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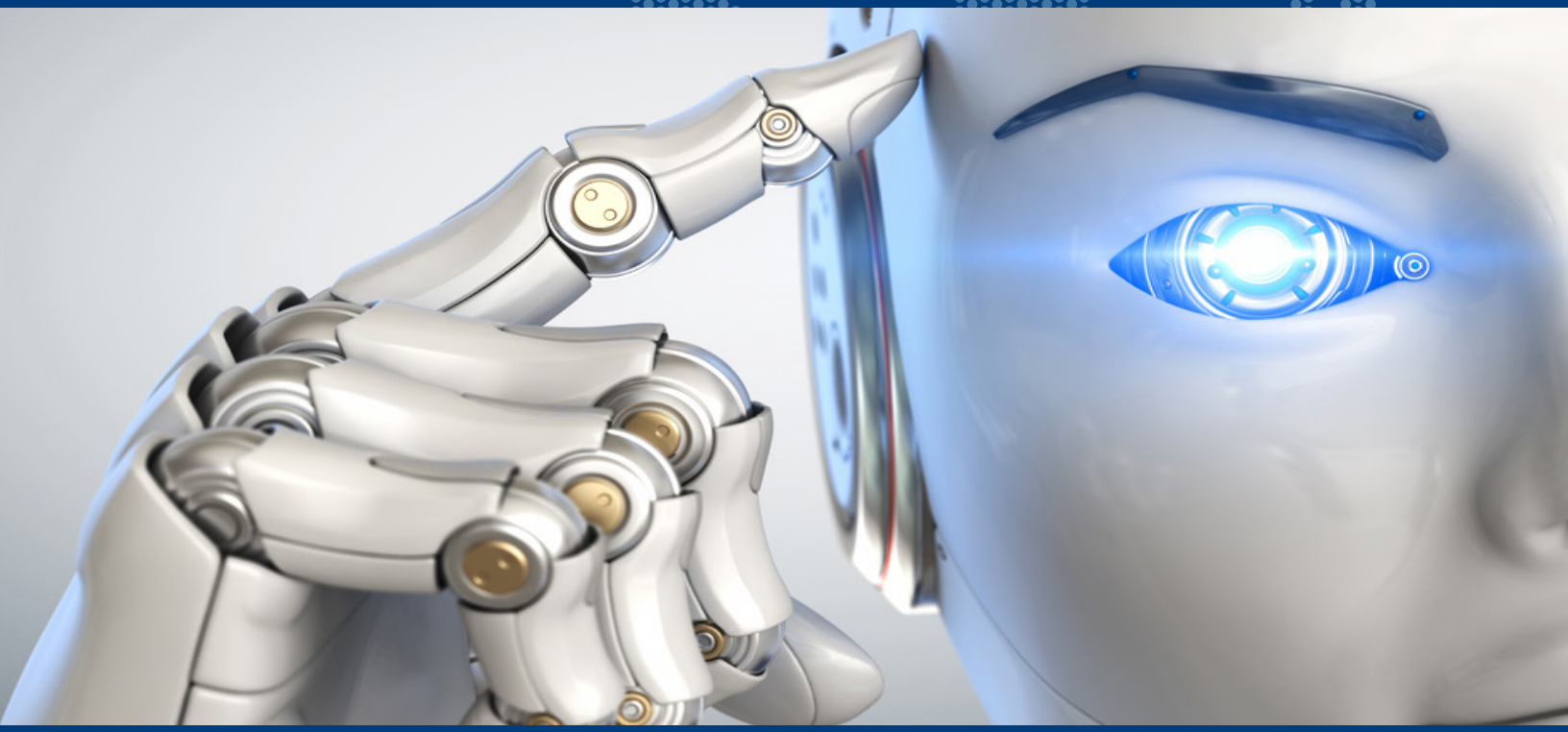

The Next Generation of Medicine: Artificial Intelligence and Machine Learning

TM Capital

Industry Spotlight

www.tmcapital.com/healthcare

Case Study: Growth Equity Capital Raise

Analytics 4 Life raised $25.6 million through the sale of Series B Convertible Preferred Stock

September 26, 2017

$25,600,000
Series B Convertible Preferred Stock

ANALYTICS 4 LIFE™

The undersigned served as financial advisor to Analytics for Life Inc. in connection with this transaction.

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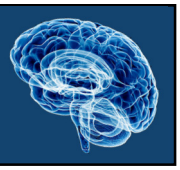
Analytics 4 Life, a Toronto-based developer of artificial intelligence-enabled medical imaging solutions, has raised $25.6 million through the sale of Series B Convertible Preferred Stock. Analytics 4 Life, led by former Sapheon, Inc. CEO Don Crawford, is focused on using artificial intelligence to improve, simplify and reduce the cost of diagnosing coronary artery disease ("CAD"), a $6 billion global market. The Company's non-invasive medical device, CorVista™, applies machine learned solutions to assess the presence of significant CAD, using physiological signals naturally emitted by the body. Beyond CAD, Analytics 4 Life has begun to apply its proprietary signal processing and artificial intelligence platform to developing new products that address other cardiac conditions and disease states in neurology and oncology.

TM Capital served as financial advisor to Analytics 4 Life in connection with this transaction. The Company plans to use the proceeds to complete the final stage of testing and apply for FDA approval. In addition, the financing will enable Analytics 4 Life to build the necessary team to bring this potentially transformative diagnostic solution to a wide audience of physicians and patients.


TM CAPITAL – DECADES OF HEALTHCARE ADVISORY EXPERTISE
$25,600,000
Series B Convertible Preferred Stock
ANALYTICS 4 LIFE™
GMD pharma solutions
a portfolio company of
HKW
has been acquired by
McKESSON
Fleet Laboratories
a portfolio company of
GRYPHON INVESTORS
has been acquired by
PrestigeBrands
Time-Cap Labs, Inc.
has been acquired by
Marksans Pharma Ltd.
Health Care in Safe Hands
Fleet Laboratories
has been acquired by
GRYPHON INVESTORS
Sapheon
has been acquired by
COVIDIEN
ESCHMANN
has been acquired by
STERIS
chs
Canadian Hospital Specialties ULC.
a portfolio company of
HKW
has been acquired by
CORTEC Group
TechHealth
Simplifying the Process of Care
has been acquired by
onecallcare MANAGEMENT
a portfolio company of
ODYSSEY INVESTMENT PARTNERS, LLC
SurpassMedical
has been acquired by
stryker
VENTION
Advancing your innovations for health
has acquired
ATEK MEDICAL
Quality. First, last, always.
VENTION
Advancing your innovations for health
has acquired
ansa med
precision devices
TechHealth
Simplifying the Process of Care
has completed a dividend recapitalization transaction
Chestnut Medical
has been acquired by
ev3
CRYOCATH
has been acquired by
Medtronic
IMMUCOR GAMMA
has acquired
BIOARRAY SOLUTIONS
FREEDOM INNOVATIONS
has completed a leveraged recapitalization led by
TELEGRAPH HILL PARTNERS
TAILWIND CAPITAL
EVerest Biomedical Instruments
has been acquired by
stryker
NanoGram corporation
has been acquired by
Greatbatch
epic therapeutics
has been acquired by
Baxter

Introduction

The AI industry – encompassing a broad set of information systems inspired by human learning and reasoning systems – is a $2.4 billion market that is expected to grow dramatically to over $59 billion by 2025. The Healthcare AI market, among the AI industry's fastest growing sub-sectors, is expected to grow at a 39.4% CAGR to over $10 billion in worldwide revenue by 2024.



Artificial Intelligence ("AI") applications, powered by an influx of big data and advancements in computing power, are positioned to transform major sectors, while simultaneously creating new industries. AI is expected to contribute up to $15.7 trillion to global GDP by 2030.[1]

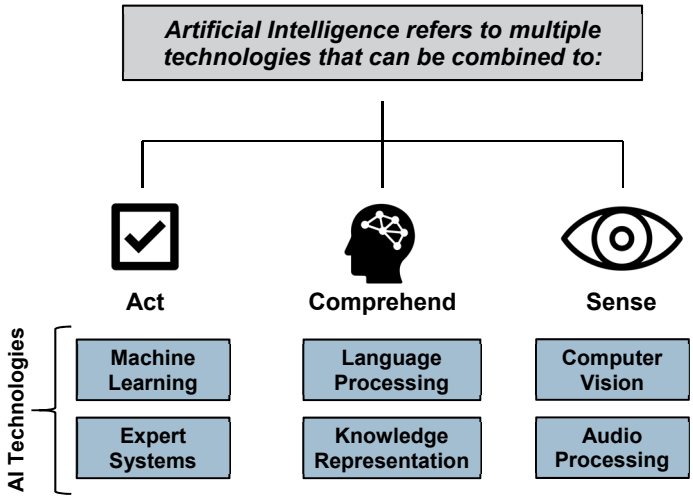
The AI industry has the capability to not only augment and improve, but also to replace many tasks that have been historically executed by humans. Simultaneously, AI will create many new jobs that are yet to be identified. According to the U.S. Department of Labor, "65% of the school children [in 2016] will be eventually employed in jobs that have yet to be created." New technologies and innovations in AI will transform most consumer, enterprise and government markets around the world. However, the commercial uses for AI applications are still nascent and ripe for investment. As such, the industry is attracting strong interest from a broad range of investors.

This report will review the important role that AI plays in healthcare, but first we will summarize the definition of AI and its evolution to date.

Defining Artificial Intelligence and Machine Learning

AI refers to multiple technologies that can be combined in different ways to sense, comprehend and act with the ability to learn from experience and adapt over time (See Figure 1). In basic terms, AI is a broad area of computer science that makes machines and computer programs capable of problem solving and learning, like a human brain. AI includes Natural Language Processing ("NLP") and translation, pattern recognition, visual perception and decision making. Machine Learning ("ML"), one of the most exciting areas of AI, involves the development of computational approaches to automatically make sense of data – this technology leverages the insight that learning is a dynamic process, made possible through examples and experiences as opposed to pre-defined rules. Like a human, a machine can retain information and becomes smarter over time. Unlike a human, a machine is not susceptible to sleep deprivation, distractions, information overload and short-term memory loss – that is where this powerful technology becomes exciting.

Figure 1: What is AI and ML?



Source: Accenture, "Why is AI The Future of Growth" (2016).

The Evolution of AI and ML

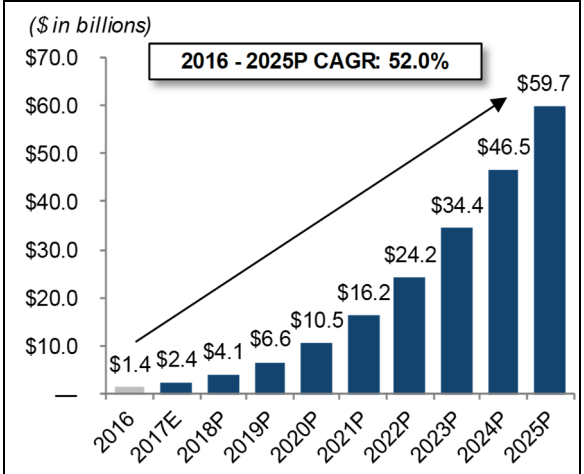
AI is not a new concept – in fact, much of its theoretical and technological underpinning was developed over the past 60 years. Although AI has been a part of our day-to-day lives for some time, this technology is at an inflection point, largely due to major recent advances in deep learning applications. Deep learning is a sub-set of ML that utilizes networks which are capable of unsupervised learning from data that is unstructured or unlabeled. The neural networks that underpin deep learning capabilities are becoming more efficient and accurate due to two significant recent technological advancements: an unprecedented access to big data and an increase in computing power. The effectiveness of neural networks correlates

[1] PwC, "AI to drive GDP gains of $15.7 trillion with productivity, personalisation improvements" (June 27, 2017)

to the amount of data available. With the influx of innovations such as mobile devices, more data is available than ever before, with annual data generation expected to grow at a 141% CAGR over the next five years.[2,3]

While some AI applications have been implemented across many industries, transformative commercial uses are still young. AI adoption outside of the tech sector is, in many cases, at an experimental stage. In McKinsey's survey of 3,000 AI-aware C-level executives, across 10 countries and 14 sectors, only 20% said they currently use any AI-related technology at scale or in a core part of their businesses. A review of more than 160 use cases shows that AI was deployed commercially in only 12% of cases.[4]

Figure 2: Worldwide AI Market Revenue



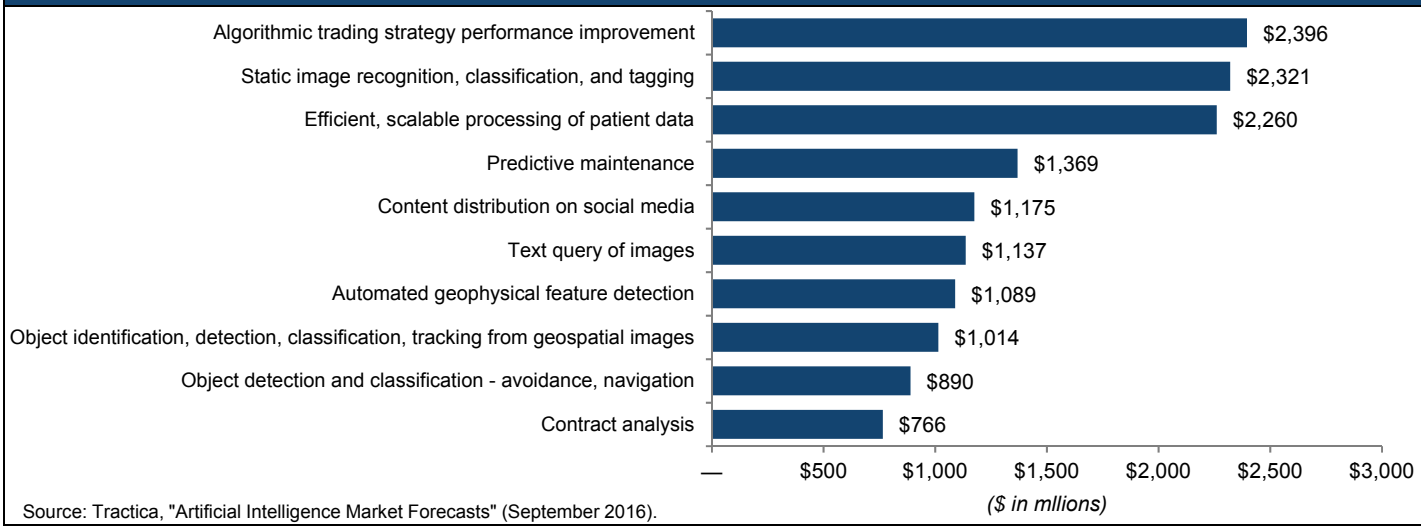
Source: Tractica, "Artificial Intelligence Market Forecasts" (May 2017)

Companies and financing sources with the resources to invest in AI are placing their bets on emerging AI companies and technologies, creating a catalyst for others to do the same or risk missing the boat on this opportunity. According to a study by Cowen and Company, 81% of IT leaders are currently investing or planning to invest in AI, while 43% are evaluating and pursuing proof of concept.[5] In 2016, despite a decline in venture capital funding across industries overall, AI startups raised a record $5 billion, a 71% CAGR since 2012.[6] Fueled by these significant investments, the worldwide AI market is expected to grow at a 52% CAGR to over $59 billion by 2025 (See Figure 2).

AI & ML Driving Industry Transformations

With applications in almost every industry, AI promises to significantly transform existing business models while simultaneously creating new ones. In financial services, for example, there are clear benefits from improved accuracy and speed in AI-optimized fraud-detection systems, forecast to be a $3B market in 2020.[4] In 2025, algorithmic trading strategy performance improvement and static image recognition, classification and tagging are predicted to be the top revenue-generating applications of AI across world markets (See Figure 3).

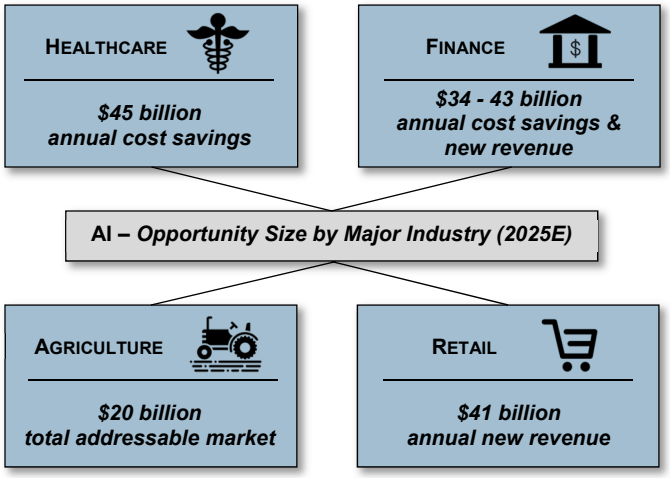
Figure 3: AI Revenue, Top 10 Use Cases, World Markets – 2025



Source: Tractica, "Artificial Intelligence Market Forecasts" (September 2016).

[2] IBM, "10 Key Marketing Trends for 2017" (2017)
[3] IDC, "The Digital Universe of Opportunities: Rich Data and the Increasing Value of the Internet of Things" (April 2014)
[4] McKinsey Global Institute, "Artificial Intelligence the Next Digital Frontier?" (June 2017)
[5] Forbes, "How Artificial Intelligence is Revolutionizing Enterprise Software in 2017" (June 2017)
[6] CB Insights, "The 2016 AI Recap: Startups See Record High In Deals and Funding" (January 2017)

Figure 4: Artificial Intelligence Ecosystem



Source: Goldman Sachs, "Profiles in Innovation: AI" (November 14, 2016).

AI's self-learning capabilities coupled with tools like data mining, pattern recognition and NLP will allow it to eventually mimic human-like behavior – developing common sense reasoning and opinions. The key advantages of AI over human intelligence are its scalability, longevity and continuous improvement capabilities. Such attributes are anticipated to dramatically increase productivity, lower costs and reduce human error. Although at a nascent stage, this technology is likely to introduce a new standard for corporate productivity, competitive advantage and, ultimately, economic growth.

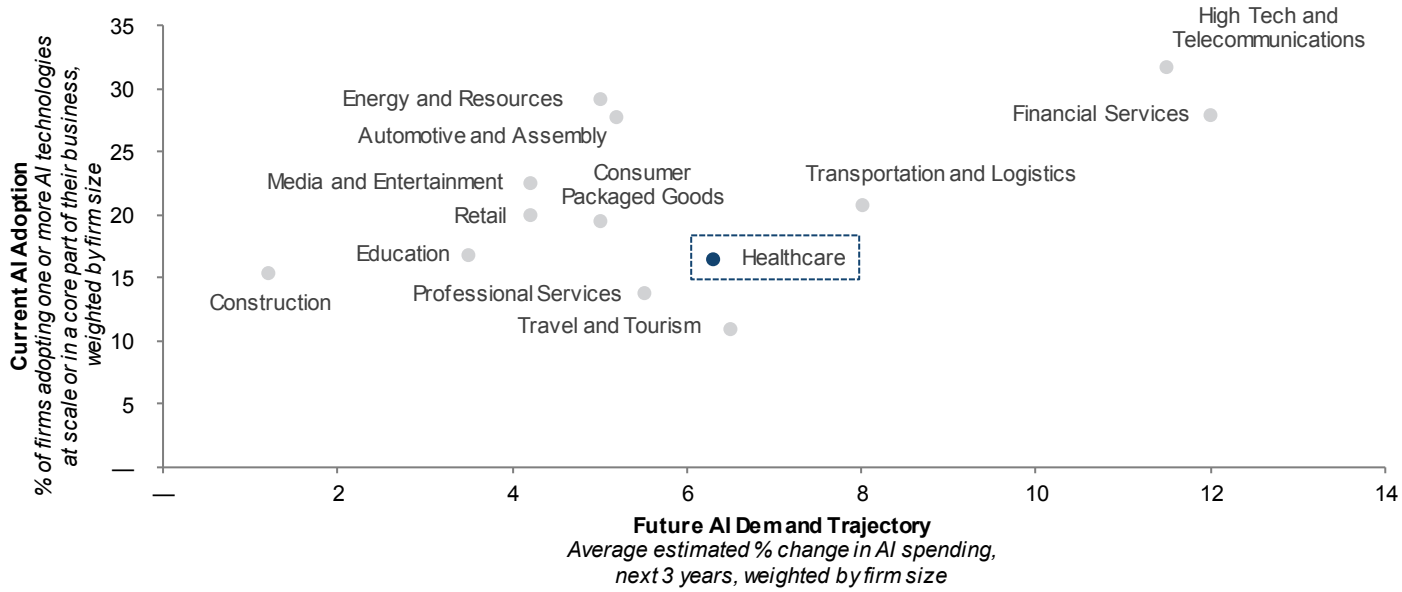
AI and ML applications have implications for disruption across every industry. The healthcare industry is expected to benefit from $45 billion in annual cost savings by 2025, followed closely by the finance industry's $34 to $43 billion in annual cost savings and new revenue and the retail industry's $41 billion in annual new revenue (See Figure 4).

AI in Healthcare

Evolution of AI in Healthcare

Healthcare is one of the largest and most rapidly growing segments of AI, driven predominantly by innovation in clinical research, robotic personal assistants and big data analytics.[7] Healthcare is poised to accelerate investments in AI over the next three years (See Figure 5). The influx of healthcare data has resulted in a growing need for AI technology to enhance data mining and computing capabilities. Personalized treatments are being bolstered by growing application of AI in the field of genomics and precision medicine. The emergence of new and promising applications for disease diagnosis and monitoring is anticipated to further drive AI market growth.

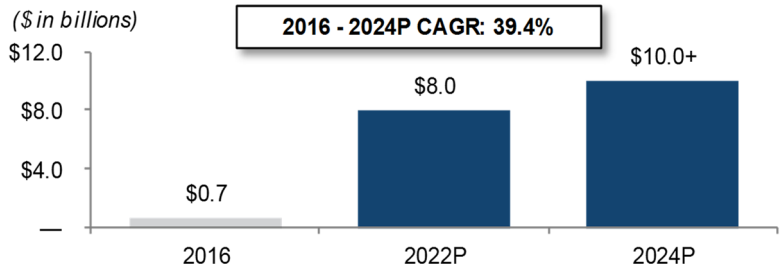
Figure 5: Sectors Leading in AI Adoption Technology Also Intend to Grow Investments Most Rapidly



Source: McKinsey Global Institute AI Adoption and Use Survey; McKinsey Global Institute Analysis

[7] Global Market Insights, "Healthcare AI Market Size, Competitive Market Share & Forecast, 2024" (2017)

Figure 6: Global Healthcare AI Market Growth Through 2024

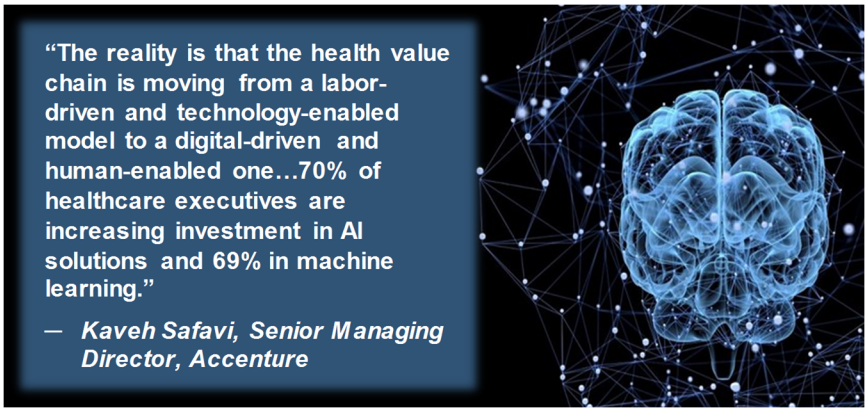


Source: Markets and Markets; Global Market Insights, Inc.

In the U.S., favorable government dynamics and the adoption of big data analytics continue to drive industry growth. The government seeks to reduce costs and improve quality of healthcare services with data analytics and AI initiatives. The U.S. healthcare AI market exceeded $320 million in 2016, and is estimated to grow by more than a 38% CAGR through 2024.[8] The global healthcare AI market is expected to grow at a 39.4% CAGR to over $10 billion by 2024 (See Figure 6).

Key Growth Drivers in the Healthcare AI Market

There is an increasing need for healthcare organizations to implement solutions that effectively improve treatment outcomes, manage rising costs and navigate through the demands confronting the sprawling healthcare system.[9] Startups are leveraging ML algorithms to help solve key problems such as reducing time and error costs in the drug discovery process, providing virtual assistance to patients and improving accuracy of diagnosis with medical imaging and diagnostic procedures.



The primary macroeconomic growth drivers of AI in healthcare include increasing individual healthcare expenses, a larger geriatric population and an imbalance between health workforce and patients (See Figure 7).[8,10] Global expenditures on healthcare increased to 9.9% of total GDP in 2014, up from 9.0% in 2000.[10] The US witnessed the highest expenditure on healthcare, 17.8% of total GDP, in 2015.[10] The world's population, aged 60 years and above, is likely to grow by 56% from 2015 to 2030.[10] The shift towards an aging population will strain the current healthcare system.[10] Because of these trends, the U.S. has a continuous shortage of nursing and technician staff. The number of vacancies for nurses will be 1.2 million by 2020.[10] AI is positioned to help medical practitioners efficiently achieve their tasks with minimal human intervention, a critical factor in meeting increasing patient demand.

Figure 7: Key Growth Drivers in the Healthcare AI Market

Industry Growth Drivers[8,10]
Adoption of AI in research areas
Increasing range of future applications
Reduced workload and increased quality of care
Growing demand for precision medicine
Growing number of cross-industry partnerships
Shortage of health workforce to meet patient demand
Need to reduce increasing healthcare costs

[8] Global Market Insights, "Healthcare AI Market Size, Competitive Market Share & Forecast, 2024" (2017)
[9] Managed Healthcare Executive, "Top 2017 Challenges Healthcare Executives Face" (December 8, 2016)
[10] Centers for Medicare and Medicaid Services, Office of the Actuary, National Health Statistics Group; US Department of Commerce, Bureau of Economic Analysis; and National Bureau of Economic Research Inc.

Key Adoption Challenges in the Healthcare AI Market

The investment marketplace's growing appetite for AI suggests strong expectations for this highly anticipated technology to produce exceptional breakthroughs in healthcare. However, this innovation continues to be challenged by inherent factors in the healthcare market, making the road to full AI integration difficult (See Figure 8). State and federal regulators are a key hurdle facing AI and ML integration, while regulators juggle the balancing act between the advantages and disadvantages of the technology. Data privacy regulation will likely be at the forefront of this battle.

Figure 8: Potential Challenges in the Healthcare AI Market

Industry Challenges[11,12]
High initial capital requirement
Potential for increased unemployment
Difficulty in deployment
Reluctance among medical practitioners to adopt AI
Ambiguous regulatory guidelines for medical software
Lack of curated healthcare data
Concerns regarding privacy and security
Lack of interoperability between AI solutions
State and Federal Regulations

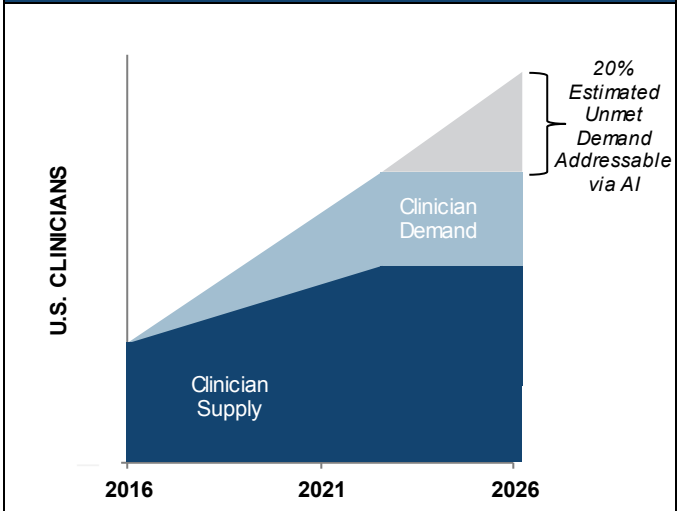
While AI's development costs, integration and the fear of replacing humans in the workplace are among key challenges for AI, one of the greatest concerns facing the industry is the response from regulators. Certificates of Need, risk-based capital requirements and burdensome reporting can create major barriers to new entrants and innovations.[13] Mobile health applications and devices that use AI pose a new regulatory challenge for the U.S. Food and Drug Administration (FDA). "We're trying to get people who have hands-on development experience with a product's full life cycle," says Bakul Patel, the FDA's associate director for digital health, "we already have some scientists who know AI and ML, but we want complementary people who can look forward and see how this technology will evolve."[14] To address this issue, the agency has formed a central digital health unit within its Center for Services and Radiological Health, assembling a team of engineers and computer scientists to help anticipate and oversee future developments in AI-driven medical software.[14] The team will be responsible for understanding how ML, AI and related subjects will affect healthcare in the U.S.[14] The new unit will also assure that the regulatory process can accommodate the rapid and iterative process of software updates commonly used to improve existing products and services.[14]

[11] Global Market Insights, "Healthcare AI Market Size, Competitive Market Share & Forecast, 2024" (2017)
[12] Markets and Markets, "Artificial Intelligence in Healthcare Market" (2017)
[13] Cardiogram, "Three Challenges for Artificial Intelligence in Medicine" (September 19, 2016)
[14] IEEE Spectrum, "FDA Assembles Team to Oversee AI Revolution in Health" (May 29, 2017)

AI's Role in the Changing Healthcare Job Market

There is little doubt that AI will change the healthcare job market, just as the advent of new technology reshaped the professional landscape during the Industrial Revolution. As large companies race to expand their AI capabilities, the prospect of AI's role within the healthcare industry raises a new question – will doctors and caregivers lose jobs to AI?

Figure 9: AI Will Address Unmet Clinical Demand



Source: Accenture Analysis. Graph is illustrative and not to scale

While these concerns are valid, AI companies, such as Infervision, that use deep learning and computer vision to diagnose cancers, market themselves as "An Extra Pair of Eyes." Infervision's CEO, Chen Kuan, insists the technology is "intended to eliminate much of the highly repetitive work and empower doctors to help them deliver faster and more accurate reports."[15] The reality of the situation, industry expert Sebastian Thrun (Stanford University's former director of the Artificial Intelligence Laboratory) notes, is that "deep-learning devices will not replace dermatologists and radiologists. They will augment the professionals, offering them expertise and assistance."[16] Robots and computer programs have already begun to replace personnel and staffing in medical facilities, particularly in administrative functions, by managing wait times and automating scheduling processes. With the physician shortage expected to double within the next nine years, AI can address an estimated 20% of unmet clinical demand by automating certain tasks and enhancing efficiency, quality and patient outcomes (See Figure 9).

Case Study: Tech Giant Investment in Healthcare AI Start-up

Tencent leads $155 million Series A investment in iCarbonX

iCarbonX 碳云智能

raised $155 million in series A funding round led by

Tencent 腾讯

Manage your life. Digitally

In June 2016, China-based Tencent Holdings (SEHK: 700), one of the largest internet and gaming companies in the world, led a $155 million series A funding round in iCarbonX, an AI-enabled health data mining start-up.

Founded in October 2015, iCarbonX has raised over $600 million at more than a $1 billion valuation, making it one of the youngest tech unicorns (start-up company valued over $1 billion). According to iCarbonX CEO Jun Wang, "after completing this round of funding, iCarbonX will develop the following four areas: nutrition, health, medical treatment and cosmetics." iCarbonX, using machine learning algorithms, analyzes genomic, physiological and behavioral data to provide customized health and medical advice directly to consumers through an app, Meum™. Released to the public in January 2017, the digital health management platform uses reams of health data to provide customized medical advice.

iCarbonX has formed alliances with leading health technology and application companies around the world which specialize in gathering different types of healthcare data. Together, these companies are working to help people better understand the medical, behavioral and environmental factors in their lives that may accelerate or mitigate disease and optimize health.

Tencent, like many tech giants, has taken a targeted interest in the healthcare AI space, investing in a number of health-related AI startups – including mobile medical device startup Scanadu, smart digital body fat scale company Picooc and Guahao, a medical services platform.

iCarbonX's "Digital Life Alliance"

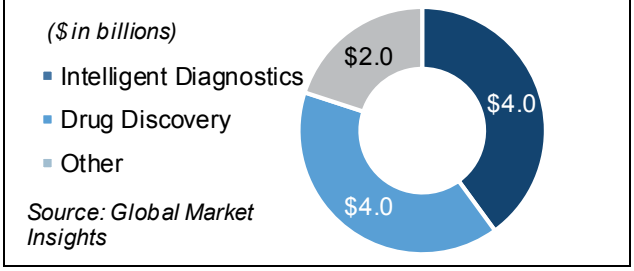
Robustnique
HealthTell
imagu
iCarbonX 碳云智能
SomaLogic
AOBIOME
patientslikeme

[15] Forbes, "See How Healthcare Artificial Intelligence Can Improve Medical Diagnosis and Healthcare" (May 16, 2017)
[16] The New Yorker, "A.I. Versus M.D." (April 2017)

AI Healthcare Industry Breakdown

AI and ML applications are driving improvements across five primary areas of healthcare: Intelligent Diagnostics, Patient Provider Data Management, Drug Discovery Process with Advanced Analytics, Medical Devices & Robotics, and Home Health (See Figure 11). Over the past five years, drug discovery has led the healthcare AI application market. Holding 35% of the global AI market share, drug discovery AI applications are anticipated to exceed $4 billion by 2024 (See Figure 10). Within this segment, AI capabilities to discover, identify and screen molecules instantly and effectively are becoming ever more effective. The table below depicts examples of AI companies within each of the key healthcare applications:

Figure 10: AI Healthcare Industry (2024)



Source: Global Market Insights

Figure 11: Key Healthcare Applications of AI

Healthcare Application	Representative Company	AI Technology Platform Overview	Use Cases and Key Benefit
Intelligent Diagnostics	ANALYTICS 4 LIFE™	▪ Analytics 4 Life is pioneering digital health using artificial intelligence to develop a completely new form of medical imaging. With an initial focus on coronary artery disease, Analytics 4 Life is advancing a novel, radiation-free, and exercise-free cardiac imaging technology aimed at improving existing care pathways ▪ By applying this platform to cardiac Phase Space Tomography Analysis ("cPSTA") data and paired coronary angiography (x-ray) results, Analytics 4 Life has developed its initial product focused on coronary artery disease ("CAD")	▪ Physicians can noninvasively assess the presence of significant CAD in a single office visit without radiation, exercise or pharmacological stressors using physiologic signals naturally emitted by the body ▪ Delivers an improved diagnostic solution previously available only through invasive, expensive tests, providing immediate and measurable benefits to patients, payors and providers
Patient and Provider Data Management	AYASDI	▪ Ayasdi offers a machine intelligence software platform, Topological Data Analysis ("TDA"), that enables organizations to analyze and build predictive models using big data or highly dimensional data sets ▪ The TDA platform draws on a range of machine learning, statistical and genomic algorithms to combine and synthesize them in accordance with the data	▪ Will allow healthcare providers and pharmaceutical companies to automatically stratify complex data and uncover relationships to optimize patient care paths, procedures, and protocols for personalized medicine, leading to faster and more effective outcomes
Drug Discovery Process with Advanced Analytics	Numerate	▪ Numerate uses its advanced, proprietary AI that can be applied to manage publicly and privately available noisy data ▪ Using its custom designed AI approach, Numerate has developed a technology that can model most important absorption, distribution, metabolism and excretion ("ADME") properties in the drug-development process	▪ Helps uncover valuable biology not easily translated by the traditional approaches enabling faster lead design and candidate identification while reducing development costs and attrition rates
Medical Devices & Robotics	VERB SURGICAL	▪ Verb Surgical has developed robotic-assisted surgical products with a platform that includes advanced imaging, robotics, big data management and machine learning to provide advanced surgical tools and capabilities to surgeons	▪ Expected to be only 20% the size of and considerably less expensive than current systems, while improving quality of precision and patient outcomes significantly ▪ Focus on improving and standardizing the outcomes in challenging procedures such as thoracic lobectomy, gastrectomy and low anterior resection
Home Health using Artificial Intelligence	Senscio Systems See what's ahead	▪ Senscio Systems uses artificial intelligence to contextualize data regarding a patient's health status and self-management behavior to provide early detection of potentially harmful health events ▪ At the core of its Ibis™ platform lies Scio™, an artificially intelligent "brain" which allows complex health management via a continuous five-step AI process including observing, learning, discovering, anticipating and prompting	▪ Significantly impacts health care quality and cost by improving self-management and enabling proactive interventions ▪ With Senscio Systems, up to 87% comply with their care plan versus a control 50% norm ▪ Significantly reduces acute care utilization

Intelligent Diagnostics

Approximately 12 million Americans are misdiagnosed in outpatient clinics annually.[17] In today's stringent healthcare compliance environment, practitioners face increasingly high stakes in events of misdiagnosis and mistreatment.

Patient medical history, genetic predispositions, treatment history and other factors converge in complicated ways that often make practitioners' jobs difficult. AI in healthcare aims to close the diagnosis veracity gap. AI-powered diagnostic systems are built with algorithms that can make sense of large sets of patient data, recognize patterns and spot relationships to ultimately arrive at a clinical decision. With the help of ML, the more data these technologies have access to, the smarter they become, leading to continually increasing capabilities, scalability, efficiency and accuracy. While early in development, AI's potential impact has already significantly influenced the imaging and diagnostics space. Research centers are now applying their expertise in AI and ML to improve diagnosis and treatment. Frost & Sullivan recently reported excellent treatment and patient outcomes quantified by the results of several studies exploring the impact of AI and ML as a decision support tool in diagnostics.[18]

Under the traditional pathway of diagnosis, practitioners are forced to make critical decisions solely based on their own ability to compare the visuals of thousands of medical images. Now, technologies like IBM's Watson are learning to recognize patterns in imaging and text in electronic health records to make accurate diagnosis of breast and cardiac specialties easily repeatable. As these systems continue to grow in penetration, harmful oversights and misdiagnoses will be minimized while patient treatment will be more easily streamlined and customized. With the presence of AI in the healthcare system, the scope of its impact will only expand – every type of medical specialty will be able to increase the accuracy of diagnosis with the assistance of such tools.[19]

Case Study: Intelligent Diagnosis Startups – Pathway Genomics, Bay Labs and Frenome

PATHWAY GENOMICS®

Area of Focus: Cancer Diagnostics

Pathway Genomics, founded in 2008, is a medical diagnostic company with mobile applications designed to empower physicians and patients to take control of their health and wellness. The Company, based in San Diego, offers genetic testing to support treatment of a variety of health conditions, including hereditary cancer, diabetes, hypertension, cardiac conditions, drug response and more.

In 2014, the Company announced its partnership with IBM Watson to help "deliver the first-ever cognitive consumer-facing app based on genetics from user's personal makeup." The mobile app, OME™, combines genetics, test results, health records and wearables with evidence-based and wellness knowledge to deliver to the user tailored and actionable recommendations for general health and fitness.

This venture capital-backed company has raised $45 million since its inception from investors, including IBM Watson Group and The Founders Fund.

BAYLABS

Area of Focus: Cardiac Diagnostics

Founded in 2013, Bay Labs, has developed software for the diagnosis of rheumatic heart disease using deep learning technology. The Company develops technology that simplifies the video recording, editing and sharing process, using intelligent video analysis and user modeling technologies.

Bay Labs' purpose is to assist practitioners in interpreting ultrasound images of the heart faster and more accurately. Bay Labs deploys AI software that, through repetition, is trained to comprehend the results of ultrasound images. This non-invasive solution can operate 20 times faster and reach eight times more people than traditional diagnostic scanning methods and costs 12.5% of the price.

Bay Labs is working with a network of world-class clinical and academic advisors as well as leading VC firms. The Company's partnerships include Allina Health, Minneapolis Heart Institute and the National Science Foundation. Bay Labs has raised over $7 million in VC-funding from Khosla Ventures and Data Collective, among others.

freenome

Area of Focus: Cancer Diagnostics

Freenome, a two year old liquid biopsy diagnosis platform, has developed a solution that applies ML for early-stage disease detection. The Company's goal, according to CEO Gabe Otte, is "to bring accurate, accessible and non-invasive disease screenings to doctors to proactively treat cancer and other diseases at their most manageable stages."

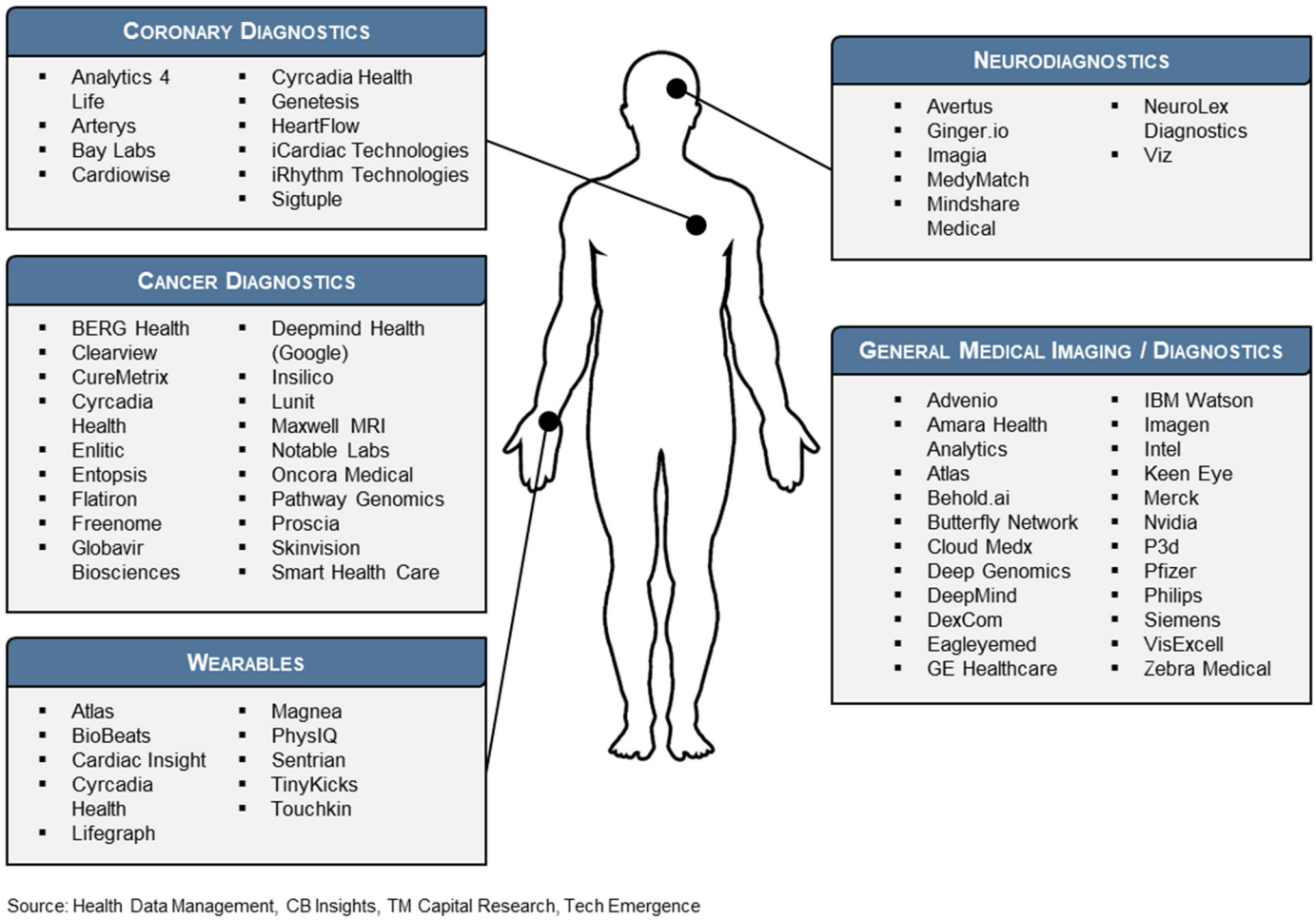
Freenome has garnered significant interest from some of the most active healthcare AI investors. The Company recently raised $65 million in Series A funding led by Andreessen Horowitz, the same VC firm that led Freenome's $5.5 million seed round less than a year ago. Other investors in the most recent financing include GV, Polaris Partners, Innovation Endeavors, Spectrum 28, Asset Management Ventures, Charles River Ventures and AME Cloud Ventures.

[17] CBS News, "12 Million Americans Misdiagnosed Each Year" (2014)
[18] Frost & Sullivan, "Transforming Healthcare Through Artificial Intelligence Systems" (2016)
[19] W3R, "How Artificial Intelligence in Healthcare Will Be a Game Changer" (January 30, 2017)

Dr. Joseph Reger, CTO of Fujitsu EMEIA said, "AI is now disrupting how businesses operate and will change the way that organizations create real value for the customer or patient. Industries can reap huge benefits by developing cooperative models that can quickly combine businesses needs with AI tech."[20] Research anticipates clinical support from AI has the potential to improve diagnostic outcomes by 30% to 40%, while reducing treatment costs by 50%.[21] By driving a significant improvement in misdiagnosis rates, AI systems have the potential to reduce hospital stays, unnecessary testing and health care costs, signifying a new era in medicine.

The imaging & diagnostics sector is among the most active areas in the healthcare AI industry. According to CB Insights, of the 50 healthcare AI-focused startups that have raised their first round of funding since January 2015, one third compete in the imaging & diagnostics space.[22] The market has seen AI and ML-enabled diagnostic technologies focusing on applications such as mental health, coronary disease, cancer and even patient wearables. The table below represents the landscape of companies, both established and start-ups, that have emerged in the healthcare AI diagnostics space:

Figure 12: Representative Healthcare AI Diagnostics Landscape



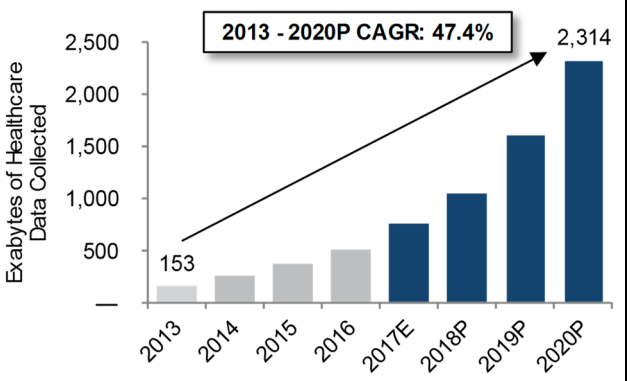
Source: Health Data Management, CB Insights, TM Capital Research, Tech Emergence

[20] Forbes, "See How Healthcare Artificial Intelligence Can Improve Medical Diagnosis and Healthcare" (May 16, 2017)
[21] Frost & Sullivan, "AI & Cognitive Computing Systems in Healthcare" (December 9, 2016)
[22] CB Insights, "AI in Healthcare Heatmap: From Diagnostics to Drug Discovery Startups, the Category Heats Up" (September 16, 2016)

Patient and Provider Data Management

The amount of "big data" available that can help drive AI applications across global healthcare organizations today is compounding and has reshaped the industry, permeating every component of the healthcare system. The global Electronic Health Records ("EHR") market size alone was estimated at around $21 billion in 2016.[23] Big data and emerging analytical solutions have grown exponentially in sophistication and adoption in the last decade as healthcare providers turned to EHRs, digitized laboratory slides, and high-resolution radiology images.

Figure 13: Global Healthcare Data Collected



Source: EMC and IDC.

In addition, a vast amount of data exists in health insurance company claims databases, pharmaceutical and academic research archives and data streaming from wearable sensors.[24] Although more data exists than ever before (See Figure 13), nearly 80% of health data is unstructured and difficult to comprehend.[25] Given that data continues to live in silos, providers are unable to effectively leverage this data to achieve actionable guidance and in many cases still struggle to understand how big data is so critical for population health management, value-based care, and other upcoming challenges. "There's no room anymore for inconsistent quality and inconsistent data," said Ann Chenoweth, MBA, RHIA, FAHIMA, President and Chair Elect of the 2017 AHIMA Board of Directors. Chenoweth points out that, "Trusted data must be reliable, accurate, and accessible, where and when it's needed. It's not the data that comes out of here versus the other system. It must be an enterprise-wide framework that you can rely on. Having that integrity and governance around the data is key."

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Improving the quality of care requires a broad base of data analysis and predictive analytics that can support clinical decision-making. As health data continues to become more accessible, significant opportunity exists for AI and ML to not only remove costs associated with procedural tasks but also improve care via deep learning and algorithmic programing. AI-powered platforms, such as CloudMedx, are now deploying healthcare specific NLP and ML technologies to generate real-time clinical insight with the goal of improving patient management, clinical outcomes and reducing unnecessary costs. CloudMedx combines evidence-based algorithms and big data architectures to make sense of the structured and unstructured data that are stored across multiple clinical workflows, allowing it to provide actionable guidance and improve value-based care.[26] As an example, the CloudMedx platform combines standard clinical algorithms with AI to capture social, economic and clinical factors that predict patient behavior and prompt interventions at appropriate times to avoid costly readmissions.

There is a need for tools that will allow healthcare organizations to understand how much data they have, how useful it is for advanced analytics and in which use cases the data can be leveraged. When searching for vendors offering data-driven solutions that address existing data challenges, providers will turn to products that are scalable, easily integrated into their existing infrastructure and maximize the value of historical data stores.[27] AI & ML-enabled technologies are estimated to be capable of driving efficiencies in healthcare information worth more than $28 billion per year globally.[28]

[23] Grand View Research, "Electronic Health Records Market Size" (April 2017)
[24] GE Healthcare, "Big Data, Analytics & AI: The Future of Health Care is Here" (2016)
[25] Healthcare Data Institute, "Big Unstructured Data's Contribution to Healthcare" (February 18, 2015)
[26] NewsCenter, "Software Startup CloudMedx Secures $4.2 Million" (August 15, 2017)
[27] Health IT Analytics, "How Healthcare Can Prep for Artificial Intelligence, Machine Learning" (2017)
[28] Goldman Sachs, "Profiles in Innovation: Artificial Intelligence" (November 14, 2016)

Drug Discovery Process with Advanced Analytics

The extensive drug development and approval process is a primary source of cost in a healthcare environment where pharmaceutical R&D spend is on the rise. Deloitte recently estimated R&D spend to reach $162 billion by 2020, a troubling estimation challenging the industry's balancing efforts between growing innovation and containing costs.[29] Furthermore, the inefficiencies in the current drug development process carries significant exposure to statistical error posing substantial financial risk for large pharmaceutical companies.

According to the California Biomedical Research Association, under the current methods of the drug development and approval process in the U.S., it takes an average of 12 years for a drug to travel from the research lab to the patient (See Figure 14). Only five in 5,000 (or 0.1%) of the drugs that begin pre-clinical testing ever make it to human testing and just one of these is ever approved for human usage. Furthermore, on average, it will cost a company $359 million to develop a new drug from the research lab to the patient. [30]

Figure 14: Drug Development Process in the United States

Drug research and discovery is a recent, but rapidly growing application for AI and ML in healthcare. These tools offer improved efficiency and accuracy at all stages of the discovery process.

Case Study: Big Pharma Investment in Healthcare AI Start-up

Roche leads $175 million Series C investment in Flatiron Health

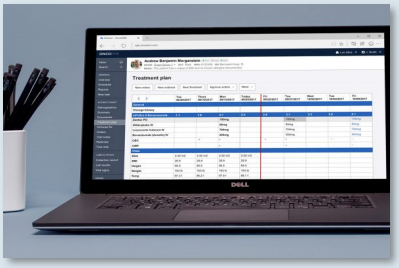
flatiron

raised $175 million in series C funding round led by

Roche

New York healthcare IT startup Flatiron Health, which is focused on accelerating cancer research and optimizing therapies based on patient data, completed a $175 million Series C financing in 2016, led by Roche Pharmaceuticals – Allen & Co. and Casdin Capital also participated in the round. Flatiron has raised $313 million in aggregate funding, including investments from GV and First Round Capital. The Company is taking a data driven approach to cancer, using machine learning to extract information from patients' electronic health records, which it then gathers into software solutions. Founded by former Google employees Nat Turner and Zac Weinberg, Flatiron plans to use this funding to further enhance its cloud-based software platform that will help cancer care providers maximize efficiency, identify revenue opportunities and better engage with patients.

In parallel with the financing round, Flatiron Health will enter into a non-exclusive agreement with Roche, in which the pharma giant will purchase a number of Flatiron's software products and collaborate on R&D to accelerate clinical trials, advance personalized medicine and enhance patient care. Roche, the world's largest biotech company and a leader in oncology diagnostics, plans to use Flatiron's data to bring new drugs to market faster, keeping its drug pipeline full of innovative new treatments. The deal highlights corporate investors' continued interest in artificial intelligence and willingness to provide financing to gain access to start-up expertise. Roche COO Daniel O'Day noted "Flatiron has tremendous data that helps us understand how medicine reacts to patients – this is a long-term strategic investment." Doctors treating more than 1.5 million cancer patients in the US – one in eight of all people diagnosed with cancer – use Flatiron Health's products; the Company believes that it can continue to transform how cancer centers, pharma companies and other healthcare professionals create faster treatments and pair patients with more effective regimens.



OncoEMR, Flatiron's electronic medical record product – optimizes clinical decision making and reduces costs

[29] Deloitte, "2016 Global Life Sciences Outlook" (2015)
[30] PwC, "What Doctor? Why AI and Robotics Will Define New Health" (June 2017)

AI and ML-driven technologies have begun to show their benefit across multiple labs worldwide. In February 2017, Boston-based startup BERG Health announced that their AI platform had selected a drug candidate for rare brain cancers that then entered clinical trials as a monotherapy (or a stand-alone treatment). BERG Health's AI-based Interrogative Biology Platform guided this drug candidate through an early development process by analyzing data from thousands of cancer patients to build an *in silico* (computer simulated) disease model and suggest possible drug treatments.[31] BERG Health's President and co-founder believes that this AI platform reduces the traditional platforms' cost and time in half, stating, "We've essentially reversed the scientific method…Instead of a preconceived hypothesis that leads us to do experiments and generate a particular type of data, we allowed the biological data from the patients to lead us to the hypothesis."[31]

A key differentiator between an AI-enabled and a traditional drug discovery process is that AI replaces the need for a human to make a hypothesis – AI enables the use of patient-derived data to generate hypotheses.[32] Researchers apply AI to the drug discovery process to investigate biological systems and understand a drug's effect on a patient's cell or tissue. The biological insight driven by ML can assist pharmaceutical companies to better identify and recruit patients for clinical trials of therapies for diseases to which they are highly susceptible, reducing attrition rates and increasing the probability of receiving FDA approval. The implications of AI & ML capabilities have been estimated to potentially provide the pharmaceutical industry with nearly $27 billion in development cost savings globally by 2025.[33] Taking full advantage of this revolution, a multitude of the most notable names in the pharmaceutical landscape have begun investing in these disruptive, AI & ML-enabled drug discovery technologies.

Established Pharmaceutical Companies Partnering with Niche Players in the Healthcare AI Market

In December 2016, IBM announced that Pfizer would be one of the first organizations to utilize the "Watson for Drug Discovery" cloud-based platform to help accelerate Pfizer's research in immuno-oncology, an approach to cancer treatment that uses the body's immune system to help fight cancer.

IBM Watson is an AI cloud-based system capable of processing high volumes of data and offers evidence-based answers to questions posed in natural language. The collaboration targets cancer therapies and aims to "help life sciences researchers discover new drug targets and alternative drug indications." Pfizer will be among the first to leverage Watson's cloud-based cognitive tool composed of machine learning, natural language processing (NLP) and other cognitive reasoning technologies to support the identification of new drug targets, combinations of therapies for study and patient selection strategies in immuno-oncology.

According to Mikael Dolsten, President of Pfizer Worldwide Research & Development, "Pfizer remains committed to staying at the forefront of immuno-oncology research…With the incredible volume of data and literature available in this complex field, we believe that tapping into advanced technologies can help our scientific experts more rapidly identify novel combinations of immune-modulating agents. We are hopeful that by leveraging Watson's cognitive capabilities in our drug discovery efforts, we will be able to bring promising new immuno-oncology therapeutics to patients more quickly."

GlaxoSmithKline ("GSK") announced a $43 million deal with UK-based AI firm Exscientia to enhance its drug discovery process. Exscientia will apply its AI-enabled drug discovery platform, in combination with GSK's expertise, to discover selective small molecules for up to ten disease-related targets, identified by GSK, across multiple therapeutic areas.

GSK also partnered with IBM Watson to use artificial intelligence to market its Theraflu® cold and flu medication. Watson's AI-powered technology, Watson Ads, enables customers to engage with the company's advertisements by empowering people to ask questions via voice or text right through GSK's online ads.

Tony Wood, Pfizer's previous Senior Vice President of Medicinal Sciences, has been appointed Senior Vice President, Platform Technology and Science, Pharma R&D at GSK – Wood is expected to assume his position in October 2017. Wood will take over for John Baldoni, who will lead a new team focused on "enhancing drug discovery through the use of in silico technology — including artificial intelligence, machine learning and deep learning."

In June 2017, Genentech, a member of the Roche group, announced a collaboration with GNS Healthcare, a precision medicine company focused on cancer therapy. The companies aim to use machine learning to convert high volumes of cancer patient data into computer models that can be used to identify novel targets for cancer therapy.

In December 2014, Roche acquired Bina Technologies, a biotech company targeting the personalized medicine sector by providing a platform for large-scale genome sequencing.

In addition, Roche is among a handful of initial pharmaceutical partners for BERG Health, a Boston-based startup company focused on applying AI drug development and discovery and healthcare diagnostics.

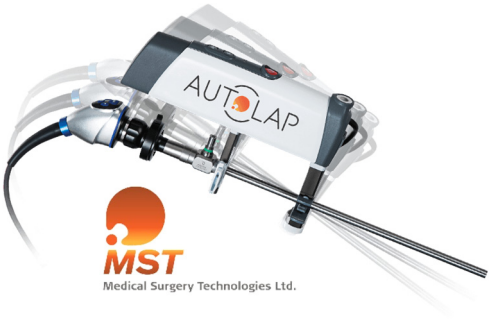
[31] Wired, "The Startup Fighting Cancer with AI" (March 22, 2016)
[32] Wall Street Journal, "How AI is Transforming Drug Creation" (June 25, 2017)
[33] Harvard University, "Make the FDA Great Again? Trump and the Future of Drug Approval" (March 22, 2017)

Medical Devices & Robotics

A vast opportunity exists for AI to transform the field of surgical robotics through devices that can perform semi-automated surgical tasks with increasing efficiency. Robotics have already proven their effectiveness in helping hospitals save costs, reduce waste, and improve patient care. It is estimated that the market for healthcare robotics will grow at a 21% 5-year CAGR to $12.8 billion by 2021, with surgical robots comprising the largest component.[34] AI and ML applications can transform surgical robots from programmable machines, as they currently exist, into smart assistants. Robotics outcomes have been shown to decrease a patient's length of stay by nearly 21% and, when combined with AI & ML capabilities, are poised to enhance the effectiveness, safety, consistency and accessibility of surgical techniques.[35]

Recent advances in sensors, combined with AI and ML, are paving the way for real-world applications of intelligent robotics in medicine. Surgery is transitioning into a digitized era and cutting-edge technology companies are working to stay at the forefront. In 2015, Google's Verily Life Sciences partnered with Johnson & Johnson's ("J&J") Ethicon, a medical device company, to further advance medical robotics. The newly formed joint venture, Verb Surgical, leverages Ethicon's expertise in surgical instrumentation and Google's capabilities across machine vision, imaging analysis, and data analytics.[36] Google and J&J aim to complement surgeons' abilities, using AI, by enabling identification of critical body structures which, in many cases, are undetectable by a screen on the tissue level.[37]

In Q1 2017, Verb Surgical announced it successfully created its first digital surgery prototype, featuring five core technology elements including robotics, visualization, advanced instrumentation, data analytics, and connectivity. Gary Pruden, Executive VP and Worldwide Chairman of Medical Devices at J&J, added, "The team has made important progress since Verb was formed in August 2015. The digitally-enabled surgery platform is a great example of how healthcare can be transformed through innovation."[36]



Founded in Caesarea, Israel, Medical Surgical Technologies ("MST"), is also at the apex of deploying intelligent medical robotics powered by AI and advanced analytics. MST's initial offering, AutoLap™, is an image-guided robotic laparoscope positioning system used across general laparoscopic, gynecologic, and urologic procedures. At the core of MST's AutoLap™ lies an imaging-analysis software which allows the laparoscope positioning system to provide real-time guidance, thus stabilizing the surgeon's motions during an operation. From an economic standpoint, AutoLap is cost-effective; significant training is not required and the system can integrate seamlessly with current standard surgical solutions.[38]

How does it work? In the operating room, the surgeon wears a wireless ring-shaped device that interacts with the AutoLap system. The embedded proprietary software collects and analyzes visual data and maneuvers the laparoscope in line with the surgeon's actions during the procedure.[39]

MST's advanced software, Follow Me™, received FDA clearance in 2016. In an interview with ISRAEL21c, MST CEO Motti Frimer stated, "We are addressing a real need in computer-assisted robotic surgery, because most robotics must be commanded by joysticks or other devices while the MST image-analysis platform responds to the surgeon's actions. We aim to be the gold standard for all laparoscopic surgery, and also hope to expand MST's image-based AI technology into additional medical robot and computer-assisted surgical domains."

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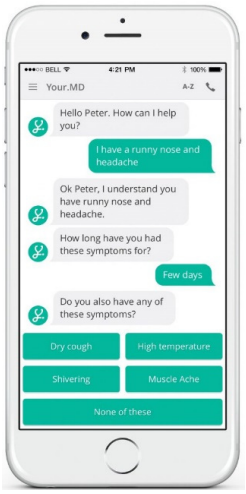
[34] Markets and Markets, "Medical Robots Market Worth 12.80 Billion USD by 2021" (2017)
[35] Accenture, "Artificial Intellignece: Healthcare's New Nervous System" (2017)
[36] Med Device Online, "J&J-Google Joint Ventue Verb Surgical Unveils Digital Surgery Prototype To Partners" (2017)
[37] Johnson & Johnson, "Johnson & Johnson Announces Definitive Agreement To Collaborate With Google To Advance Surgical Robotics"
[38] ISRAEL21c, "7 Israeli robots that are transforming surgery"
[39] MST Medical Surgery Technologies Ltc., Company Website

Home Health using Artificial Intelligence

In addition to the operating room, AI improvements to robotics can transform the home health and end-of-life care sector. Advances in NLP and social awareness algorithms have already begun to make social robots dramatically more useful to consumers as companions or personal assistants. In an industry characterized by increased demand from aging populations and a deficit of care workers, the global personal robot market, including smart "care-bots", is expected to grow to $17.4 billion by 2020. By providing AI and robotic-driven solutions, the private sector can redefine the way healthcare is delivered.[40]



Recently developed AI-enabled home care solutions can remotely assess patient symptoms and alert clinicians when patient care is needed. Such home solutions can reduce needless hospital visits, thus reducing the burden on practitioners and associated healthcare costs. For example, Accenture estimates that such solutions can save 20% of Registered Nurse (RN) time. With the ability to learn consistently, virtual assistants will eventually be capable of patient diagnosis, and will grow into experts.[41]

Your.MD, a healthcare startup, is using AI to bring a physician to the patient's home. Your.MD has developed an advanced medical data model capable of linking probabilities between patient symptoms and conditions. Its innovative Chatbot deploys machine-learning algorithms and NLP to communicate with patients directly and deliver health advice based on symptoms. A substantial medical vocabulary library helps Your.MD identify the patient's symptoms. The Chatbot personalizes questions based on patient variables such as age and gender, to offer suggestions or connect the patient to a physician where necessary. ML-enabled, Chatbot can learn and improve its informational diagnosis capabilities from each patient case.[42]

LifeGraph, another cutting-edge startup in the AI space, is making an impact on the health and lives of individuals every day. LifeGraph has developed a clinically proven, smart-phone based behavioral monitoring solution servicing patients suffering from behavioral illnesses. LifeGraph leverages built-in smart-phone sensors to track patients' sleep, motion, and vocal attributes. Through machine-learning algorithms, LifeGraph is capable of detecting real-time changes in a patient's clinical behavior two to four weeks prior to the occurrence of a mental health episode. LifeGraph's continuous monitoring abilities have the potential to prevent hospitalization and significantly improve patient medication management.[43]

How does it work? A patient can download the application and allow the application to operate passively on the smart-phone device, without external interference. If abnormalities are detected in the patient's day-to-day behavior, which could be identified by a change in the pitch of a patient's voice or the patient's travel patterns, an alert log is displayed through a dashboard, delivering information and warning signs. ML algorithms adapt to the patient and send necessary alerts to the doctor when a patient exhibits out of the ordinary behavior. The application provides objective information, previously revealed only after deterioration and hospitalization have occurred.[43]

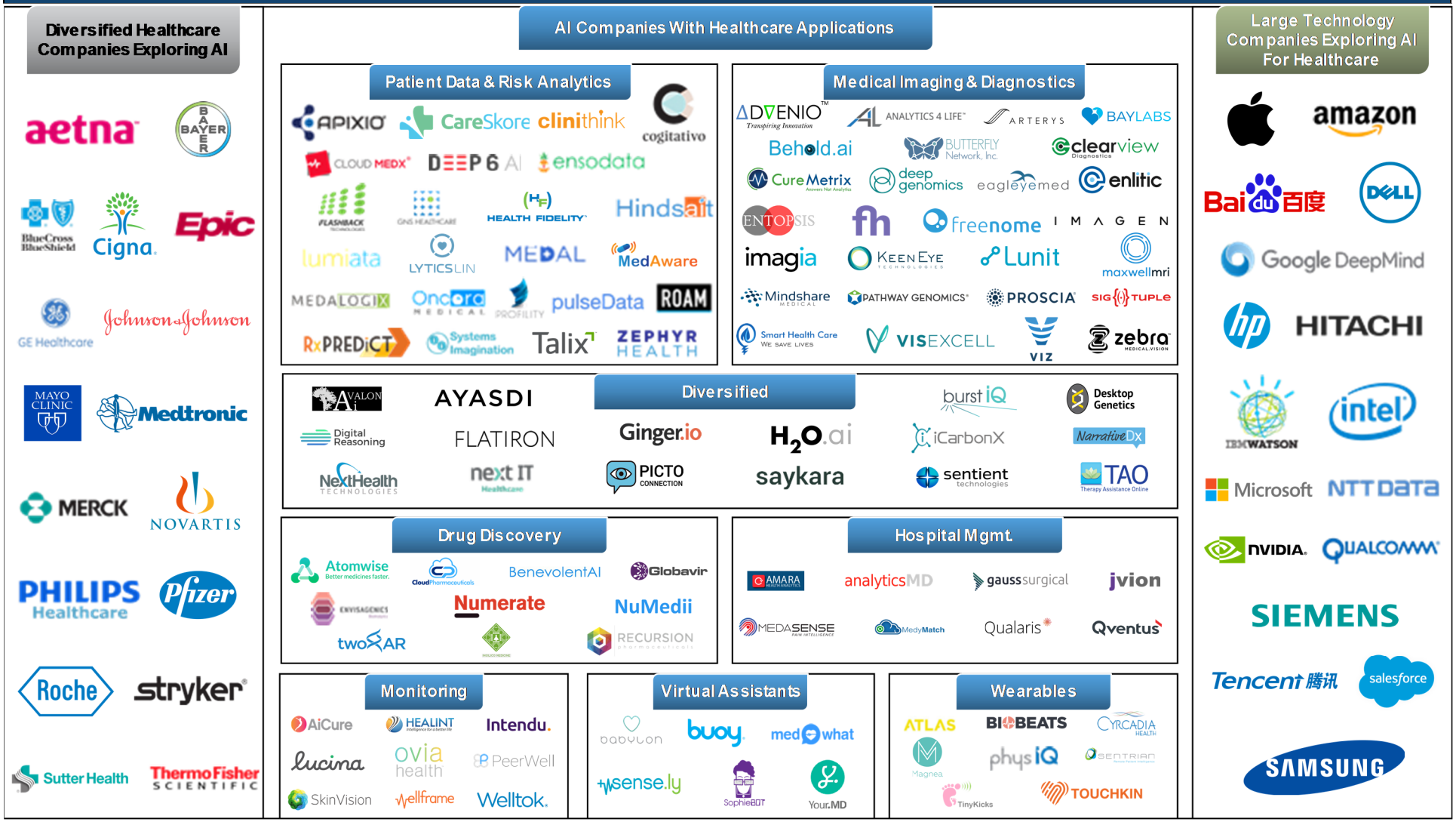
AI-enabled technologies with ML capabilities, such as LifeGraph, hold significant potential to improve health and provide accurate information to practitioners. In addition, such tools have potential to substantially increase patient compliance with necessary treatments, reduce hospitalization rates and, ultimately, enhance the quality of a patient lives.

[40] Capital Group "The Long View: Investment Insights" (2017)
[41] Accenture, "Artificial Intellignece: Healthcare's New Nervous System" (2017)
[42] Digital Trends, "The Chatbot Will See You Now: AI May Play Doctor in the Future of Healthcare" (2016)
[43] CNBC, "How your smartphone could predict and prevent your next nervous breakdown" (2016)

AI and ML Healthcare Applications Industry Landscape

The AI and ML Healthcare market is highly fragmented and characterized by three major categories of companies: 1) diversified healthcare corporations increasingly developing AI capabilities, 2) technology giants exploring AI applications in multiple industries and 3) AI-focused startups (See Figure 15). Large technology and healthcare corporations are investing in niche AI startups, whose specialized expertise and concentrated talent pool drives substantial scarcity value – in 2016, corporate participation in financing increased 3x compared to 2013. The table below depicts the major players currently competing and collaborating in the industry:

Figure 15: Representative Healthcare Artificial Intelligence Industry Landscape



Financing Activity & Key Partnerships

Venture Capital Activity

AI is among the most active areas for venture capital (VC) activity – 2016 gave rise to ~$5 billion in disclosed AI financing, across a variety of industries, in over 700 deals.[44] Healthcare AI companies have been the leading recipients of investments since 2012. Healthcare AI VC deal volume and funding hit a 5 year high in 2016, with $794 million in investments across 90 deals in the Healthcare AI space.[44] Figure 16 shows some of the most active VC investors:

Figure 16: Active Venture Capital Investors in Healthcare AI

VC Firm	ACCEL PARTNERS	ANDREESSEN HOROWITZ	DCVC Data Collective	General Catalyst Partners	khosla ventures
Selected Healthcare AI Investments	▪ KRY ▪ SigTuple	▪ Accolade ▪ BioAge Labs ▪ Freenome ▪ Q Bio ▪ TwoXAR	▪ Atomwise ▪ Bay Labs ▪ Freenome ▪ Element AI ▪ Enilitic	▪ OM1 ▪ Reverie Labs ▪ Spring Health	▪ Atomwise ▪ Bay Labs ▪ Ginger.io ▪ Lumiata ▪ Zebra Medical

Corporate Investment

In addition to financial investors, large technology and healthcare corporations are increasingly turning to targeted investments in AI startups to augment and propel internal corporate investment and development initiatives. Figure 17 depicts some of the most active corporate investors in the healthcare AI space:

Figure 17: Active Corporate Investors in Healthcare AI

Corporate Investor	BlueCross BlueShield Venture Partners	GE VENTURES	GV (Google Ventures)	IBM Watson	QUALCOMM VENTURES	Tencent 腾讯
Selected Healthcare AI Investments	▪ Lumiata ▪ Picwell	▪ Arterys ▪ Health Reveal ▪ MedAware	▪ Flatiron Health ▪ Freenome ▪ Predilytics ▪ Zephyr Health	▪ Merge ▪ Truven Health ▪ Pathway Gen. ▪ Welltok	▪ Predilytics ▪ Welltok	▪ CloudMedX ▪ iCarbonX

Strategic Partnerships

To adapt to a rapidly changing healthcare environment, large traditional healthcare players are joining forces with some of the largest technology companies through nontraditional partnerships and strategic alliances. Such relationships are mutually beneficial – providing technology companies with the data points and research they need to drive continued innovation within AI applications for healthcare, while concurrently improving efficiency and patient outcomes for healthcare companies and institutions. Figure 18 depicts some of these key partnerships / alliances:

Figure 18: Strategic AI Partnerships – Technology & Healthcare Companies Working in Unison

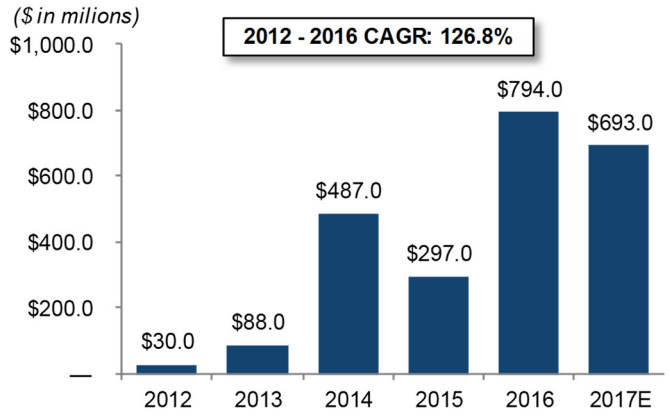
Partnership	MedyMatch + IBM Watson	GE Healthcare + Partners HealthCare	Microsoft + Knight Cancer Institute (Oregon Health & Science University)	Google DeepMind + NHS	Philips + PathAI	Nuance + Epic
Purpose	*Detect intracranial bleeding resulting from head trauma and stroke*	*Develop and integrate deep learning technology*	*Predict the most effective cancer drug treatment options*	*Speed up response times for treating kidney issues*	*Improve precision and accuracy of cancer diagnosis*	*Deliver computer-assisted physician documentation capabilities*

[44] CB Insights, "The State of Artificial Intelligence." (2017)

Healthcare AI Financing Activity

AI-focused healthcare and wellness startups are projected to raise over $690 million from venture capital firms in 2017, a modest decline from 2016 (See Figure 19).[45] Early stage financings continue to dominate the deal landscape – Seed and Series A financings have accounted for over 50% of the deal share from 2012 to 2014 and over 60% of deals in the space since 2015.[45] About 73% of financings since 2012 have involved United States based AI companies, followed by the United Kingdom (9.3%) and Israel (3.7%) – several investments have also included companies based in China, Canada and India.[46] Total investment in healthcare AI reached an all-time high in 2016; top financing rounds went to unicorn companies Flatiron Health ($175 million in Series C) and iCarbonX ($154 million in Series A), each valued at over one billion dollars.[46] The table below provides a summary of financing activity within the healthcare AI space in the twelve-month period ended September 2017:

Figure 19: VC Funding for Healthcare AI



Source: CB Insights, August 2017.

Selected Healthcare Artificial Intelligence Company Financing Activity (October 2016 through September 2017)

($ in millions)

Date Closed	Company	Deal Type	Investor	Company Description	Investment Amount
9/28/2017	VoxelCloud	Early Stage VC	Sequoia Capital; Tencent; United Capital Investment	Provides automated medical image analysis services and diagnosis assistance platform	$15.0
9/27/2017	Cardinal Analytx	Series A	Led by Cardinal Partners	Provides healthcare analytical services intended to predict healthcare spending	$6.1
9/26/2017	Analytics for Life, Inc.	Series B	Accredited Investors	Develops radiation-free cardiac imaging technology for coronary artery disease diagnosis	$25.6
9/21/2017	Precision Health Intelligence	Series A	SymphonyAI	Develops a platform designed to apply artificial intelligence into Oncology	$20.0
9/21/2017	Cogitativo	Series A	Health Care Service Corporation	Provides a data science as service platform dedicated to improving healthcare operations	$5.0
9/19/2017	Siris Medical	Series A1	California Institute for Quantitative Biosciences & DigiTx Partners	Develops an artificial intelligence treatment decision support system in radiation therapy	$4.0
9/12/2017	Ieso Digital Health	Later Stage VC	Ananda Ventures; Draper Esprit; Touchstone Innovations	Develops a digital mental health delivery platform designed to transform mental health delivery	$23.9
9/7/2017	Sophia Genetics	Accelerator / Incubator	Microsoft Accelerator	Develops a clinical genomics analysis platform designed to perform routine diagnostic testing	—
9/7/2017	WuXi NextCODE Genomics	Series B	Led by Temasek Holdings and Yunfeng Capital	Provides a global genomics platform created to provide genomic sequence data	$240.0
9/5/2017	Aifloo	Series A	EQT Ventures	Develops an e-health system designed to detect health problems	$6.1
8/21/2017	GNS Healthcare, Inc.	Growth	Not Disclosed	Provides analytics solutions for the healthcare industry	$6.0
8/16/2017	MedAware Ltd	Series A	Becton, Dickinson and Company; OurCrowd Ltd.; Gefen Capital	Develops solutions to detect and eliminate prescription errors	$8.0
8/14/2017	Freenome Inc.	Series A	Led by Andreessen Horowitz LLC	Develops a genomic thermometer	$72.0
7/28/2017	BioAge Labs, Inc.	Series A	Led by Andreessen Horowitz LLC	Develops a machine learning powered platform to measure human aging and accelerate drug discovery	$10.9
7/28/2017	Miew	Growth	Not Disclosed	Develops artificial intelligence and software for the medical industry	$1.4
7/27/2017	CloudMedx Inc.	Venture	Not Disclosed	Provides cloud-based predictive health analytics and care coordination platform	—
7/17/2017	Synaptive Medical Inc.	Growth	18 Investors	Develops solutions that combine informatics, imaging, surgical planning, navigation and advanced optics	$14.2

[45] CB Insights, "Up and Up: Healthcare AI Startups See Record Deals." (August 22, 2017)
[46] CB Insights, "The State of Artificial Intelligence." (2017)

Selected Healthcare Artificial Intelligence Company Financing Activity (October 2016 through September 2017)

($ in millions)

Date Closed	Company	Deal Type	Investor	Company Description	Investment Amount
7/14/2017	Imsight Medical Technology Co. Ltd.	Series A	Lenovo Capital and Incubator Group	Develops artificial intelligence assisted medical imaging analysis tools	$3.0
7/3/2017	Mendel Health Inc.	Seed	DCM; LaunchCapital LLC; BootstrapLabs	Develops a technology to architect intricate clinical trial matching service	$2.0
6/23/2017	Nimblr, Inc.	Seed	Ideas & Capital and On Ventures	Develops an artificial intelligence powered software assistant that manages healthcare appointments	$0.8
6/14/2017	Element AI Inc.	Series A	Led by Data Collective	Operates platform that helps organizations identify opportunities to use AI and ML	$102.0
6/8/2017	Multiplier Solutions Pvt. Ltd.	Venture	Norwest Venture Partners	Develops a data analysis platform for the healthcare industry	$1.5
6/1/2017	Aidence B.V.	Seed	Northzone Ventures; HenQ Capital Partners; Health Innovations	Develops and delivers a platform for radiologists that detects and classifies disorders on multiple imaging modalities	$2.5
6/1/2017	Medwhat.com, Inc.	Venture	Not Disclosed	Develops virtual medical assistant application	$2.6
5/24/2017	VoxelCloud Inc.	Series A	Sequoia Capital	Develops cloud computing and artificial intelligence solutions to assist with interpreting medical images and clinical data	$10.0
5/24/2017	Insight Rx, Inc.	Venture	GreatPoint Ventures; OSF Ventures	Operates a cloud-based platform that applies quantitative pharmacology and machine learning to improve patient care	$3.3
5/17/2017	Oncora Medical, Inc.	Venture	Ben Franklin Technology Partners	Develops an analytics platform that helps radiation oncologists to use data to provide the care for cancer patients	—
5/11/2017	Guardant Health Inc.	Series E	Led by SoftBank Capital	Provides sequencing and rare-cell diagnostics services focusing on cancer	$360.0
5/9/2017	Edico Genome Inc.	Series B	Led by Dell Technologies Capital	Develops bioinformatics processor chip that helps in DNA analysis	$22.0
5/9/2017	Viz	Seed	Led by DHVC	Operates as an AI medical imaging company that helps optimize emergency treatment	$7.5
4/26/2017	GRAIL, Inc.	Series B	Led by Arch Venture Partners	Develops a blood screening test for early cancer detection	$973.2
4/25/2017	AltheaDx, Inc.	Series D	Not Disclosed	Operates as a molecular diagnostics company for pharmacogenetics (PGx) in the United States	$27.0
4/25/2017	Babylon Healthcare Services Limited	Venture	Not Disclosed	Operates a subscription based mobile healthcare application	$60.1
4/24/2017	Niramai Health Analytix	Seed	Led by Pi Ventures	Develops cancer screening SaaS software that uses machine intelligence over thermography images	—
4/24/2017	Care Design Institute Inc.	Venture	Innovation Network Corporation of Japan	Develops and offers a nursing care platform	$13.7
4/6/2017	OM1, Inc	Series A	Led by General Catalyst Partners	Develops a platform that enables healthcare organizations and other stakeholders to collect and leverage health outcomes data	$15.0
3/16/2017	Notable Labs, Inc.	Venture	Not Disclosed	Develops and operates a platform that provides lab testing services for brain cancer patients	$2.7
2/22/2017	Leaf Healthcare, Inc.	Growth	Smith & Nephew plc	Designs and develops wireless patient monitoring solutions to improve patient safety and clinical outcomes	—
2/13/2017	SigTuple Technologies	Series A	Led by Accel Partners	Develops solutions for the automated analysis of medical images and data to aid diagnosis	$5.8
2/9/2017	HealthReveal, Inc.	Series A	Led by GE Ventures	Leverages advanced analytics and biomonitoring for the detection and management of chronic disease	$10.8
2/1/2017	CoheroHealth, LLC	Series A	Led by Three Leaf Ventures	Develops medication inhaler sensors	$13.3
1/31/2017	FRONTEO Healthcare, Inc.	Venture	FRONTEO, Inc.	Provides artificial intelligence-based medical data analysis solutions	$4.4
1/25/2017	KenSci Inc.	Series A	Ignition Partners; Osage Partners LLC; Mindset Ventures	Develops a vertically integrated machine learning platform for healthcare clients	$8.5
1/12/2017	Nanotech Galaxy, Inc.	Accelerator	Techstars Central LLC	Provides an artificial intelligence platform that analyzes medical imaging to provide predictive patient insights	$0.1
1/5/2017	PatientsLikeMe Inc.	Growth	The Invus Group, LLC; iCarbonx	Operates a healthcare data-sharing platform	$100.0
12/31/2016	Beijing Tuixiang Technology Co.	Venture	Sequoia Capital China	Develops artificial intelligence system for analyzing the CT scans and diagnosis of thoracic pulmonary disease	—
12/15/2016	Tiny Kicks, LLC	Venture	Not Disclosed	Develops a wireless smart sensor system that predicts and guide healthy pregnancy outcomes	$0.6
12/5/2016	Innoplexus AG	Pre-Series A	HCS Beteiligungsgesellschaft	Develops and provides platforms for health care industry using artificial intelligence	—
11/23/2016	GNS Healthcare, Inc.	Growth	Not Disclosed	Provides analytics solutions for the healthcare industry	$4.0
11/22/2016	Recursion Pharmaceuticals, Inc.	Series A	Led by Lux Capital Management	Researches, discovers and develops pharmaceuticals that focus on a molecular target related to rare genetic diseases	$15.1
11/16/2016	analyticsMD, Inc.	Series A	Co-led by Mayfield Fund and Norwest Venture Partners	Provides software solutions that streamline hospital operations using real time data analytics	$13.0
10/5/2016	Welltok, Inc.	Series E	27 New and Existing Investors	Designs and develops a technology that assists consumers in optimizing personal health	$33.7
10/5/2016	DocSynk, Inc.	Seed	Naya Ventures	Provides a big data platform that uses machine learning to enhance patient engagement	$1.0

Healthcare AI M&A Activity

To date, most of the investment in healthcare AI has come in the form of VC financing – reflecting the early stage of the industry. The abundance of VC interest in healthcare AI startups is an indicator of future M&A activity, which will occur as the industry matures and these startups continue to scale – around 48% of AI companies acquired since 2012 have had VC backing.[47] Corporate tech giants, such as Google, IBM and Salesforce, who are already active in AI investing, are also racing to acquire private AI companies, including participants in the healthcare space. Since 2012, over 250 private companies using AI algorithms across different verticals have been acquired.[47] Google has been the most active buyer of healthcare AI startups – most notably purchasing deep learning and neural network startup DNNresearch in 2013 and DeepMind Technologies in 2014 (for $600 million). Salesforce acquired AI startup MetaMind, whose deep learning capabilities include medical image understanding, for $48 million in 2016. IBM acquired Truven Health Analytics, a leading provider of cloud-based healthcare data, analytics and insights, for $3.6 billion in 2016 – this is the Company's fourth major health data related acquisition since launching the Watson health unit in April 2015. The table below provides a summary of M&A activity within the healthcare AI space in the twelve-month period ended September 2017:

Selected Healthcare Artificial Intelligence Company M&A Activity (October 2016 through September 2017)

($ in millions)

Date Closed	Target Company	Buyer	Company Description	Deal Value
Pending	ZirMed, Inc.	Navicure, Inc.	Provides cloud-based claims management solutions to healthcare providers and organizations	$750.0
9/12/2017	inviCRO, LLC	Konica Minolta, Inc.	Provides a suite of services and software for medical imaging analysis	$285.0
8/7/2017	Accordion Health, Inc.	Evolent Health, Inc.	Develops healthcare predictive analytics software solutions	$4.0
8/3/2017	Curoverse, Inc.	Veritas Genetics International Ltd.	Develops and operates a cloud based open source platform for analyzing and sharing genomic data	—
8/1/2017	CytoBioScience, Inc.	Skyline Medical Inc.	Manufactures devices that allow companies to understand how human cells react to medicine	—
6/23/2017	Praxify Technologies, Inc.	athenahealth, Inc.	Develops electronic health record (EHR) applications for physicians ad patients	$63.0
5/13/2017	Lattice Data, Inc.	Apple Inc.	Offers data analytics solutions for a range of industries, including healthcare	$200.0
5/11/2017	DeepRadiology Inc.	Senetas Corporation Limited	Develops a medical machine learning software system for medical image interpretation	—
4/24/2017	Forecast Health, Inc.	Lumeris, Inc.	Provides predictive analytics and planning tools to enable population health programs for health systems	—
4/18/2017	Eliza Corporation	HMS Holdings Corp.	Provides health engagement management solutions	$170.0
4/4/2017	WPC Healthcare, Inc.	Intermedix Corporation	Develops, implements and supports data solutions for the food, health and medicine industry	—
2/21/2017	Predixion Healthcare	Jvion, LLC	Offers an appliance that enables patient-level interventions to predict adverse health events	—
1/23/2017	Meta	Chan Zuckerberg Initiative	Big-data-as-a-service company for science and IP	—
12/22/2016	KingFit Preventive Health & Performance	e2e Accelerator	Operates a health and wellness platform powered by artificial intelligence	—
10/19/2016	Health Data Intelligence, LLC	TrendShift, LLC	Provides cloud-based healthcare analytics solutions and evidence-based business decision support	—

[47] CB Insights, "The Race For AI: Google, Baidu, Intel, Apple In A Rush To Grab Artificial Intelligence Startups" (July 21, 2017)

Conclusion: The Future of AI & ML in Healthcare

AI and ML-powered solutions have already shown the ability to perform tasks, in many cases, better than humans. Leaders like Amazon are calling AI a "golden age" and are setting a new standard for competitive differentiation. Amazon is pinning its future on AI as Jeff Bezos, CEO, hinted that AI is being used in "literally hundreds of things" across the firm, stating "we are now solving problems with ML and AI that were in the realm of science fiction for the last several decades…there is no institution in the world that can't be improved by machine learning."[48]

Most organizations anticipate sizable benefits from AI in areas including IT, operations and manufacturing, supply chain management, and other customer-facing activities. However, the gap between ambition and execution for AI is large at many companies. According to research conducted by MIT Sloan Management Review, only about one in five companies have incorporated AI in some offerings or process, revealing large gaps between industry leaders and laggards.[49] While nearly 85% of executives report confidence that AI will allow their companies to obtain a meaningful competitive advantage, lack of specialized talent, establishing priorities for AI investments, and fear of job replacement are some of the key hurdles facing AI integration.

While intelligent automation can make sense out of masses of data, people are still the most important part of the equation. In the healthcare sector, as Humana president and CEO Bruce Broussard recently wrote, "No technology will be a substitute for a smiling face, assisting in feeding or comforting with an arm to hold. Physicians, clinicians or family members simply cannot be replaced by ML in health care."[50]

However, the healthcare sector is particularly well positioned to benefit from the revolutionary capabilities that AI and ML will bring, with dramatic benefits including superior patient care, reduced system-wide costs, and the opportunity for researchers and doctors to leverage previously unimagined capabilities.

[48] CNBC, "Amazon CEO Jeff Bezoz Says AI is in 'Golden Age'" (May 8, 2017)
[49] Boston Consulting Group, "Reshaping Business with Artificial Intelligence" (2017)
[50] Humana News, "Why Self-Driving Cars Won't Work in Health Care" (May 5, 2016)

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