Thematic Research: Healthcare

Intelligent Treatments

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Contents

Executive Summary

Intelligent treatments represent the intersection between digitization, virtual reality (VR), artificial intelligence (AI), and robotics. This theme covers the cutting-edge methods of delivering medical procedures through the use of advanced technology. As technologies converge and are integrated into holistic solutions, innovations such as remote surgery, diagnostic and procedural assistant AIs, and augmented reality-enhanced procedures will become possible.

The healthcare industry is moving towards digitalization and automation, thereby reducing human error and the burden on healthcare providers and staff. For example, surgical robots allow for minimally invasive procedures and reduce human error, while other robots such as hospital and care robots reduce the burden of patient care and mundane tasks.

Furthermore, healthcare continues to move beyond the one-size-fits-all approach to precision and personalized medicine, with medication, care, and devices customized to each patient. Technologies such as genetic profiling, big data analysis, AI solutions, and 3D printing are utilized in this regard. Precision and personalized medicine leads to better patient outcomes and lower healthcare costs in the long term.

Compared to other industries, healthcare is highly risk averse, regulated, and intricate, and therefore slow to adopt new technologies and modernize. However, due to the many advantages of advanced technology, its use in the healthcare space is expected to continue to increase in the next five years.

Leaders and disruptors

Examples of leaders (i.e., those who are positioned well to benefit from this theme) and disruptors in the intelligent treatments field are listed below.

Genomics

- **Leaders:** Pfizer, Roche, Merck, Abbott, and GlaxoSmithKline.
- **Disruptors:** Illumina, Quest Diagnostics, and Myriad Genetics.

Artificial intelligence (AI)

- **Leaders:** Baidu, Google, and Microsoft.
- **Disruptors:** Atomwise, iCarbonX, and Enlitic.

Robotics

- **Leaders**: Stryker, Zimmer, and Medtronic.
- **Disruptors:** Verb Surgical, Omnicell, and Ekso Bionics.

3D printing

- **Leaders:** Stratasys, 3D Systems, and 3T RPD.
- **Disruptors:** Organovo, Concept Laser, and QMENTA.

Virtual/augmented reality

- **Leaders:** Google, Microsoft, and Sony.
- **Disruptors:** XRHealth, Augmedix, and LENSAR.

Inside

Related reports

- Thematic Research: MedTech
- Thematic Research – Robotics in Healthcare - 2020
- Thematic Research: 3D Printing in Healthcare
- Thematic Research: Artificial Intelligence (2020)

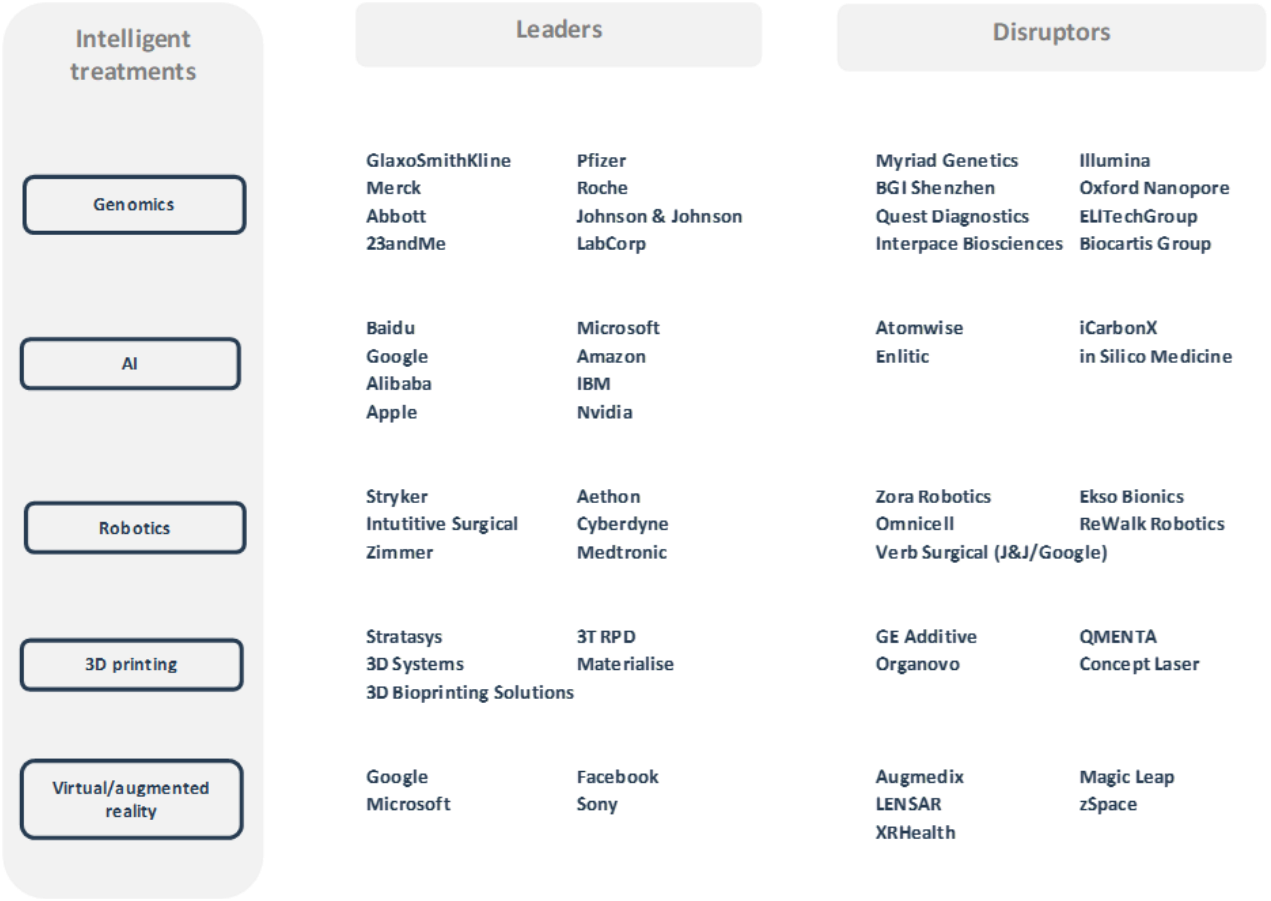
Report type

- **Single theme**
- Multi-theme
- Sector Scorecard

Players

The schematic below identifies some of the leading companies in the intelligent treatments theme and categorizes their position in the value chain.

Who are the leading players in the intelligent treatments theme and where do they sit in the value chain?



Source: GlobalData

Trends

The main trends shaping the intelligent treatments theme over the next 12 to 24 months are shown below. We classify these trends into three categories: healthcare trends, technology trends, and regulatory trends.

Healthcare trends

The table below highlights the key healthcare trends impacting the intelligent treatments theme.

Trend	What's happening?
Growing aging population and burden of disease	Globally, the elderly population continues to grow, leading to an increased burden of disease. According to the UN, the population of individuals ages 65 and over will be approximately 1.5 billion by 2050. As the aging population has a higher risk of developing various diseases, there will be an increase in the demand for surgical intervention and medical care. This will also result in an increase in demand for various intelligent treatments to increase the quality of care and decrease costs.
Remote surgery	The evolution of technologies such as cloud computing and AI will drive innovation in robotics, thus reducing and sometimes even eliminating the need for the surgeon to be physically present. This is especially helpful for complicated procedures that require specialists who may not be present in the same geographic location as the patient. Robot surgical systems aid during remote surgery, thus increasing patients' access to top-notch healthcare. The first successful remote surgery was done in 2001, with a surgeon in New York City performing a cholecystectomy on a patient in Strasbourg, France. The ZEUS Robotic Surgical System or ZRSS was used during this procedure. The future utilization of 5G (fifth-generation wireless) technology will better enable remote surgery. 5G is the latest iteration of cellular technology, built with the aim of increasing the speed and responsiveness of wireless networks. 5G will act as an enabler for tasks and processes that require large volumes of data and low latency connection speeds.
Medical Robotics	The four main types of medical robots are surgical robots, exoskeletons, care robots, and hospital robots. According to GlobalData, the number of surgeries performed in the US using robotic surgical systems has grown in the past five years and is expected to continue to grow in the next five years. The main drivers are the growing elderly population and rise of minimally invasive surgery. The use of robots varies by therapy area; some procedures, such as prostatectomy, heavily utilize robotics while others, such as cardiovascular surgeries, do not. Care robots can dramatically cut the cost of nursing elderly patients. The number of robots used to provide care and support to the elderly and disabled is currently very low but is expected to increase significantly over the next decade, particularly in countries like Japan which are facing a predicted shortfall in the number of caregivers. Initial use cases for these products are relatively simple (such as helping people get into and out of bed) but they will increasingly be called upon to perform more complex tasks, from reminding patients when to take medication to providing emotional support and human-like interaction for those lacking regular human contact. Robots can aid recovery as well as assist with surgery. For example, Cyberdyne's Hybrid Assistive Limb (HAL) exoskeleton, which uses sensors placed on the skin to detect small electrical signals in the patient's body and respond with movement at the joint, is designed to assist patients with rehabilitating from conditions leading to lower limb disorders, including spinal cord injuries and strokes. Hospital robots, like Aethon's TUG autonomous mobile robot, can be used to deliver medications, laboratory specimens, or other sensitive materials within a hospital environment.

Trend	What's happening?
Precision and personalized medicine	Precision and personalized medicine refers to a medical model that proposes the customization of healthcare, with decisions and practices being tailored to the individual patient by use of genetic or other information. This trend is expected to continue to grow and replace the "one size fits all" approach in medicine. It can help optimize patient treatment, reduce side effects, and treat untreated or undertreated diseases. Genetic testing and profiling are an important aspect of precision and personalized medicine. It can help in predicting future diseases in patients and hence in preventing them. Furthermore, it can help in diagnosing and treating patients. In addition to finding targeted and personalized pharmaceuticals, genetic data may also be used to determine the correct dosing for medication, as different people may metabolize a drug at different rates. The accuracy and research behind this technology continues to grow while the price continues to decrease. The price of this technology has been a limitation to its widespread use in the past.
Preventative medicine	Preventative care is a growing trend in healthcare, and seamless financing of these services can help reduce costs in the long term. Preventative medicine leads to healthier patients. Being able to prevent disease before it occurs or predicting health outcomes from early indicators reduces healthcare costs and future doctor visits. Data collected from genomic sequencing, health monitoring devices, clinical studies, and other sources can help with this endeavor.
Reimbursement	As medical procedures and drug technology improve and change, ways of funding these health services must also adapt. Funding bottlenecks and limitations can be a major hindrance in providing top-tier healthcare to populations. Finding new ways to bring payers and payees together while reducing barriers and additional costs will ensure that healthcare value remains high.
Digitalization of health data	Through the increased use of electronic health records (EHR), electronic medical records (EMR), personal health devices, and apps, personal health data has become digitalized. Compared to paper records, EHRs provide greater accessibility and transparency. Digital formatting allows data to be shared over networks and can result in better coordination between healthcare providers. It standardizes records and allows for the collection of data for clinical and epidemiological studies. The records can be continuously updated and patient health can be tracked without the difficulty of trying to track down previous paper records. However, in many cases the available data is incompatible, incomplete, or difficult to aggregate. Big data analytical tools are required to extract actionable insights from this large set of data.
Remote patient monitoring and wearables	Biosensors and remote patient monitoring devices can help better profile and monitor many physiological indicators over time, hence providing a more precise overall map of a patient's health. This information can be used in combination with genetic profiling to better personalize medical care for a patient. According to GlobalData, the market for remote patient monitoring and wearables will continued to grow in the next 5 years.

Source: GlobalData

Technology trends

The table below highlights the key technology trends impacting the intelligent treatments theme.

Trend	What's happening?
3D printing	3D printing may be used in producing personalized pharmaceuticals and medical devices. Additionally, 3D bio-printing can be used for regenerative medicine and organ replacement. In all cases, this technology can help better personalize treatments and adapt to different patient needs.
Artificial Intelligence (AI)	AI is rapidly evolving and is being applied to increasingly complex problem-solving tasks such as natural language processing and even early disease diagnosis. As healthcare continues to embrace the digitization of patient data sets and patient care, AI will increasingly be applied to support both physicians and patients to empower better healthcare outcomes. Scientific literature has already demonstrated AI to be as effective as human experts in diagnosing certain diseases, and AI integration into chatbots and virtual assistants is already a reality. As this technology advances, it is expected that the healthcare industry will be able to deliver increasingly complex healthcare options without taxing resources. AI technology continues to advance and its use in the healthcare industry continues to grow. AI tools are required to organize, screen, and analyze big data. They can help provide in-depth insight and increase the speed of decision making.
Cloud	As computing moves from in-house corporate data centers to third-party cloud data centers, corporations need to buy less of their own IT equipment. The rise in the use of cloud computing in the healthcare industry has allowed for a more scalable, cost-effective, and interconnected method of storing and sharing health data. Many cloud-based platforms are tailored for the storage and analysis of health data. Most also provide extra security against cyber-attacks and are HIPAA-compliant.
5G	The full-scale mainstream adoption of 5G, which is still a few years away, has the potential to increase data consumption globally. 5G is expected to enable faster speeds (up to 20 gigabits per second [Gbps] per user) and connect around one million devices per square kilometer (approximately 10 times more than with 4G). 5G is also likely to have a significant impact on applications that rely on real-time data analytics. It will allow for better remote patient monitoring systems, remote surgery, as well as sharing of high-resolution medical images.
Big data	The term "big data" refers to large and complex data sets that traditional data-processing applications are unable to process. Big data can provide immense value for payers, providers, and patients. It allows for the practice of evidence-based medicine, value-based care, personalized and precision medicine, preventative and predictive medicine, and can help increase efficiency and decrease costs across the healthcare industry. GlobalData expects the utilization of big data in the healthcare industry to continue to grow over the next five years.
Virtual/augmented reality	VR is all about immersing the user in an entirely artificial world. It uses special equipment, such as headsets and gloves, fitted with sensors to simulate the user's physical presence in a 3D environment (see "Use of VR for rehabilitation and more" in the Use Cases section of this report). Augmented reality (AR) technology allows the user to see the real world overlaid with digital data. Currently AR is being using in medicine for education, surgical visualization, and patient vein visualization. Over the next five years, virtual and augmented reality could revolutionize physician training programs, the ways medical procedures are performed, as well as patient education and treatment options.

Source: GlobalData

Regulatory trends

The table below highlights the key regulatory trends impacting the intelligent treatments theme.

Trend	What's happening?
Data security and privacy	The number of healthcare record breaches has continued to grow in the past few years. Personal health data contains private and confidential information that can be valuable to hackers. Additionally, privacy and how personal data is utilized is also an important topic of concern. In 2017, the UK Information Commissioner's office found that a transfer of health records for 1.6 million patients from a London hospital to Google's DeepMind, an AI company, did not comply with the data protection act. Concerns were raised regarding DeepMind's mobile app, which was undergoing testing at the time of the transfer, and the fact that a large quantity of private health data was used for the testing process.
General Data Protection Regulation (GDPR)	The collection, storage, sharing, and analysis of personal health data is an important part of the intelligent treatments theme. It is relevant to segments such as genomics, AI and more. Regulations surrounding the protection of patient data is an important aspect to consider. GDPR was introduced in the EU in May 2018. It is a regulation in EU law about data protection and the privacy of EU and European Economic Area residents. In the first year of its enforcement, more than 89,000 personal data breach notifications were sent to EU data protection supervisory authorities (DPAs), while over 144,000 queries and complaints were made to DPAs by individuals who believed their rights under GDPR had been violated. Authorities have begun using the powers provided by GDPR to levy significant fines on non-compliant companies.
Health Insurance Portability and Accountability Act (HIPAA)	HIPAA is US legislation that protects medical data privacy and security. It provides guidelines to ensure compliance related to the security and proper management of confidential information. Again, this is relevant to the intelligent treatments theme as the analysis of personal health data is an important driver of these technologies.
Food and Drug Administration (FDA)	The FDA in the US regulates diagnostic tests, therapeutics, devices, and imaging systems, that fall under intelligent treatment theme. Presenting the required clinical data and passing the regulatory requirements by the FDA is seen as one of the hurdles faced by companies in this space.

Source: GlobalData

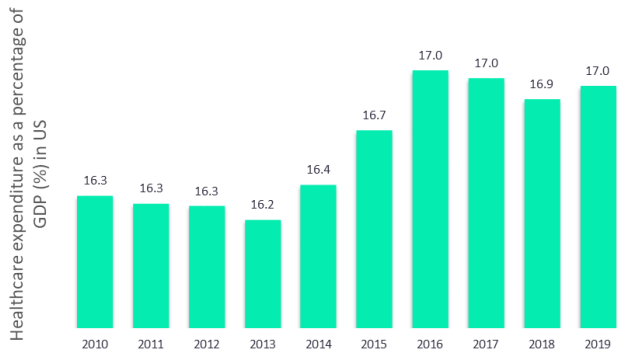
Industry analysis

Healthcare costs continue to rise globally

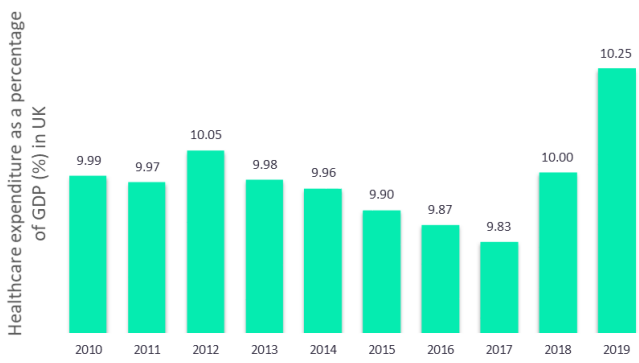
Globally, healthcare costs are rising. This increase is expected to continue into the future. Two of the main reasons for rising costs are the growing elderly population and increased burden of disease. According to the United Nations, the global population of individuals ages 65 years and over will be approximately 1.5 billion by 2050. While the initial utilization of some of the technologies in the intelligent treatment theme maybe expensive at first, in the long term they are expected to increase patient health outcomes and ultimately the overall cost of health.

Healthcare spending as a percentage of GDP in the US and UK has grown in the past 10 Years

Health expenditure corresponded to 17% of GDP in 2019 in the US, showing an increase since 2010.



Health expenditure corresponded to 10.3% of GDP in 2019 in the UK, increasing at a Compound Annual Growth Rate (CAGR) of 0.3% during 2010–2019.



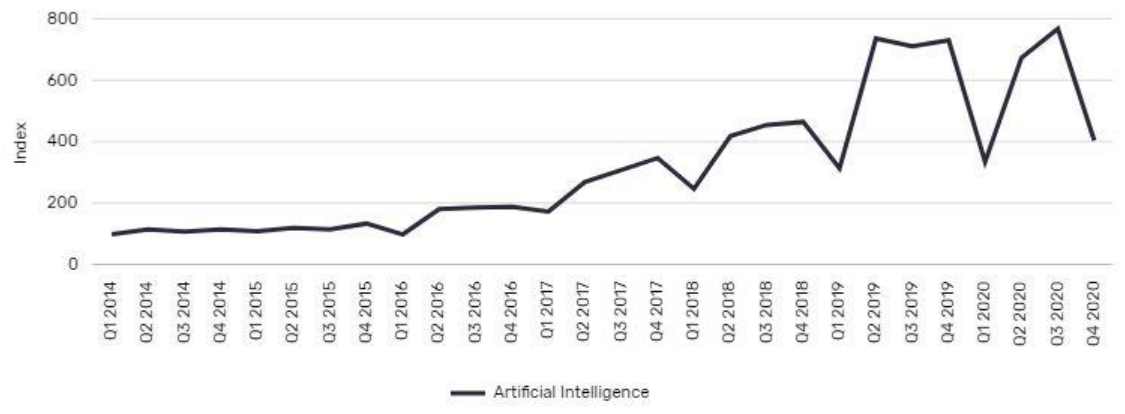
Source: GlobalData; OECD (2020) "Health expenditure and financing"

AI in healthcare

AI refers to software-based systems that use data inputs to make decisions on their own. The medical community is quickly adopting AI into its processes. AI will be a key driver of healthcare innovation in the future through management of chronic diseases, improvement of medical imaging, healthcare operational and decision support, and integration of the Internet of Things (IoT) ecosystem of devices.

Overall, the utilization of AI is growing in most industries. GlobalData forecasts suggest that the market for AI platforms will reach $52B in 2024, up from $29B in 2019. The graph below shows the growth of this theme according to the GlobalData Composite Index over the past six years. The GlobalData Composite Index is a combination of stock, deals, and company filing analytics indices.

The AI theme has trended upward, according to GlobalData's composite index



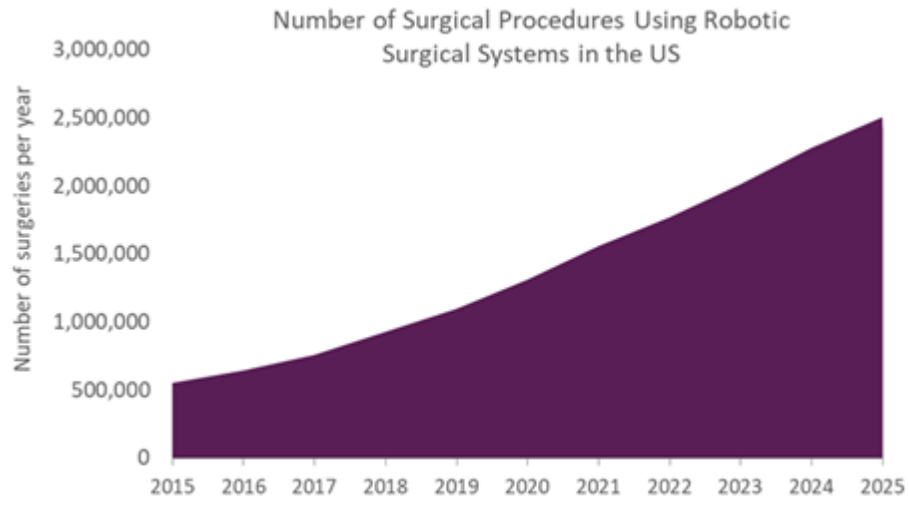
Source: GlobalData

Robotics

Robots continue to become smarter, cheaper, faster, and more commonplace. In 2019 the global robotics market was worth $115B, and it is expected to surpass $275B by 2025, according to GlobalData forecasts. In the healthcare industry, medical robots including surgical robots, exoskeletons, care robots, and hospital robots continue to be utilized to improve patient health outcomes and reduce burden on healthcare workers. The main drivers for the increasing use of robotics in the healthcare industry include aging populations and technological advancements. Some of the limitations include the high cost of the technology and inadequate research, data, and experience. Overall, GlobalData expects that the use of robots will increase within the healthcare industry over the next five years. Healthcare providers that take advantage of robotics in their facilities are expected to benefit.

According to GlobalData, the number of surgeries performed in the US using robotic surgical systems has grown in the past five years and is expected to continue to grow in the next five years. The main driver is the growing elderly population. The use of robots varies by therapy area; some procedures, such as prostatectomy, heavily utilize robotics while others, such as cardiovascular surgeries, do not.

The number of surgeries performed using robotic surgical systems is growing in the US



Source: GlobalData

Use cases

Value of AI during the COVID-19 pandemic

The COVID-19 pandemic has further illuminated the value of AI in the healthcare industry.

AI can be used to track and report on the spread of COVID-19. As an example, the Toronto based BlueDot AI platform was among the first to register the rise of COVID-19 in Wuhan. Additionally, AI technology can be used to predict the spread of COVID-19, anticipate impact, aid with contact tracing and alerts, as well as assist drug and vaccine discovery.

Furthermore, AI can be used for better detection and treatment of COVID-19. Alibaba has announced an AI technology that it says will diagnose COVID-19 cases in seconds with an accuracy of 96% using CT scans. It normally takes a doctor five to 15 minutes to interpret a CT scan. The US National Institute of Health (NIH) recently announced the launch of the Medical Imaging and Data Resource Center (MIDRC) to fight COVID-19. MIDRC is aiming to utilize AI technology to analyze lung and heart medical images, such as X rays and CT scans, to help better detect and personalize therapies for COVID-19 patients. An automated AI process for the analysis of medical images is both faster and more accurate. In order to do this, thousands of medical images (X rays, CT scans) will be annotated and used for machine learning and predictive analysis. Specific features of lungs and hearts observed through medical imaging in COVID-19 patients may help evaluate the severity of the disease and predict how the patient will react to treatment.

Moreover, AI technology can help reduce the need for direct physical contact between humans in order to decrease the spread of COVID-19. This can be done through robots that deliver food, medication, and care to sick and quarantined people, as well as AI-enabled remote patient monitoring solutions.

If anything, the COVID-19 pandemic has likely increased the interest in AI and provided a glimpse into how powerful it can be in preventing and combating an infectious outbreak.

COVID-19 and robotics in healthcare

The COVID-19 pandemic has increased interest in medical robots. However, due to financial losses, many health care providers are currently wary of acquiring expensive robotic technology without clearly and strongly demonstrated value.

Due to the less invasive nature and the precision of robotic surgery compared to traditional surgery, patients require shorter post-op hospital stays. This is valuable during a pandemic when hospital beds and resources are needed for COVID-19 patients. Additionally, a shorter hospital stay will reduce the chance of contracting COVID-19. However, the number of robot-assisted surgeries performed during the pandemic is expected to decline due to the postponement of elective surgeries.

During the pandemic, robots can reduce the rate of infection in healthcare settings in various ways. For example, UV-disinfecting (UVD) robots are being used to disinfect hospitals. They can move around the hospital and sterilize different rooms. One current leader in this area is the Danish company UVD Robots. Additionally, care robots and hospital robots that carry medicine and tend to patients can reduce the need for direct physical contact between patients and healthcare providers, thus reducing the risk of infection and the need for personal protective equipment. As an example, during the pandemic, Boston Dynamics' quadruped Spot robot was used at the Brigham and Women's Hospital of Harvard University as a mobile telemedicine device to allow healthcare workers to remotely triage patients. The robot carries an iPad and has a two-way radio allowing for live communication between patients and healthcare staff. There is potential to add sensors and equipment to the robot to measure vitals such as the patient's core body temperature.

Use of VR for rehabilitation and more

XRHealth (XRHealth) is a technology- and communication-based company that develops breakthrough medical and wellness applications utilizing VR to deliver an enhanced experience and real-time data analytics for patients, clinicians, and healthcare providers, at clinics and at home.

XRHealth is using VR technology to help patients in their rehabilitation and physiotherapy. These solutions, which present like video games, are more engaging for patients and can be used in the patient's home. They help patients extend their range of motion and re-train their muscles. Patients can track their movements and progression.

According to their XRHealth website, VR therapy can help during physical therapy, stress management, pain management, ADHD, memory training, hot flashes, and post-COVID rehab. XRHealth has created a VR telehealth clinic, where patients are matched with an XRHealth clinician who they will consult with before and during their VR therapy. Patients will receive their VR Telehealth Kit, which will include a VR headset to use at home.

Mergers and acquisitions

Some of the key M&A transactions associated with the intelligent treatments theme in the last 30 months are listed in the table below.

Date announced	Acquirer	Target	Value ($M)	Target company description
Nov 2020	Impact Lab Group	HeartGenetics	Not disclosed	Bioinformatic software and genetic tests and services
Sep 2020	Regent Pacific Group	Deep Longevity	3.8	AI to track the rate of aging
July 2020	Medtronic	Medicrea	187.1	Spinal surgery AI, predictive modeling, and patient-specific implants solutions
Jun 2020	Illumina	Bluebee	Not disclosed	Genomics platform
Feb 2020	Medtronic	Digital Surgery	Not disclosed	Surgical AI
Jan 2020	Predictive Oncology	Quantitative Medicine	1.8	Novel drug discovery platform
Jan 2020	SonarMD	Triggr Health	Not disclosed	AI-based care coordination company
Dec 2019	Johnson & Johnson	Verb Surgical	Not disclosed	Surgical system combining robotics and data science
Aug 2019	Siemens Healthineers	Corindus Vascular Robotics	1.1	Precision vascular robotics
Feb 2019	Johnson & Johnson	Auris Health	3.4	Surgical robots for respiratory procedures and detection of lunch cancer
Sep 2018	Medtronic	Mazor Robotics	1.6	Robotic guidance system for spine surgery
Aug 2018	Stryker	K2M	1.4	Complex spine and minimally invasive solutions

Source: GlobalData

Timeline

The major milestones in the journey of the intelligent treatments theme are set out in the timeline below.

The intelligent treatments story

How did this theme get here and where is it going?

1983	The use of robots during surgery began with Arthrobot in Canada.
1996	HIPAA legislation passed to ensure electronic protection of medical records.
1998	Herceptin was approved by the FDA for the treatment of human epidermal growth factor 2 positive (HER2+) breast cancer.
1999	Research team from Wake Forest Institute created the world's first lab-grown organ (bladder tissue) that was successfully implanted into a patient
2000	Da Vinci robotic surgical system was approved by the FDA to perform surgical procedures.
2000	Medical field began using 3D printing.
2001	The first successful remote surgery was performed using a robotic system.
2003	US NHGRI and the International Human Genome Sequencing Consortium (IHGSC) announced the successful completion of the Human Genome Project (HGP).
2008	US Genetic Information Non-Discrimination Act (GINA) was signed.
2008	The first 3D-printed prosthetic leg is created.
2012	3D-printed jaw was manufactured by LayerWise.
2014	Keytruda was the first drug approved by the FDA based on biomarker status.
2015	First robot-operated hospital in North America, Humber River Hospital in Toronto, Canada, opened its doors.
2015	The Precision Medicine Initiative was signed in the US.
2017	Stevie, a care robot, was developed by a team at Trinity College in Dublin.
2017	The FDA approved the first personalized medicine biosimilar in the US.
2018	The National Institutes of Health (NIH) launched the All of Us research program (previously called the Precision Medicine Initiative) to better understand the relationships between biomarkers/genetics and diseases.
2018	CMS finalizes the coverage of NGS tests.
2020	FabRx launched M3DIMAKER, the first 3D printer for the manufacture of personalized medicines.

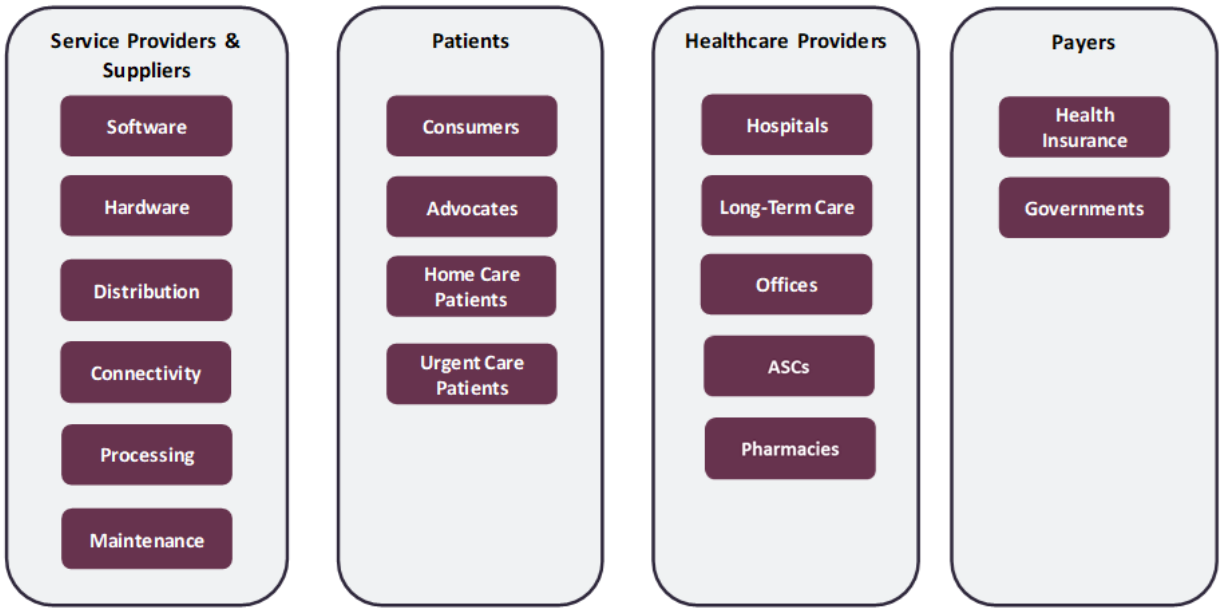
Source: GlobalData

Value chain

The intelligent treatments value chain includes different sectors of the healthcare industry. Service providers and suppliers provide many of the needed tools and software, while healthcare providers utilize them to enhance patient treatment and outcome. Payers, both private and public, need to recognize and reimburse the expenses of these solutions/technologies.

The intelligent treatments theme affects or involves a vast expanse of the healthcare sector. The figure below illustrates the different healthcare sectors and the entities within them that are most affected by this theme.

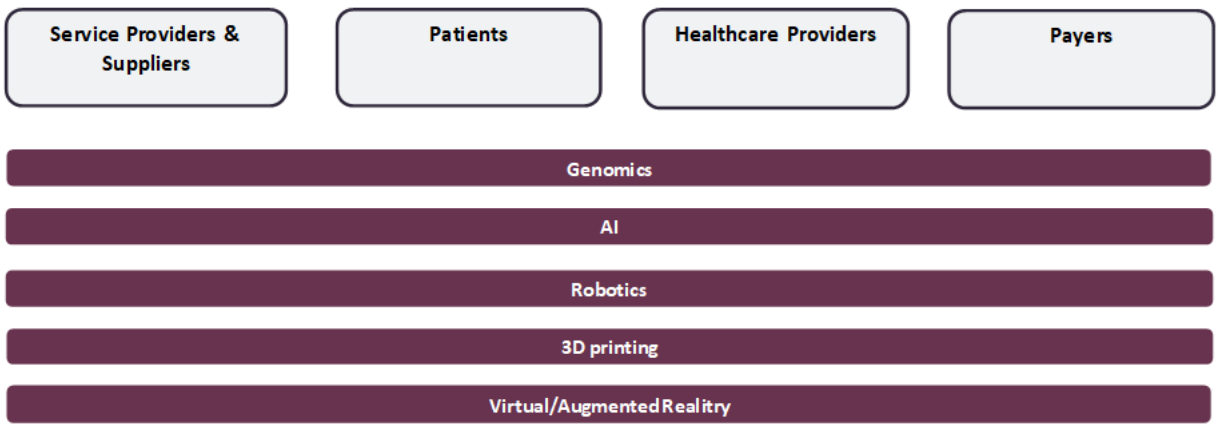
Healthcare value chain, intelligent treatments



Source: GlobalData

The next figure illustrates some of the main tools and technologies utilized in the intelligent treatments theme and their position within the healthcare value chain.

Healthcare Value Chain Level 2



Source: GlobalData

Genomics

Genetic testing and profiling is an important aspect of precision and personalized medicine. It can help in predicting future diseases in patients and hence preventing them. Furthermore, it can help in diagnosing and treating patients. In addition to finding targeted and personalized pharmaceuticals, genetic data may also be used to determine the correct dosing for medication, as different people may metabolize a drug at different rates. The accuracy and research behind this technology continues to grow while the price continues to decrease. The price of this technology has been a limitation to its widespread use in the past. Reimbursement by payers is necessary to allow for a more widespread utilization of these services.

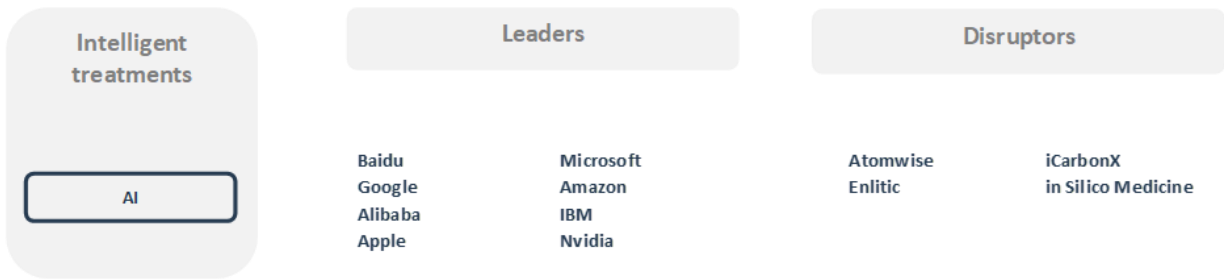
The genomics segment

Source: GlobalData

AI

The use of AI in healthcare, especially machine learning, is growing significantly. The growth of The Internet of Medical Things is generating a massive volume of real-time data. Until now, this data was not being fully utilized. This is especially true when considering the data that can now be mined from patient records, which can be used to design treatment plans, create drugs, or improve clinical trial outcomes. AI has been used in the past to predict which drugs can be used to treat diseases in novel ways, and to create treatment plans that improve patient outcomes beyond the pill. On the medical side, AI is being used to improve diagnoses through medical diagnoses software and apps, which have seen promise when sourcing the global experts of a specific disease. Additionally, AI technologies, most notably machine learning, are integral to the development of smart robots, which are capable of anticipating and adapting to certain situations based on the interpretation of data derived from an array of sensors (e.g., 3D cameras, ultrasound transmitters, force sensors, and obstacle detectors).

The AI segment

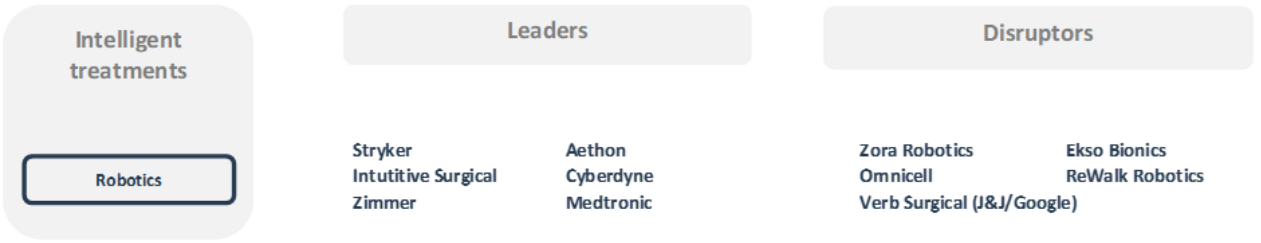


Source: GlobalData

Robotics

The four main types of medical robots are: surgical robots, exoskeletons, care robots, and hospital robots. The healthcare industry uses all four types to improve the current standard of care, while also helping humans to do things that they may not have been able to do in the past, or do things quicker and with fewer errors. As an example, The Humber River hospital in Toronto, Canada extensively uses robots to carry food, supplies, and medicine. They can find their way around the building, call elevators, and open doors. This reduces the workload of staff and allows them more time to care for patients. Additionally, robots are involved in the pharmacy, where they help sort and package medication, thereby reducing human error. In addition to reducing human error in terms of drugs and dosages, prevention of spillage is also very important when it comes to certain chemotherapy drugs, which are quite toxic. Furthermore, the hospital has a robotic radiology suite, where robots move patients and adjust their positions. Traditionally, patients needed to move around and adjust their own body to allow the machines to capture images from different angles, which could be uncomfortable or painful for certain patients.

The robotics segment



Source: GlobalData

3D printing

The market for 3D printing in healthcare is a growing one, driven by the demands of an ageing population that is living longer in many countries, with a consequent increase in demand for dental work and devices such as hearing aids or implants. 3D printing is playing a growing role in medicine such as the 3D printing of organs or even on the operating table, where 3D printed tools can guide surgeons. 3D printing may be used in producing personalized pharmaceuticals and medical devices. In all cases, this technology can help better personalize treatments and adapt to different patient needs. Uptake is dependent on familiarity and training of healthcare providers and proper reimbursement.

In one of the most recent high-profile examples, 3D printing was used to help separate conjoined twins. Surgeons at Great Ormond Street Children's Hospital performed the complex surgery in three stages over five months, having used 3D printing to create models of the two girls' brains.

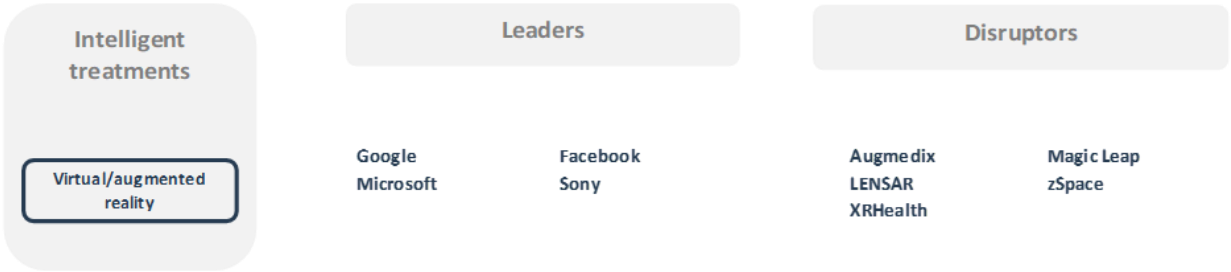
The 3D printing segment

Source: GlobalData

VR/AR

Because healthcare is very complex and has a low margin for error, virtual reality (VR) and augmented reality (AR) have been adopted at a slower pace compared to other technologies. However, recently, VR and AR have been increasingly used in medical training, medical analysis, and surgical support as aids to improve treatment (see "VR for rehabilitation and more" in the "Use case" section) and answer patient queries. While VR has several important uses in healthcare, GlobalData sees AR as being more important in the short and long term. AR can be used to help radiologists review patient scans to see issues that would not have been caught by the human eye alone and to build 3D renderings of patients in order to create previously unavailable views. Additionally, it can be used for patient education and increased engagement.

The VR/AR segment



Source: GlobalData

Companies

In this section, GlobalData highlights publicly listed and private companies that are making their mark within the intelligent treatments theme.

Public companies

The table below lists some of the leading listed players associated with this theme and summarizes their competitive position.

Company	Country	Competitive position in the intelligent treatments theme
Abbott Laboratories	US	Abbott Laboratories discovers, develops, manufactures, and sells a diversified range of healthcare products including branded generic pharmaceuticals, diagnostic systems and tests, and pediatric and adult nutritional products. Abbott produces diagnostic tests to help improve and personalize treatments for patients.
Biocartis Group	Belgium	Biocartis operates as a molecular diagnostics company that provides personalized medicine for patients through its molecular diagnostics. The company undertakes the development of diagnostics technology platforms for multiplexed detection of bio-analytes, with oncology as its key focus area. Its Idylla is a molecular diagnostics system that provides easy access to clinical molecular diagnostic information. Biocartis also offers a wide range of oncology assays such as Idylla BRAF Mutation Test, Idylla EGFR Mutation Test, Idylla KRAS Mutation Test, and Idylla NRAS Mutation.
IBM	US	In August 2017, JDRF, a leading charitable organization dedicated to funding type 1 diabetes (T1D) research globally, announced a collaboration with IBM to develop and apply machine learning methods to identify factors leading to the onset of T1D. IBM's cognitive computer superpower will help find disease patterns, with a goal to create a foundational set of features that is common to all data sets. This is not the first time that IBM will put its AI platform into use for healthcare issues. Earlier in 2017, IBM teamed up with the American Heart Association (AHA) to collect and analyze data on employees' health based on AHA metrics and the workplace health environment. In 2016, IBM started a partnership with the American Diabetes Association (ADA), bringing together IBM Watson's cognitive computer power and the vast repository of ADA's clinical and research data on type 2 diabetes (T2D).
Illumina	US	Illumina provides genomic sequencing and array-based solutions for genetic analysis in the areas of molecular diagnostics, translational and consumer genomics, and cancer. The company's portfolio encompasses sequencing tools and systems; sequencing kits and reagents; microarray kits and reagents; molecular biology reagents; and arrays and reagents. It offers human whole-genome sequencing; microarray services; and instrument services, training, and consulting.
Intuitive Surgical	US	Intuitive Surgical is a leader in medical robot assistants for minimally invasive surgical procedures. The number of Da Vinci surgeries performed in the US has increased by more than 50% since 2013, hitting nearly 700,000 procedures in 2017. The company faces competition from two medical equipment incumbents who have formed joint ventures with robotics companies. Medtronic teamed up with Mazor Robotics, a partnership that led to Medtronic acquiring Mazor in 2018, and Johnson & Johnson joined forces with Google to form Verb Surgical. Intuitive is likely to experience falling prices as these rivals gain momentum. Meanwhile, it derives more revenue from after-sales instruments, accessories, and services as a hedge against any dip in non-recurring Da Vinci revenues.

Company	Country	Competitive position in the intelligent treatments theme
LabCorp	US	LabCorp is a provider of clinical laboratory services and end-to-end drug development support. It focuses on the development and commercialization of a range of diagnostic technologies and testing services. The company offers clinical diagnostics laboratory services such as core testing and genomic and esoteric testing. Its services include general and specialty laboratory testing, bone marrow and human leukocyte antigen (HLA) testing, clinical trials services, drug testing services, deoxyribonucleic acid (DNA) identification services, forensic identity services, insurance health plan services, paternity testing services, patient services, personalized medicine, and hospital services. It also offers drug development services through Covance.
Medtronic	Ireland	Medtronic is a large medical technology company that designs, develops, manufactures, and markets a wide range of medical devices and solutions including various medical robots. Mazor Robotics, which is a subsidiary of Medtronic, is a medical devices company manufacturing robotic guidance systems for spine surgery.
Myriad Genetics	US	Myriad Genetics is a specialty molecular diagnostic company that discovers and commercializes molecular diagnostic tests, personalized medicine, and services for major diseases. The company's product portfolio includes molecular diagnostic testing products that analyze genes, their expression levels, and corresponding proteins to assess a person's risk for developing disease later in life; accurately diagnose disease; and determine a patient's likelihood of responding to a particular drug. It also provides an array of pharmaceutical and clinical services.
Roche	Switzerland	Roche is a biotechnology company that develops drugs and diagnostics to treat major diseases. It provides pharmaceuticals in oncology, immunology, neuroscience, ophthalmology, infectious diseases, respiratory, and other therapeutic areas. The company also provides *in vitro* diagnostics and tissue-based cancer diagnostics, besides diabetes management solutions. Roche conducts research to identify novel methods to prevent, diagnose, and treat diseases.
Stryker	US	Stryker is a leader in implants and implant procedures for hip and knee replacements. The numbers of people requiring knee and hip replacements is rising rapidly and is not going to slow in the foreseeable future, especially with rapid urbanization in China, India, and Africa. In 2018, Stryker acquired K2M, a leader in complex spine and minimally invasive solutions, for $1.4B. According to Stryker, this deal complemented its own leadership in the spine and neurotechnology markets.
Zimmer	Us	Zimmer Biomet Holdings Inc. (Zimmer Biomet) is a medical device company that focuses on musculoskeletal healthcare. The company designs, manufactures, and markets orthopedic reconstructive products; sports medicine, biologics, extremities, and trauma products; spine, craniomaxillofacial, and thoracic products; office-based technologies; dental implants; and related surgical products. Its products and solutions assist in treating patients suffering from disorders or injuries in bones, joints and supporting soft tissues. Zimmer offers various medical robotic technologies including knee robotic technology for total knee replacement.

Source: GlobalData

Private companies

The table below lists some of the interesting private companies associated with this theme and summarizes their competitive position.

Company	Country	Competitive position in the intelligent treatments theme
23andMe	US	23andMe is a personalized DNA service that provides tools for individuals to explore their DNA. They use the Illumina HumanOmniExpress-24 format chip for detecting genetic variations. The service tells customers how their genetics relate to things like abnormal blood clotting, cystic fibrosis, or their response to certain medications.
AtomWise	US	AtomWise, which is backed by Draper Fisher Jurvetson, AME Cloud Ventures, and Khosla Ventures, uses convolutional neural networks and supercomputers to facilitate the discovery of new medicines by analyzing millions of molecules at high speed.
iCarbonX	China	iCarbonX is a Shenzhen BGI spin-out led by BGI co-founder Wang Jun and backed by $158M in funding from Tencent and the Development Bank. It aims to build the ultimate live medicine platform from data points at all stages in life, including genetic data. It turns this data into insight using AI and utilizes access to China's supercomputing resources.
Verb Surgical	US	Verb Surgical is a company engaged in the development of digital surgery platform. Its digital surgery platform includes visualization, robotics, advanced instrumentation, connectivity, and data analytics/AI. The platform uses technologies developed by Verily, formerly Google Life Sciences and Ethicon Endo-Surgery, Inc., a subsidiary of Johnson & Johnson Medical Devices companies.
XRHealth	Israel	XRHealth is a technology- and communication-based company that develops breakthrough medical and wellness applications utilizing VR to deliver an enhanced experience and real-time data analytics for patients, clinicians, and healthcare providers, at clinics and at home.

Source: GlobalData

Glossary

Term	Definition
3D printing	Also known as additive manufacturing, it refers to the process of joining materials to make objects from three-dimensional model data, usually layer upon layer.
5G	5G refers to the fifth generation of cellular technology standards that will be based on IMT2020 standards, under development by the 3GPP. The term "5G" does not refer to any specific technology or standard and is therefore a loose term that can be used and interpreted in multiple different ways, typically for marketing purposes.
Artificial intelligence (AI)	Refers to software-based systems that use data inputs to make decisions on their own.
Augmented reality (AR)	Technology that allows the user to see the real world overlaid with a layer of digital content. This digital content layer can include sensor-based data, sound, video, graphics, or other datasets.
Big data	Extremely large data sets that may be analyzed computationally to reveal patterns, trends, and associations, especially relating to human behavior and interactions.
Bioprinting	A branch of 3D printing dedicated to the creation of living, organic cells by 'printing' them one layer at a time.
Cloud computing	Computing delivered as an online service. It encompasses the provision of IT infrastructure, operating software, middleware, and applications hosted within a data center and accessed by the end user via the internet.
Cybersecurity	The practice of defending computers, servers, mobile devices, electronic systems, networks, and data from malicious attacks.
Cybersecurity breaches	Unauthorized access to sensitive data, applications, networks, or servers is gained by bypassing the security mechanism.
Data privacy	The way in which customers' information is handled and shared by a company based on its importance, individual's consent, or regulatory obligations.
Exoskeleton	In robotics, this refers to a wearable mobile machine, powered by a combination of technologies that allows for limb movement with increased strength and endurance.
General Data Protection Regulation (GDPR)	A regulation that came into force across the EU in May 2018, giving consumers certain rights and protections over the data that organizations hold on them, including the right to data portability.
Genomics	The branch of molecular biology concerned with the structure, function, evolution and mapping of genomes.
Hospital robot	A robot that delivers food and drugs in a hospital.
Medical robot	A robot used in the medical sciences. This category of robot incorporates surgical robots, which either allow surgical operations to be carried out with greater precision than an unaided human surgeon, or allow for remote surgery (where a human surgeon is not physically present with the patient) to be performed.
Robot	A machine capable of carrying out a complex series of actions (typically programmed by a computer) automatically and repeatedly.
Virtual reality (VR)	Technology that aims to immerse the user in an entirely artificial world, which has the illusion of reality. It uses special equipment such as a headsets or gloves fitted with sensors to simulate a user's physical presence in a 3D environment.
Wearable tech	A blanket term for electronic devices that can be worn on the body, either as an accessory (like a watch or a pair of glasses) or as part of the material used in clothing (such as sportswear that measures biometrics).

Source: GlobalData

Further reading

GlobalData reports

Publication date	Report title
October 2020	Thematic Research: Artificial Intelligence (2020)
August 2020	Thematic Research – Robotics in Healthcare - 2020
May 2020	Thematic Research: 3D Printing in Healthcare
May 2018	Thematic Research: MedTech

Source: GlobalData

Our thematic research methodology

Companies that invest in the right themes become success stories. Those that miss the important themes in their industry end up as failures.

Viewing the world's data by themes makes it easier to make important decisions

We define a theme as any issue that keeps a CEO awake at night. GlobalData's thematic research ecosystem is a single, integrated global research platform that provides an easy-to-use framework for tracking all themes across all companies in all sectors. It has a proven track record of identifying the important themes early, enabling companies to make the right investments ahead of the competition, and secure that all-important competitive advantage.

Traditional research does a poor job of picking winners and losers

The difficulty in picking tomorrow's winners and losers in any industry arises from the sheer number of technology cycles – and other themes – that are in full swing right now. Companies are impacted by multiple themes that frequently conflict with one another. What is needed is an effective methodology that reflects, understands, and reconciles these conflicts.

That is why we developed our "thematic engine"

At GlobalData, we have developed a unique thematic methodology for ranking all companies in all sectors based on their relative strength in the big investment themes that are impacting their industries. Our thematic engine identifies which companies are best placed to succeed in a future filled with multiple disruptive threats.

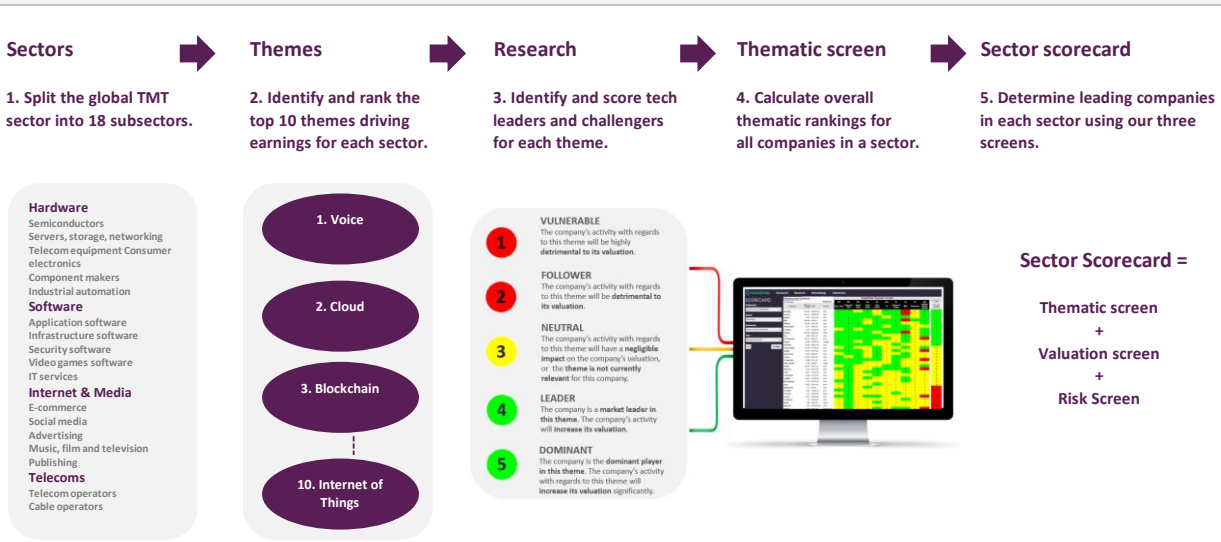
To do this, we rate the performance of the top 1,000 companies against the 50 most important themes impacting those companies, generating 50,000 thematic scores. The algorithms in GlobalData's thematic engine help to identify the long-term winners and losers within each sector.

How do we create our sector scorecards?

First, we split each industry into its component sectors, because each sector is driven by a different set of themes. Taking the TMT (technology, media and telecom) industry as an example, we split this industry into the 18 sectors shown in the graphic below.

Our five-step approach for generating a sector scorecard

Here we use the tech, media and telecom sector as an example sector, for illustration purposes



Source: GlobalData

Second, we identify and rank the top 10 themes for each sector (these can be technology themes, macroeconomic themes, or industry-specific themes). Third, we publish in-depth research on specific themes, identifying the winners and losers within each theme. The problem is that companies are exposed to multiple investment themes and the relative importance of specific themes can fluctuate. So, our fourth step is to create a thematic screen for each sector to calculate overall thematic leadership rankings after taking account of all themes impacting that sector. Finally, to give a crystal-clear picture, we combine this thematic screen with our valuation and risk screens to generate a sector scorecard used to help assess overall winners and losers.

What is in our sector scorecards?

Our sector scorecards help us determine which companies are best positioned for a future filled with disruptive threats. Each sector scorecard has three screens:

- **The thematic screen** tells us who are the overall technology leaders in the 10 themes that matter most, based on our thematic engine;
- **The valuation screen** tells us whether publicly listed players appear cheap or expensive relative to their peers, based on consensus forecasts from investment analysts; and
- **The risk screen** tells us who the riskiest players in each industry are, based on our assessment of four risk categories: corporate governance risk, accounting risk, technology risk, and political risk.

How do we score companies in our thematic screen?

Our thematic screen ranks companies within a sector based on overall technology leadership in the 10 themes that matter most to their industry, generating a leading indicator of future earnings growth.

Thematic scores predict the future, not the past.

Our thematic scores are based on our analysts' assessment of their competitive position in relation to a theme, on a scale of 1 to 5:

1	**Vulnerable**	The company's activity with regards to this theme will be highly detrimental to its future performance.
2	**Follower**	The company's activity with regards to this theme will be detrimental to its future performance.
3	**Neutral**	The company's activity with regards to this theme will have a negligible impact on the company's future performance, or this theme is not currently relevant for this company.
4	**Leader**	The company is a market leader in this theme. The company's activity with regards to this theme will improve its future performance.
5	**Dominant**	The company is a dominant player in this theme. The company's activity with regards to this theme will significantly improve its future performance.

How our research reports fit into our overall thematic research ecosystem?

Our thematic research ecosystem is designed to assess the impact of all major themes on the leading companies in a sector. To do this, we produce three tiers of thematic reports:

- **Single Theme:** These reports offer in-depth research into a specific theme (e.g. artificial intelligence). They identify winners and losers based on technology leadership, market position, and other factors.
- **Multi-Theme:** These reports cover all themes impacting a sector and the implications for the key players in that sector.
- **Sector Scorecard:** These reports identify those companies most likely to succeed in a world filled with disruptive threats. They incorporate our thematic screen to show how conflicting themes interact with one another, as well as our valuation and risk screens.

About GlobalData

GlobalData is a leading provider of data, analytics, and insights on the world's largest industries.

In an increasingly fast-moving, complex, and uncertain world, it has never been harder for organizations and decision makers to predict and navigate the future. This is why GlobalData's mission is to help our clients to decode the future and profit from faster, more informed decisions. As a leading information services company, thousands of clients rely on GlobalData for trusted, timely, and actionable intelligence. Our solutions are designed to provide a daily edge to professionals within corporations, financial institutions, professional services, and government agencies.

Unique Data

We continuously update and enrich 50+ terabytes of unique data to provide an unbiased, authoritative view of the sectors, markets, and companies offering growth opportunities across the world's largest industries.

Expert Analysis

We leverage the collective expertise of over 2,000 in-house industry analysts, data scientists, and journalists, as well as a global community of industry professionals, to provide decision-makers with timely, actionable insight.

Innovative Solutions

We help you work smarter and faster by giving you access to powerful analytics and customizable workflow tools tailored to your role, alongside direct access to our expert community of analysts.

One Platform

We have a single taxonomy across all of our data assets and integrate our capabilities into a single platform – giving you easy access to a complete, dynamic, and comparable view of the world's largest industries.

Contact Us

If you have any more questions regarding our thematic research services, please get in touch.

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