—making the process faster, more precise and far more cost-effective. By harnessing vast datasets and predictive algorithms, AI is not only accelerating the development of novel therapies for complex diseases like cancer and Alzheimer's but also uncovering new uses for existing drugs, reducing reliance on traditional trial-and-error methods and streamlining clinical research. As these technologies continue to mature and integrate across pharmaceutical and clinical workflows, they hold the potential to fundamentally reshape medicine, delivering safer, more effective treatments to patients with unprecedented speed and efficiency.

4. Patient Monitoring and Remote Care (Digital Care)

With the increased popularity of wearable health-monitoring devices (Whoop, Fitbit, Oura Ring) and "Internet of Things" (IoT) sensors (heart rate, blood pressure and glucose monitors, among others), AI continuously monitors patient health, adding a new layer of consistent data that can be evaluated for improved patient outcomes. This data is particularly helpful in addressing the following:

- **Chronic Disease Management**: Continuous glucose monitoring for diabetics, heart rate tracking for cardiac patients and other chronic conditions are analyzed by AI for early-warning.
- **Remote Patient Monitoring (RPM)**: AI detects abnormalities in real-time and is capable of sending alerts to health care providers and telehealth options.
- **Post-Surgery Recovery Tracking**: AI-powered apps monitor wound healing and mobility.

AI-powered wearable devices are proving to help prevent complications and improve long-term outcomes. These monitoring devices, including smartwatches, patches, feeds from pacemakers and even smart clothing, can track vital signs, activity levels, sleep patterns and more, providing valuable insights into a patient's health status. Wearable patches, like the Zio and KardiaPatch, are used for continuous ECG monitoring. Improved chronic disease management not only upgrades outcomes but reduces associated costs by minimizing acute episodes and limits hospital readmissions. By continuously capturing and analyzing real-time health data, these devices not only enhance clinical decision-making but also empower patients to take a more proactive role in managing their own health

When integrated with AI, these wearable technologies form a powerful ecosystem for remote patient monitoring, enabling continuous, real-time tracking and personalized interventions that further improve outcomes. Many of these devices have taken their medical assistance a step further, and AI-enabled technologies have created Virtual Personal Assistants which deliver individualized health care advice to patients. [xiv]

Building on the capabilities of AI-enhanced wearables and virtual assistants, telemedicine is now leveraging these technologies to extend continuous, personalized care beyond the clinic, making remote health management more effective and accessible than ever. While forms of

telemedicine have been available for years, their deployment has been slow, which is why institutions like Heartland Forward have worked to expand access through telehealth education and adoption modules.

5. Administrative and Operational Efficiency

Beyond clinical and patient applications, AI helps reduce the administrative burden on health systems, freeing up more time for hands-on patient care. These applications of AI include:

- **Medical Transcription**: Speech-to-text AI tools create accurate patient records.
- **Scheduling Optimization**: Predictive scheduling to minimize patient wait times.
- **Billing and Claims Processing**: AI detects fraudulent claims and automates coding.

Rapid increases in health care spending have been associated with rising administrative responsibilities such as scheduling and documenting patient visits, reviewing patient records, managing medical files and processing claims. Studies demonstrate that nurses in the U.S. allocate an average 25% of their workday on administrative tasks. [xvii] AI provides the opportunity to streamline health administrative systems, boost efficiency and alleviate the burden on health care providers.,

This is exemplified in AI's ability to automate appointment scheduling, reduce back-and-forth communication and minimize no-shows through automated reminders. Additionally, AI can efficiently transcribe patient interactions and generates accurate chart notes in real-time, saving clinicians critical time and effort. Beyond documentation, AI-powered tools can verify insurance eligibility, detect coding errors and automate claim submissions, improving efficiency, reducing errors and detecting fraudulent submissions. Similarly, AI can streamline the insurance authorization process by automating the exchange of information and validating medical necessity, reducing delays and administrative overhead. Moreover, AI can ensure accurate and proper documentation, reducing claim denials and rejections.

While not a direct application of AI, the technology's ability to accomplish administrative tasks helps to address an increasingly prevalent issue in health care: physician well-being and provider burnout. Recent research identified that approximately 26% of physicians reported experiencing symptoms associated with burnout. Further, it highlighted that 75% of survey respondents listed electronic health records maintenance as a primary cause. [xviii] Many health care organizations are introducing natural language processing-based AI to improve electronic health records systems and reduce administrative burden on physicians.

6. Virtual Health Assistants and Chatbots

AI-powered virtual assistants are intelligent software systems that can interact with patients and clinicians, providing personalized health guidance, appointment reminders, medication instructions and support for administrative tasks, thereby enhancing patient engagement and streamlining clinical workflows. These assistants often help with:

- **Symptom Checking**: Tools like Ada Health or Buoy Health provide preliminary advice based on patient-reported symptoms.
- **Medication Reminders**: Apps send alerts to improve medication adherence.
- **Mental Health Support**: AI chatbots provide CBT-based guidance for anxiety and depression.

Digital health companies such as Buoy Health and Ada Health have developed AI-powered systems to help individuals understand their health concerns and navigate the health care system. Users can interact with these AI-driven systems and receive answers to questions about their symptoms. This interaction is designed to resemble a conversation with a doctor and is voice-enabled in most cases on an app. Based on the user's input, the virtual assistant delivers personalized information concerning potential causes of their symptoms, possible diagnoses and guidance on next steps for care. The leading apps cover over 10,000 symptoms and 3,600 conditions, including chronic conditions, mental health, obstetric, pediatric and rare disease issues. [xix]

These AI-powered platforms aim to steer consumers to the right level of care, whether self-treatment at home, a trip to a primary care physician, or seeking immediate medical attention such as urgent care or an emergency room. Additionally, these AI-powered chatbots have demonstrated efficacy in aiding the informed consent process. In one study[xx], patients undergoing coronary angiography were assigned to either an AI-supported chatbot group or a conventional informed consent group. The AI group had statistically significant higher levels of comprehension of the procedure and risks, demonstrating that AI’s approach to informing patients improved patient understanding of the medical intervention.

Outside ensuring patient understanding of medical procedures, another critical challenge to achieving effective treatment and maintaining favorable patient outcomes is lack of adherence to prescribed medications. In many cases, patients forget to take medications as prescribed or may reduce adherence due to high drug costs. This can result in the worsening of patient conditions that would otherwise be avoidable. However, AI tools can play a vital role in this space with AI-powered apps like Medisafe which creates personalized reminders, medication interaction warnings, refill alerts and progress reports. It also allows data sharing with caregivers. Other apps such as MyTherapy combine medication tracking with symptom journaling and activity logging.

As discussed above, AI is additionally becoming more prominent as a key tool in providing mental health care. AI-powered apps now offer a range of features from mood tracking and guided meditation to AI-driven therapy and connections to human therapists. These apps

leverage AI to provide personalized support, track progress and offer coping mechanisms for various mental health challenges. There has been resistance to wider utilization of AI chat-bots in the mental health area, but patient acceptance has improved, especially for those seeking remote support with a degree of confidentiality. [xxi]

Taken together, AI-powered virtual assistants are emerging as vital partners in modern health care, bridging critical gaps in access, understanding and adherence to medical guidance. By helping patients navigate symptom checking, strengthening informed consent, supporting medication management and even delivering mental health care, these tools empower individuals to take a more active role in their health while easing burdens on clinicians. As the technology continues to evolve, virtual assistants are poised to become an integral part of patient-centered care, improving outcomes, reducing costs and making health support more accessible and personalized than ever before.

7. Public Health and Population-Level Insights

As AI becomes more integrated into health care and understands broader societal data and trends, it is clear AI will become valuable for predicting and managing large-scale health issues.

- **Epidemic Prediction**: Models analyze mobility patterns, climate and historical data to forecast outbreaks.
- **Resource Allocation**: Predictive analytics guide distribution of medical resources.

AI-based epidemic prediction models are rapidly advancing and playing an increasingly vital role in public health by enhancing our capacity to anticipate and respond to outbreaks of disease and pandemic-scale events. The COVID-19 global pandemic provided an opportunity to demonstrate the advantages of AI-powered epidemiological models in predicting the rate of transmission of the virus and guide decision-making. [xxii] These models leverage diverse data sources, from traditional epidemiological records to real-time digital streams and genomic data, to provide insights that were previously unavailable or challenging to obtain with traditional epidemiological methods. These models discern the influence of factors, uncovering complex, non-linear relationships in the rate of infection, population density, human travel patterns and hospitalization rates utilizing real-time data.

AI helps create optimal intervention strategies that can be developed based upon scenarios and the manipulation of causal factors being fed into the models, offering policymakers valuable perspectives on the responses to their actions. AI-generated models aided in decisions of resource allocation, guided implementation of public health measures and ameliorated stress on health care systems during the outbreak of COVID-19. At the time, AI proved highly effective in disease cluster identification, disease diagnosis, monitoring patients, predicting mortality risk, contact tracing and resource allocation.[xxiii] AI is also able to predict patient inflows at clinics and hospitals, leading to better staffing plans, improving allocation and utilization of resources. Additionally, AI has demonstrated accuracy in developing patient triage protocols during pandemics.

In summary, AI-based epidemic prediction models can represent a transformative step forward in global health preparedness. By integrating vast and varied data streams with advanced analytics, these systems not only improve the speed and accuracy of outbreak detection but also strengthen the ability of health care systems to respond effectively under pressure. As future public health challenges emerge, AI will remain an indispensable tool for anticipating risks, optimizing interventions and ultimately safeguarding populations against the spread of infectious disease.

8. Medical Education and Health Professional Training

As AI tools become more ubiquitous across health care, AI must be integrated into medical school training and continuing education as well as becoming part of interdisciplinary collaboration between data science and engineering.

- **Medical School Training**: Integrating AI into medical school curricula is essential to preparing physicians for a rapidly evolving health care landscape.
- **Interdisciplinary Collaboration**: Physicians must interact with experts in AI, data science and engineering to serve their patients.
- **Continuing Education**: AI training must be provided to practicing health care professionals.

Integrating AI into medical school curricula is crucial to prepare future physicians for a rapidly evolving health care landscape where AI will play an increasingly prominent role and provide access to the latest medical science, along with an extensive volume of medical literature. This integration can take various forms, enhancing both the acquisition of foundational knowledge and the development of clinical skills.

AI has advanced at a rapid pace in medical sciences, storing, retrieving and analyzing medical data, permitting health professionals to allocate additional time and focus on patient counseling and treatment. Additionally, the technology allows medical students to interact with AI-generated virtual patients on a computer or within a virtual reality environment, boosting confidence and reducing anxiety when they interact with human patients. The AI system can respond to student questions and evaluate their performance based on established standards like the Objective Structured Clinical Examination (OSCE) assessment tool, offering real-time feedback and adapted scenarios.

By integrating AI into medical training, it is possible to provide a more individually customized learning environment and augment student teachings to improve individual performance. [xxvi] AI has demonstrated the ability to analyze students' learning progression and isolate specific domains where gaps exist in curriculum knowledge. Students are empowered to learn at a speed consistent with their innate abilities and inclinations based upon continuous and tailored feedback through AI-powered assessment. AI-powered tools can provide valuable opportunities for students to practice diagnostic reasoning and refine communication skills in a safe and interactive environment. Further, interdisciplinary learning will be essential, and collaboration must be encouraged between medical students and experts in AI, data science and engineering to tackle real-world health care challenges.

The inclusion of AI in the medical profession is improving but is in its early stages. Many clinicians have limited knowledge of how AI can be applied in their daily practice. This lack of awareness with AI restricts clinicians from harnessing this enormous power to improve patient health. This is not attributable to reluctance to become proficient in AI—the challenge stems from a dearth of educational opportunities for both students and practicing clinicians. Encouragement is found in a recent experimental investigation that evaluated the efficacy of an AI course designed for fourth-year medical students. The students averaged a score of 97%--a highly promising outcome. [xxvii]

As AI is more integrated in medicine, many routine tasks currently performed by health care workers will be automated, displacing some of the incumbents. This highlights the necessity of job reskilling to adapt to new roles in interacting with AI. More AI training must be made available to practicing health care professionals through continuing education. Specialized modules can be integrated into continuing medical education programs to introduce core AI and machine learning concepts. Formal courses, both online and in-person, offer structured learning experiences, covering topics like AI terminology, data analysis and the ethical considerations of AI in health care are required. Workshops and seminars provide firsthand training and opportunities for health care professionals to interact with experts and discuss real-world applications of AI. While AI will displace some jobs, it has the potential to create new occupational roles. [xxviii]

Conclusion:

Artificial intelligence is no longer a future prospect in health care but a present-day force shaping nearly every aspect of the field. From AI-powered wearables and remote monitoring tools that help patients manage chronic conditions, to virtual assistants that guide individuals through symptom checks, medication adherence and informed consent, AI is expanding the reach of care beyond the clinic. AI has the opportunity to enhance efficiency and accuracy, but just as importantly, it has the potential to empower patients with information and tools to take a more active role in their own health. Whether through preventing complications, expanding access to care or strengthening preparedness for future public health crises, AI is becoming a critical partner in advancing health outcomes. As adoption continues, its integration promises not only to modernize the delivery of care but to redefine the very relationship between patients, providers and the health care system itself.

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