

# AUS Repository

## A Review of the Impact of Artificial Intelligence on the Healthcare Industry: A United Arab Emirates Perspective

Item Type	Article
Authors	Kais, El-Cheikh Fadi;Ghafouri, Ali;Al Shamsi, Mohamed
Download date	2024-12-03 11:25:58
Link to Item	<a href="http://hdl.handle.net/11073/21507">http://hdl.handle.net/11073/21507</a>

A Review of the Impact of Artificial Intelligence on the Healthcare Industry: A United Arab  
Emirates Perspective

El- Cheikh Fadi Kais\*

Ali Ghafouri

Mohamed Al Shamsi

MBA graduates

American University of Sharjah

Sharjah, United Arab Emirates

\* corresponding first-author

**Abstract.** The last few decades have seen an unprecedented scope and intensity of disruptors to key industries globally. Among the most impactful of these disruptors is artificial intelligence (AI), which has manifested in numerous ways across a very wide-ranging and diverse set of industries. This review article aims to provide a broad overview of global disruption and a brief history of AI as a key disruptor. The current and future impacts of AI are outlined, with a particular focus on its use in the healthcare industry, broadly defined. From this base, the article discusses specific implications of the application of AI in hospitals, using some recent examples from the United Arab Emirates. With this review article, we aim to contribute to current knowledge on the distribution of AI across the healthcare industry, and the future implications for hospitals and their immediate stakeholders.

**Keywords.** Artificial Intelligence; disruptors; healthcare; hospitals.

## **1. Introduction**

In this paper, we aim to present a review of artificial intelligence, with a particular focus on the healthcare industry. Beginning with a general introduction on global disruption, in which artificial intelligence has played a major role, the paper moves on to discuss the genesis of artificial intelligence. We then develop perspectives on the current and future impacts of artificial intelligence on the healthcare industry in general, and on hospitals, specifically. The paper concludes with a discussion of the strategic implications of these impacts on hospitals and other players in healthcare; using examples from the United Arab Emirates for illustrative purposes.

The world has changed dramatically over the past century. When was the last time you went to the bank to cash your cheque? Or booked a ticket by going to a travel agency office? And where are all the video rental shops? Whole businesses have been disrupted or destroyed by new forces, and ‘traditional’ economic models are being turned around. How can businesses prepare for the impact of these forces on their industries and their firms now and in the future?

From the time when the industries started emerging and many companies entered these industries, the formula of the world economy has been changed. Companies increasingly compete by using new emerging global disruptors in their industries. In Business, disrupt means to radically change (an industry, business strategy, etc.), for example, by introducing a new product or service that creates a new market (*Dictionary.com*, 2020). As a result, a disruptor can be formed from innovative or entrepreneurial actions. Global disruptors open the way for disruptors at the industry and firm level. As such, businesses can change whole industries either in terms of increasing the accessibility for the customers or changing the industry dynamics. To be a disruptor is to create an item, administration, or method for doing things which dislodges the current market pioneers and inevitably replaces them at the forefront of the industry. Disruptors

are frequently connected to industries characterized by fast-moving innovation, yet can be found in practically any area of business.

A key aspect of such change is the notion of disruptive innovation. Disruptive innovation is a process by which an underrated service or product starts to become popular enough to replace, or displace, a conventional service or product (Daisyme, n.d.). Incumbent companies would experience the new entrant to the market as a significant loss of market share or changing trends in the market.

## **2. Historical, Present and Future Examples of Global Disruption**

Disruption is inevitable. How fast businesses, governments or even individuals adapt and harness these disruptions can dictate whether they will fall behind or lead the change. A classic example of a global mega disruptor seen throughout history is the Industrial Revolution which began in Britain in the 18<sup>th</sup> century. This process propelled industries to evolve from an agrarian and handicraft economy to one dominated by industry and machine manufacturing (Augustyn et al, 2019). This revolution spread across the globe and had rippling effects across technological, socioeconomic, and cultural landscapes. Technological changes included the usage of new materials such as iron and steel as well as new energy sources such as the steam engine, electricity, petroleum, and the internal-combustion engine. In addition, new machines were invented such as the spinning jenny and the power loom that permitted increased production, sparing human energy (Augustyn et al, 2019). New organized work systems were also created, predominantly known as the factory system, which focused on increased division of labor and specialization of function. Developments in transportation and communication occurred,

including the steamship, automobile, airplane, telegraph, and radio. These technological changes resulted in an increased use of natural resources and the mass production of manufactured goods (Augustyn et al, 2019).

Today, our world is undergoing an even more dramatic transition due to the convergence of four fundamental disruptive forces (Dobbs, Manyika, & Woetzel, 2015). Compared with the Industrial Revolution, McKinsey estimates that this change is happening ten times faster and at 300 times the scale, or roughly 3,000 times the impact (Dobbs, Manyika, & Woetzel, 2015). The first disruptive force is the economic impact of technology and people's appetite for gaining an advantage through fast technology adoption. In the past, people took time to assimilate emerging technologies. Now, in comparison, people are hungry for what is next. For example, it took radio 38 years to attract 50 million listeners, whereas Facebook attracted 6 million users in its first year and that number multiplied 100 times over the next five years (Dobbs, Manyika, & Woetzel, 2015). Automation, digitalization, artificial intelligence, big data are quickly adopted by businesses, governments and individuals around the globe, leading to accelerated innovation in multiple sectors and markets.

The second global disruptor identified by McKinsey is the aging population. For the first time in human history, aging could mean that the planet's population will plateau in most of the world. In 2013, about 60 percent of the world's population lived in countries with fertility rates below the replacement rate (2.1 children per woman) (Dobbs, Manyika, & Woetzel, 2015). This will result in a greater burden being placed on a smaller workforce to maintain, or improve, productivity. In addition, caring for large numbers of elderly people will put pressure on government finances, which may result in increased taxes and other ramifications. Alternatively,

this disruption can be perceived as an opportunity for the healthcare and pharmaceuticals industries.

The third disruptive force is what McKinsey describes as the “flow” of trade through the movement between, and connection of, capital, people, and information. In the past, globalization was fueled through trade and finance. However, today, the global trading system has evolved into a much more complex network connecting flows between emerging markets in Asia, which is becoming the world’s largest trading region (Dobbs, Manyika, & Woetzel, 2015). In 2012, the flow of goods, services and finance reached \$26 trillion, which accounts for 36% of global GDP, 1.5 times the level in 1990 (Manyika et al., 2014). The volume of trade between China and Africa rose from \$9 billion in 2000 to \$211 billion in 2012. This ushers in a new period of globalization, introducing new opportunities, but also possible unexpected volatility (Dobbs, Manyika, & Woetzel, 2015).

The final trend is the shifting of the economic hotspot to emerging markets like China. As recently as 2000, 95 percent of the Fortune Global 500, the world’s largest international companies including Airbus, IBM, Nestlé, Shell, and The Coca-Cola Company, were headquartered in developed economies (Dobbs, Manyika, & Woetzel, 2015). In 2019, 129 Chinese companies (including Taiwan) made it to the 2019 Fortune Global 500 surpassing the US that has 121 companies in this list. In 2018, there were 120 Chinese companies listed (Xiaoyang, 2019). According to the study by McKinsey, it is expected that nearly half of the world’s large companies (defined as those with revenue of \$1 billion or more) will be headquartered in emerging markets by 2025 (Dobbs, Manyika, & Woetzel, 2015). What was not anticipated in this study, was the unforeseen novel coronavirus outbreak, or COVID-19, that originated in Wuhan, China on 31 December 2019 and is currently spreading across the globe

(Novel Coronavirus - China, 2020). In the first quarter of 2020, China's economy shrank by 6.8% as a result of the coronavirus pandemic (Kuo, 2020). However, during the second quarter of 2020, China's economy grew by 3.2% which is a sign of recovery (Patranobis, 2020).

This century is best described as the era of uncertainty (Klein, 2017). While analysts try to predict future trends in 2030 or 2050, from prediction advancements in tools such as automation, to Cloud computing, to Internet of Things, there are still mega disruptors under the surface that may steer significant changes in the next couple of decades. One example is resource scarcity. As the world's population continues to grow, there is increased pressure to conserve natural resources that have significant implications on poverty, inequality, demographics, and public health. Water scarcity will become a severe problem in the future, as only 60% of the fresh water needed will be available by 2050 (Klein, 2017).

Environmental awareness is another disruptor that is only just emerging from under the radar. More than 2 billion aspirational consumers prefer sustainable consumption. According to a survey in 2016, 63% of all consumers are positive influencers and encourage others to buy from environmentally and socially responsible companies (Klein, 2017). Consumers, businesses and governments are becoming more and more demanding of cruelty free, zero-waste and environmentally sustainable products and practices. 'Green' buildings have become the trend in the 21st century, but now entirely 'green' cities will become the standard, which will most likely reform the construction industry (Klein, 2017).

Another future technological disruptor can be seen in the healthcare industry, and is commonly referred to as "The Technization of Healthcare". Advances in technology have propelled the development of digital medicine and bioinformatics, advanced genomics, digital



manufacturing, nanotechnology, and the widespread development of genetically modified products (Klein, 2017). The confluence of biomedicine and information technology has transformed medicine to become a data-driven science, capable of providing affordable healthcare to anyone anywhere. This will enable physicians and other caregivers to obtain vital patient biometrics in real time through the transmission of med-tech industry sensor-enabled remote monitoring devices (Klein, 2017). In addition, through developments in AI and robotics, surgeries conducted remotely will become common practice in the future.

Geospatial technology, the process of gathering and analyzing geographical data to understand the locational patterns of a subject, has disrupted many industries and will continue to do so in the next couple of decades. The ways in which locational data are collected, analyzed, and stored are critical for achieving sustainable advantages; this is particularly the case when the concept of “liquid data” comes into play (Klein, 2017). When combined with AI, this technology can provide businesses with significant advantages. For example, it can be used in the healthcare industry to identify hotspots for possible accidents, or can be used by the defense industry to predict terrorist attacks or potential crime hotspots.

Out of all these global disruptors, Artificial Intelligence (AI) had attracted our attention the most, because of its various impacts in a wide range of industries. In the next section will discuss AI’s history, current manifestations and its future impacts.

### **3. The History of Artificial Intelligence**

Artificial intelligence is “a system’s ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation.”

(Haenlein, & Kaplan, 2019, p. 5). In 1956, the field of Artificial Intelligence (AI) was formally founded at a conference at Dartmouth College, but achieving AI was not simple. AI researchers at that time faced limitations, such as slow processing speeds and not enough memory. During the period of 1970s-1980 the U.S and the U.K had dropped their interest and funding to AI research due to the limitations that researchers faced at that time. This period became known as the 'first AI winter', but, after the introduction of expert systems, this winter period had come to an end (Foote, 2016).

Expert systems are “a subset of AI projects that attempt to achieve expert-level results in solving tough problems like contract estimation or air freight scheduling. An expert system is a computer program that mimics the behavior of an expert.” (Leonard-Barton, & Sviokla,1988, p.91). Expert systems were adopted across many industries. An example of these systems is MUDMAN, which analyzes oil drilling fluids; it differentiated the company, Baroid, from its rivals and offered something unique to its customers. For example, MUDMAN had correctly diagnosed a mud contamination problem at a site in the North Sea that human experts had misdiagnosed for more than a decade. This prompted Baroid’s customers to change their policies and invite Baroid to bid on more than the normal share of business (Leonard-Barton, & Sviokla,1988). Expert systems are a valuable tool for capturing and circulating skills and knowledge, this example demonstrated how expert systems can support various competitive strategies by using a differentiated product or service to achieve competitive advantage (Leonard-Barton, & Sviokla,1988). Another historical success of AI was the IBM AI computer called Deep Blue that was developed in 1997 and defeated the chess grandmaster Garry Kasparov (Lewis, 2014).

#### **4. Artificial Intelligence - Current Manifestations and Impacts**

Nowadays, artificial intelligence is impacting our daily lives in many different ways. Our smartphones include several AI based applications such as Bixby, Siri, Alexa, Google assistants and others (Agarwal. 2020). These applications are virtual assistants that users can interact with using text or speech; these applications then execute the user commands. For example, if a user has Samsung smartphone, he/she can tell Bixby to set an alarm using their voice; when Bixby asks “what time do you want me to wake you up?” and if the user replies “what time do you prefer?”, Bixby can set a time alone. In addition, the ‘feeds’ on a user’s social media timelines include advertisements that are selected by AI. This is possible because AI utilizes the user’s web searches, interactions and other smartphone activities the user has engaged in to tailor the experience of these feeds exclusively to the user (Agarwal. 2020).

AI had also disrupted the automobile industry, Tesla cars have autopilots which use AI to predict automobile accidents before they occur (Snappy, 2017). The autopilot made Tesla cars nine times safer than that of cars driven without an autopilot (Dow, 2019). AI is changing the financial industry as well. The Bank of America has developed Erica, an AI enabled chatbot that provides bank clients with financial guidance 24/7 through text and voice messages. As with other industries, AI chatbots would decrease the banking sector’s costs of hiring employees. It is estimated that AI will save the banking industry more than \$1 trillion by 2030 (Maskey, 2018). However, small to medium sized institutions are struggling to catch up with and use these technologies. Larger firms have more capabilities when compared to smaller sized firms in offering attractive paychecks for AI and machine learning experts (Maskey, 2018). Although this gives bigger firms the first mover advantage in adopting AI technology, there are fears of reduced customer loyalty due to less personal contact.

Artificial Intelligence (AI) is changing the educational industry. For example, AI tutors provide instruction in a wide range of topics, providing individualized and efficient feedback to each student. In addition, AI tutors can address a student's specific learning needs. AI makes learning happen anywhere at any time. Some AI systems can read facial cues to assess if students are feeling tired, stressed, or energetic. AI can collect data in massive quantities and use these data to understand a student's learning pattern and knowledge gap; it can then determine the teaching methods that can work most effectively with a specific student. Furthermore, AI can perform grading, giving teachers more time to focus on teaching. At this time AI cannot replace any in-person instructor (Maskey, 2020), but is seen as a useful supplement.

In the same way that AI has changed the daily lives of individuals, from our smart phone applications, learning processes, navigation, among many others, it is also changing how companies compete and do business. One of the industries that had been disrupted significantly by AI is the medical industry, and this is apparent across the healthcare sector in the UAE. In recognizing the importance of AI in this sector, the Dubai Health Authority (DHA) launched its artificial intelligence strategy during the seventh DHA Transformation Forum in May 2018 (Nazzal, 2018). The authority noted that AI would strengthen its medical personnel and systems by offering diagnosis and treatment to patients. One of these AI technologies is a 24/7 video link that connects patients to medical doctors around the world, and this application is already being used by millions of patients worldwide (Banda, 2018). In addition, the DHA taught nurses and physicians in DHA hospitals how to use an AI machine that monitors and regulates patients' blood sugar levels in real time, by using biosensors that read various physiological parameters. These AI technologies improve the standard of care and help hospitals and health authorities to control costs. Another AI medical technology included in DHA's strategy is the neuro headband

that allows for early detection of the likelihood of strokes occurring in high risk patients (Banda, 2018). This will give DHA hospitals a first mover advantage in using AI over other hospitals in the UAE. Following this lead, Al-Zahra Hospital in Dubai installed an Artificially Intelligent Magnetic Resonance Imaging (MRI) machine, which diagnosis patients more accurately and much faster than the traditional MRI, thus leading to reduced MRI waiting lists (“Artificial Intelligence A Key Growth Enabler for UAE’s Healthcare Sector: Al Zahra Hospital,” 2019).

## **5. The Future impacts of Artificial Intelligence Developments**

In the future, AI will likely be used for early detection, or even prediction, of disease outbreaks, as long as there is sufficient data on the new disease (Thomson, & Ring, 2020). This will help by preventing the disease from spreading at a very early stage and limit diseases from causing public disruptions. AI machines can also be trained for drug discoveries, which will make the finding of new therapies faster. For example, a company called Exscientia uses AI for drug discovery, which helped it design a new compound for Obsessive Compulsive Disorder (OCD) five times faster than average; the compound is currently in the laboratory testing phase (Thomson, & Ring, 2020).

HSBC is planning to introduce AI bots to combat money laundering, fraud and terrorism activity by comparing customers transactions against public data to detect any suspicious activity. Banks spend five billion British sterling pounds per year to combat these crimes, and AI is expected to reduce these costs (Worledge, 2018). AI robotics will help firms to maximize sales and minimize delivery times in the distribution channels, and companies will have the ability to manage risks and profitability more efficiently (Dirican,2015). AI will likely replace people in

the education sector due to the applications that already exist (e.g. AI tutors), and others in development (Dirican,2015). Developments in AI technology are expected to lead to the unemployment of some low skilled human workforces. In addition, it may lead to a decrease in enrollment rates at schools and universities due to the ease of reaching and processing of education data (Dirican,2015), often at much lower cost to the consumer. AI is impacting people's daily lives in many different ways, as it disrupts and changes many industries. AI is helping firms decrease their costs and improve quality. In the next section, we will expand our discussion about the healthcare industry, the current and future impacts of AI in healthcare and its implications for hospitals in the UAE.

## **6. Review of the Healthcare Industry**

The healthcare industry is the industry which provides goods and services to treat and cure patients. This industry is devoted to prevention, diagnosis, rehabilitation and treatment of medical conditions. In the US, healthcare makes the largest part of the GDP after the military (Cohen, 2014); however, the industry is facing risks and challenges since it requires continuous innovation under increased regulations ("Overview of Healthcare Industry," 2012). The healthcare industry consists of four main interrelated sectors: healthcare services and facilities, such as hospitals; manufacturers of medical equipment and devices; medical insurance providers; and pharmaceutical companies (Wilston, 2019).

Advancements in the healthcare industry are used to draw the margin between developing and developed countries, usually by assessing life expectancies and death rates (Wilston, 2019). Several international country indices rank countries around the globe based on healthcare

criteria, mainly life expectancies. One of these indices is the Human Development Index (HDI), which uses life expectancy at birth as a criterion for human development (“Human Development Index and its components,” 2019). Another index is the World Happiness Index, which uses life expectancies to rank the happiest countries (Hrala, 2016). Such indices highlight the importance of a nation’s healthcare industry to achieve lifelong expectancy for its citizens by providing quality healthcare.

In the past decade, the activity of hospital mergers and acquisitions (M&A) has increased significantly. M&A helps in creating operational, strategic, and financial value for the seller and buyer mainly driven by the capability of achieving economies of scale (Peterson & Thomas, n.d.). Moreover, M&A, or collaborations, helps pharmaceutical companies to strengthen their R&D capabilities. For example, in the past few years, new R&D collaborations have occurred between biopharmaceuticals and AI companies to boost early stage drug discovery (Buvailo, 2018). Many AI companies are increasingly confident in their approach and are now looking to partner with companies instead of being acquired (Palmer & Gillet, 2020).

The healthcare industry is facing issues, such as the need for care model innovation, because patients are increasingly demanding transparency, access, convenience and personalized products and services. There is also a widening supply-demand gap of skilled professionals, especially among physicians and nurses. In addition to issues related to financial and performance improvements, the entry of non-traditional players using digital and AI disruption have the potential to suppress or support the growth of revenues for organizations operating in the healthcare industry (Burrill, n.d.).

## **7. Current Impacts of Artificial Intelligence on the Healthcare Industry**

Currently, there are more than 230 biotechnology and pharmaceutical startups using AI in drug discovery (Smith, 2020). Pharmaceutical and technology companies are investing billions of dollars in building their AI capabilities in a hope for a faster discovery process and a decrease in costs of discovery (Nelson, 2018).

GlaxoSmithKline (GSK) opened an AI drug discovery unit in Baltimore which helped the company search through its database of 230,000 drug candidates that were designed to target a specific brain disease. AI algorithms analyzed common features of chemical structures that were able to get into the brain and revealed that all candidates were not helpful to target this disease (Nelson, 2018). GSK would have lost time and resources in testing these drug candidates if it didn't invest in AI. In 2016, BenevolentAI which is Europe's largest private AI company identified five drug candidates for amyotrophic lateral sclerosis (ALS) within just a week; without AI, it could have taken years to identify these candidates (Nelson, 2018).

Johns Hopkins Hospital partnered with General Electric (GE) for the usage of predictive AI techniques to make patient operational flow more efficient. Since its implementation there has been an improvement of 60% in the hospital's ability to admit patients and 21% increase in patient discharges before noon. This resulted in a much faster and more convenient patient experience (Daley, 2020). An AI tool called KenSci can predict a hospital's financial, clinical and operational risks, which can tell everything from who is at risk of getting sick, to what is driving up the hospital's costs. This is achieved by combining AI and big data collected from existing sources (Daley, 2020).



Artificially intelligent robots are being used as assistants in surgeries. They are assisting medical teams in many different procedures, from minimally invasive procedures to open heart surgeries. Some of these robots are equipped with mechanical arms, surgical instruments, and cameras. Surgeons control the mechanical arms while seated and viewing the surgical site in a magnified three-dimensional view from their computer screen transmitted by the robot. Robot-assisted surgeries have led to less pain, fewer surgery related complications, and a quicker recovery time. The most well-known type of robot surgery assistant is the da Vinci type which received FDA approval more than 18 years ago; it has since evolved to incorporate AI technologies to assist in more complex surgeries. Today, da Vinci platforms provide analytics to surgeons by constantly collecting data to improve future surgeries (Daley, 2020).

Several free AI smartphone applications are currently available to track and measure the user's health. BioBase is an application that gives the user an opportunity to track, measure, manage stress, and then track the stress over weeks. BioBase helps in measuring body stress, conducting brain function tests and tracking mood. Another AI application is Youper, this application was installed by more than 1 Million users, it is an emotional health assistant that assists users through conversations and incorporates strategies such as acceptance and commitment therapy, cognitive-behavioral therapy and other scientific approaches then personalizes them to fit the user's needs (Choudhury, 2019). Since such AI applications offer free psychotherapies, many patients would view AI mental health applications as a cheaper and more convenient source of therapy than visiting a psychologist or a psychiatrist. This would have a huge impact on the healthcare industry, especially on psychotherapy clinics.

## **8. Future Impacts of Artificial Intelligence on the Healthcare Industry**

As AI technology is changing every day, the healthcare industry among those affected the most, and it is likely that more shifts will occur in the future. In the healthcare sector, AI can be divided in terms of the type of data being analyzed. The analysis of structured data is known as Machine Learning (ML), and analysis of unstructured data is called Natural Language Processing (NLP) (Williams, 2018). These two categories are helping the industry to remain in the growth phase of the healthcare industry life cycle. ML has shifted the industry by improving imaging data, and NLP followed in the context of managing data associated with clinical notes and medical literature. Natural Language Processing is “the ability for computers to understand the latest human speech terms and text.” (“Natural language processing in healthcare,” n.d., para. 1). NLP in healthcare uses specialized engines that are able to purify large sets of unstructured data to discover improperly coded patients’ conditions or those that were previously missed (“Natural language processing in healthcare,” n.d.). Initial analyses suggest that the impact of technology can renew industry life cycles by five years (Fountain, McCarthy, & Saleh, 2019). For example, with the evolution of existing technology and the subsequent development of new MRI machines over the previous five years, imaging times have become faster, clearer and more efficient than previous models, which enhances diagnostic speed and accuracy.

It is reasonable to assume that, after a decade, multiple sources of wellbeing information will converge to make a multifaceted and profoundly customized image of each user’s wellbeing. According to Unfoldlabs (2017), wearable gadgets like smartwatches, which track the heart rate, sleeping time, and walking steps, have become unified with people’s daily lives, which was barely conceived of a decade ago. The most recent updates of these devices can change the pattern of data collection and analysis in such a way that the measurements become invisible. The accessibility of information and customized AI can empower exactness,

prosperity, and continuous micro-interventions that permit societies to prepare ahead of serious infections occurring (Batra, Betts, & Davis, 2019).

While it is difficult to predict the future accurately, we can observe signals in the market today, including powerful shifts occurring in different businesses, to help assess the future of healthcare. If the trends continue, we will see major shifts arising from the use of AI in the healthcare industry in the next decade. An example can be observed in how the COVID-19 pandemic is currently impacting global R&D spending for AI in healthcare and pharmaceuticals. According to Petrara (2020) this will increase to US\$1.5 billion by 2025. The utilization of new knowledge in healthcare and pharmaceuticals, driven by vast amounts of information and brilliant simulated intelligence could help recognize ailments early, empower proactive mediation, and improve the comprehension of infection migration.

The use of robots in surgeries is starting to shift the healthcare industry dramatically. Using various forms of AI, robots can substantially reduce human errors during surgical procedures, with benefits spilling over into many parts of the healthcare industry, as well to patients directly. New companies focused on AI are emerging in the field of healthcare, such as Tempus, which is a company that focuses on data harnessing technology to personalize cancer treatments. Another example is QuiO, which is a medical supplier that provides AI enabled wireless medical devices (Thomas, 2019). Such companies will make the healthcare industry more attractive for investments, with estimates suggesting that this will reach more than 6.6 billion dollars by 2021. Much of this investment will be targeted towards software solution providers that will supply hospitals, pharmaceutical companies and medical equipment manufacturers (“Artificial Intelligence in the Healthcare Market Size, Share & Trends Analysis Industry Report,” n.d.). Moreover, the new concept of mobile health is expected to create a

massive revolution in the industry, with the future belonging to mobile health. “Mobile Health, or mHealth, describes the use of mobile and wireless communication technologies to improve healthcare delivery, outcomes, and research. mHealth is poised to play a larger role in engaging patients in self-care as smartphone ownership is rising globally” (Singh & Landman, 2017, p.183).

Given the advances and uptake of AI in the healthcare industry, it is assumed that the healthcare industry will not be able to survive without AI. The players that are likely to be affected the most are insurance companies, pharmacies, hospitals, clinics, medical equipment manufacturers and delivery couriers. Technical integration will be necessary to accommodate and leverage from this shift. New solutions that will eliminate some existing processes through automation will change the industry’s structure and dynamics, which, in turn, will demand the adoption of new competencies and capabilities. Organizations in the healthcare industry will be required to implement training for medical personnel to shift into this new model, and will also engage in the acquisition of the latest technologies in their field. Considering all the factors discussed, corporate strategies will need to be re-formulated accordingly to keep ahead of these changes.

## **9. Implications of the Strategic Impact of AI on the Healthcare Industry**

In this section of the paper we discuss the implications of the strategic impact of AI in healthcare, particularly in hospitals, with reference to the United Arab Emirates for illustrative purposes.

Currently, all UAE's public hospitals are using or will soon be going to use AI technologies that were provided by the UAE Ministry of Health and Prevention to improve the efficiency and management of patient flow at emergency departments by reducing waiting time which is done by smart prediction of patient flow. In addition, these hospitals are using such AI technologies to monitor patients in the newborn and adults' intensive care units (ICUs) through high quality cameras connected to patients' monitoring devices which sends audio and visual alarms during emergency cases ("United Arab Emirates Ministry of Health & Prevention," 2019).

The Cleveland Clinic Abu Dhabi is the result of an agreement signed in 2006 between Mubadala Investment Company and US-based Cleveland Clinic, in support of the Abu Dhabi government's Economic Vision 2030 to develop a robust healthcare sector in the emirate. The hospital acts as a catalyst for medical innovation in the UAE and has already made great strides towards implementing innovations such as robotic surgeries, 3D printing for pre-surgical planning as well as AI-powered operational solutions ("State of the Clinic Report," 2018). This hospital is already taking a lead in terms of innovation, fast adoption and achievements in medical firsts in the UAE. However, like all hospitals, their future success will depend on how fast they adopt AI and how the following resulting implications are handled. Other private hospitals such as Al-Zahra Hospital in Dubai had installed an Artificially Intelligent Magnetic Resonance Imaging (MRI) machine ("Artificial Intelligence A Key Growth Enabler for UAE's Healthcare Sector: Al Zahra Hospital," 2019). Furthermore, the American Hospital in Dubai is planning to customize cancer treatments using AI (Chaudhary, 2020).

The first major implication caused by AI's disruption of the healthcare sector is its consequent impact on healthcare education. AI will change the healthcare workforce and will bring with it new activities and skills that revolve around innovation, entrepreneurship,

continuous learning, and multidisciplinary working (Spatharou, Hieronimus, & Jenkins, 2020). AI in healthcare will require leaders well-versed in both biomedical and science. Therefore, continuous learning is integral as AI is driving the health industry to rethink education and skills. Upgrading clinical training is also essential since AI is driving the demand for professionals with multidisciplinary roles. For example, in data-rich areas, such as genomics, new professionals would emerge including 'hybrid' roles, such as clinical bioinformaticians, specialists in genomic medicine, and genomic counsellors (Spatharou, Hieronimus, & Jenkins, 2020).

The second implication triggered by AI is the need for health systems to attract and retain scarce and valuable talent. According to The World Health Organization, demand for healthcare workers with both new and existing skills will increase by 2030. In Europe for example, demand is expected to rise to 18.2 million by 2030 while the current supply of nurses, midwives, and healthcare assistants across is only 8.6 million (Spatharou, Hieronimus, & Jenkins, 2020). Healthcare management will help to alleviate these workforce shortages in healthcare through advancements in mobile medicine, automated diagnosis and remote surgeries. However, due to an overall increase in demand for healthcare workers, provision of attractive offers to recruit and retain talent will be central to organizational strategies for AI integration.

The third implication is the need for proper data management and governance. Given the volume of data required for AI, inept processes could result in expensive and inefficient implementations. This step is the most critical as basic digitization of systems and data has to be in place before embarking on AI deployments (Spatharou, Hieronimus, & Jenkins, 2020). Setting up the governance around data management can be challenging, since it requires 1) access to available data, 2) quality of the available data, 3) data anonymization or the process of protecting private or sensitive information by erasing or encrypting identifiers that connect an individual to

stored data (“What is Data Anonymization,” 2020). Consolidating and linking different datasets are also important; hence, in order to make the most of the rich data that is available, healthcare systems need an interconnected data infrastructure (Spatharou, Hieronimus, & Jenkins, 2020).

This brings us to the fourth implication: quality. According to a survey developed by Mckinsey, the lack of multidisciplinary development and early involvement of healthcare staff were cited as major barriers to addressing quality issues (cited in Spatharou, Hieronimus, & Jenkins, 2020). Practitioners need to be involved in the design phase of AI implementation in order to provide valuable feedback on the underlying data to avoid biases that might be embedded in algorithms. According to the report, transparency and collaboration between innovators and practitioners will be key in scaling AI in healthcare.

The fifth and perhaps the most obvious implication is change management. A survey by Mckinsey revealed that AI can help remove or minimize time spent on routine, administrative tasks, which can take up to 70% of a healthcare practitioner’s time. More and more AI driven solutions are being introduced in a broader number of specialties, such as oncology, cardiology, or neurology (Spatharou, Hieronimus, & Jenkins, 2020). This highlights the need for hospitals to manage the inevitable change in organizational culture requiring healthcare workers to seamlessly integrate new processes into their workflow in ways not previously utilized.

The sixth implication results from the fact that an increasing number of governments around the world have set out aspirations for AI in healthcare. For example, in the UAE, controls have been put in place in the new artificial intelligence policy laid out by the Department of Health in Abu Dhabi. All healthcare providers, drug producers, researchers and insurers must now comply with new artificial intelligence regulations and guidance issued by government regulators (Webster, 2018). “The true path to the development of the emirate’s healthcare

systems and services is through artificial intelligence,” said Mohamed Al Hameli, acting undersecretary of Department of Health, Abu Dhabi. This step is essential as AI begins to dominate technological innovations in the industry (Webster, 2018). These kinds of initiative pave the way for collaboration between practitioners and innovators in designing AI technologies; research suggests that this will help to avoid potential biases embedded in AI algorithms (Spatharou, Hieronimus, & Jenkins, 2020).

The final implication to be discussed in this paper is the result of an intersection between two major disruptors: AI and an aging population. Medical science has improved rapidly, raising life expectancy around the world, but as longevity increases, healthcare systems face growing demand for their services (Spatharou, Hieronimus, & Jenkins, 2020). The population aged 65+ in 2020 is 0.9% of UAE’s population. In 2050, this number will increase to 24.6% (“The demographic Profile of the United Arab Emirates,” 2019). Managing patients with age-related illnesses is expensive and requires systems to shift from an episodic care-based philosophy to one that is much more proactive and focused on long-term care management (Spatharou, Hieronimus, & Jenkins, 2020).

In summary, healthcare is an industry that is being significantly impacted by AI. Many components in healthcare will change to impact internal stakeholders (physicians, nurses, staff and patients) as well as external stakeholders (e.g. insurance providers, and a range of suppliers). Our research highlights the current and future impacts of AI in healthcare, and suggests that, while AI is still a relatively new concept in healthcare, its long-term implications are uncertain. Building organizational AI infrastructure today can prepare industries to quickly enable innovation and adoption tomorrow.



## **Acknowledgement.**

The authors thank Professor Valerie Lindsay (AUS) for her support in reviewing this article.

## **References**

Agarwal, R. (2020, March 8). 15 Examples of Artificial Intelligence You're Using in Daily Life.

Retrieved March 8, 2020, from website: <https://beebom.com/examples-of-artificial-intelligence/>

Artificial Intelligence in the Healthcare Market Size, Share & Trends Analysis Industry Report

By component (Hardware, Software, Services), By Application, By Region, Competitive Insights, And segment forecasts 2019-2025. (n.d.). Grand View Research, Retrieved from

<https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-ai-healthcare-market/methodology>

Artificial Intelligence: A Key Growth Enabler for UAE's Healthcare Sector: Al Zahra Hospital.

(2019, July 27). Retrieved March 9, 2020, from website: <https://www.dubaihealthcareguide.com/artificial-intelligence-key-growth-enabler-uaes-healthcare-sector-al-zahra-hospital/>

Augustyn, A. (2019, September 4). Industrial Revolution. Retrieved March 10, 2020, from

<https://www.britannica.com/event/Industrial-Revolution>

- Banda, E. (2018, August 24). Retrieved March 9, 2020, from website: <https://www.computerweekly.com/news/252447416/Dubai-Health-Authority-launches-artificial-intelligence-strategy>
- Batra, N., Betts, D., & Davis, S. (2019, April 30). Forces of change. Deloitte, Retrieved from <https://www2.deloitte.com/us/en/insights/industry/health-care/forces-of-change-health-care.html>
- Burrill, S. (n.d.). 2020 US and global health care outlook. Deloitte, Retrieved April 26, 2020, from Deloitte website: <https://www2.deloitte.com/us/en/pages/life-sciences-and-health-care/articles/global-health-care-sector-outlook.html>
- Buvailo, A. (2018, October 8). How Big Pharma Adopts AI To Boost Drug Discovery. Retrieved April 27, 2020, from website: <https://www.biopharmatrend.com/post/34-biopharmas-hunt-for-artificial-intelligence-who-does-what/>
- Chaudhary, S. (2020, March 8). American Hospital in sync with UAE's vision for healthcare innovation, *Gulf News*. Retrieved from <https://gulfnews.com/uae/health/american-hospital-in-sync-with-uaes-vision-for-healthcare-innovation-1.69969932>
- Choudhury, A. (2019, December 15). Retrieved April 28, 2020, from: <https://analyticsindiamag.com/top-ai-based-mental-health-apps-in-2019/>
- Cohen, G. (2014, April 2). What is the purpose of healthcare? *Thomson Reuters Foundation News*. Retrieved from <https://news.trust.org/item/20140402123148-6vk7g/>

- Daisyme, P. (n.d.). What Is Disruption, Really? 8 Examples and What to Learn from Them. Retrieved March 10, 2020, from <https://www.startupgrind.com/blog/what-is-disruption-really-8-examples-and-what-to-learn-from-them/>
- Daley, S. (2020, March 25). Surgical Robots, New Medicines and Better Care: 32 Examples of AI in Healthcare. Retrieved April 28, 2020, from <https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare>
- Dirican, C. (2015). The impacts of robotics, artificial intelligence on business and economics. *Procedia-Social and Behavioral Sciences*, 195, 564-573.
- Disrupt. (2020). *Dictionary.com*. Retrieved from <https://www.dictionary.com/browse/disruptor>
- Dobbs, R., Manyika, J., & Woetzel, J. (2015, April). The four global forces breaking all the trends. Retrieved March 10, 2020, from <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/the-four-global-forces-breaking-all-the-trends>
- Dow. J. (2019, October 23). Retrieved March 9, 2020, from website: <https://electrek.co/2019/10/23/tesla-autopilot-safety-9x-safer-than-average-driving/>
- Foote. K. (2016, April 5). Retrieved March 8, 2020, from website: <https://www.dataversity.net/brief-history-artificial-intelligence/>
- Fontaine, T., McCarthy, B., & Saleh, T. (2019, June 18). Building the AI-Powered Organization. Retrieved from <https://hbr.org/2019/07/building-the-ai-powere-organization>

Haenlein, M., & Kaplan, A. (2019). A brief history of artificial intelligence: On the past, present, and future of artificial intelligence. *California Management Review*, 61(4), 5-14.

Hrala, J. (2016, March 17). The World Happiness Index 2016 Just Ranked the Happiest Countries on Earth. *Science alert*, Retrieved April 27, 2020, from website: <https://www.sciencealert.com/the-world-happiness-index-2016-just-ranked-the-happiest-countries-on-earth>

*Human Development Index and its components*. Retrieved from United Nations Development Programme website: <http://hdr.undp.org/en/content/table-1-human-development-index-and-its-components-1>

Klein, F. (2017, July). Beyond the Noise the Megatrends of Tomorrow's World. Retrieved March 10, 2020, from website: <https://www2.deloitte.com/content/dam/Deloitte/nl/Documents/public-sector/deloitte-nl-ps-megatrends-2ndedition.pdf>

Kuo, L. (2020, April 17). China's economy shrinks as coronavirus hits world trade. *The Guardian*. Retrieved from <https://www.theguardian.com/world/2020/apr/17/china-economy-shrinks-record-wuhan-covid-19-death-toll-rises-50-percent>

Leonard-Barton, D., & Sviokla, J. J. (1988). Putting expert systems to work. *Harvard Business Review*, 66(2), 91-98.

Lewis, T. (2014, December 4). A Brief History of Artificial Intelligence. Retrieved June 8, 2020, from livescience website: <https://www.livescience.com/49007-history-of-artificial-intelligence.html>

- Manyika, J., Bughin, J., Lund, S., Nottebohm, O., Poulter, D., Jauch, S., & Ramaswamy, S. (2014, April 1). Global flows in a digital age. Retrieved August 15, 2020, from: <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/global-flows-in-a-digital-age#>
- Maskey, S. (2020, March 3). AI's Potential in Education. Forbes, Retrieved from <https://www.forbes.com/sites/forbestechcouncil/2020/03/03/ais-potential-in-education/#33b2bbf85201>
- Maskey, S. (2018, December 5). How Artificial Intelligence Is Helping Financial Institutions. Forbes, Retrieved from <https://www.forbes.com/sites/forbestechcouncil/2018/12/05/how-artificial-intelligence-is-helping-financial-institutions/#76eeca88460a>
- Natural language processing in healthcare. (n.d.), foresee medical, Retrieved October 20, 2020, from: <https://www.foreseemed.com/natural-language-processing-in-healthcare#:~:text=Natural%20language%20processing%20in%20healthcare%20Natural%20language%20processing,privacy%2C%20personal%20voice%20assistants%20and%20language%20translation%20applications.>
- Nazzal, N. (2018, May 21). DHA launches Innovation and AI strategy. *GULF NEWS*. Retrieved from <https://gulfnews.com/uae/health/dha-launches-innovation-and-ai-strategy-1.2224516>
- Nelson, B. (2018, March 1). Why Big Pharma and biotech are betting big on AI. Retrieved April 27, 2020, from: <https://www.nbcnews.com/mach/science/why-big-pharma-betting-big-ai-ncna852246>

Novel Coronavirus - China. (2020, January 12). Retrieved March 10, 2020, from World Health Organization website: <https://www.who.int/csr/don/12-january-2020-novel-coronavirus-china/en/>

Overview of Healthcare Industry. (2012, June 22). Retrieved April 26, 2020, from website: <https://www.technofunc.com/index.php/domain-knowledge/healthcare-industry/item/overview-of-healthcare-industry>

Palmer, M., & Gillet, K. (2020, February 17). “Bigger than DNA”-how AI is transforming the pharma industry. Retrieved April 27, 2020, from <https://sifted.eu/articles/ai-transforming-pharma/>

Patranobis, S. (2020, July 16). Chinese economy bounces to 3.2% growth in second quarter after shrinking in first. *hindustantimes*. Retrieved from <https://www.hindustantimes.com/world-news/chinese-economy-bounces-to-3-2-growth-in-second-quarter-after-shrinking-in-first/story-6xzCy9WTEC4v82fGLSUpJL.html>

Peterson, J. & Thomas, S. (n.d.). Hospital mergers and acquisitions. Deloitte, Retrieved April 27, 2020, from Deloitte website: <https://www2.deloitte.com/us/en/pages/life-sciences-and-health-care/articles/hospital-mergers-and-acquisitions.html>

Petrara, D. (2020, April 15). COVID-19 Pandemic Impact: Global R&D Spend for AI in Healthcare and Pharmaceuticals Will Increase US\$1.5 Billion By 2025. Retrieved May 8, 2020, from <https://www.prnewswire.com/news-releases/covid-19-pandemic-impact--global-rd-spend-for-ai-in-healthcare-and-pharmaceuticals-will-increase-us1-5-billion-by-2025--301041073.html>

Singh, K., & Landman, A. B. (2017, July 14). Mobile Health. Retrieved from <https://www.sciencedirect.com/science/article/pii/B9780128095232000133#kys0010>

Smith, S. (2020, April 8). 230 Startups Using Artificial Intelligence in Drug Discovery [Web log post]. Retrieved from <https://blog.benchsci.com/startups-using-artificial-intelligence-in-drug-discovery>

Snappy (Shared). (2017, February 7). Tesla Autopilot Predicts Car Crash before it happen [Video file]. Retrieved from <https://www.youtube.com/watch?v=DUIrjRAzNPQ>

Spatharou, A., Hieronimus, S., & Jenkins, J. (2020, March). Transforming healthcare with AI: The impact on the workforce and organizations. Retrieved April 26, 2020, from <https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/transforming-healthcare-with-ai>

State of the Clinic Report. (2018). Retrieved April 26, 2020, from <https://www.clevelandclinicabudhabi.ae/en/about-us/pages/state-of-the-clinic-report.aspx>

The demographic Profile of the United Arab Emirates. (2019). Retrieved April 26, 2020, from <http://futuredirections.org.au/wp-content/uploads/2014/11/uae.pdf>

Thomas, M. (2019, May 12). 25 Healthcare Technology Startups & Companies on the Forefront of Modern Medicine. Retrieved May 8, 2020, from <https://builtin.com/healthcare-technology/healthcare-technology-companies>

Thomson, A., & Ring, S. (2020, February 20). Artificial Intelligence Could Fight a Future Coronavirus. Bloomberg, Retrieved from <https://www.bloomberg.com/news/articles/2020-02-21/artificial-intelligence-gears-up-to-fight-a-future-coronavirus>

UnfoldLabs. (2017, August 24). The Impact of Artificial Intelligence in Healthcare. Retrieved from <https://medium.com/@Unfoldlabs/the-impact-of-artificial-intelligence-in-healthcare-4bc657f129f5>

United Arab Emirates Ministry of Health & Prevention. (2019). Retrieved May 3, 2020, from <https://www.mohap.gov.ae/en/MediaCenter/News/Pages/2033.aspx>

Webster, N. (2018, May 28). Abu Dhabi health department issues region's first AI controls. Retrieved April 27, 2020, from <https://www.thenational.ae/uae/abu-dhabi-health-department-issues-region-s-first-ai-controls-1.734682>

What is Data Anonymization: Pros, Cons & Common Techniques: Imperva. (2020). Retrieved April 26, 2020, from <https://www.imperva.com/learn/data-security/anonymization/>

Williams, A. (2018, November 21). Medical Robotics Has an 'Incredibly Exciting' Future, Predict Experts. Retrieved from <https://www.roboticsbusinessreview.com/health-medical/medical-robotics-exciting-future/>

Wilston, N. (2019, July 17). An Overview of Key Sectors of Healthcare Industry [Web log post]. Retrieved from <https://medium.com/@neil.wilston123/an-overview-of-key-sectors-of-healthcare-industry-d507823da03f>

Worldedge, M. (2018, July 7). Bots for banks: How will artificial intelligence change financial services? Retrieved March 9, 2020, from website: <https://www.globalbankingandfinance.com/bots-for-banks-how-will-artificial-intelligence-change-financial-services/>



Xiaoyang, L. (2019, August 5). More Chinese Firms in Fortune Global 500. Retrieved August 14, 2020, from [http://www.bjreview.com/Special\\_Reports/2019/2019\\_in\\_Retrospect/Top\\_10\\_Business\\_News\\_Stories/201912/t20191226\\_800188521.html](http://www.bjreview.com/Special_Reports/2019/2019_in_Retrospect/Top_10_Business_News_Stories/201912/t20191226_800188521.html)