#BIG TRENDS

Healthcare

Analysis of Disruptive technologies in the Healthcare Industry

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Introduction

The COVID-19 pandemic is putting an enormous strain on the global healthcare sector. Besides that, COVID-19 is also accelerating change across the health sector ecosystem and forcing public and private health systems to adapt and innovate in a relatively short period. We consider the Healthcare a dynamic industry with lots of opportunities, however the concerns about costs, uncertainty, and the complexity of the industry makes it hard to determine where the real value is created. The ongoing disruption to the health industry coming from different forces results in shifting profit pools and therefore appealing investment opportunities we as investors can capitalize on.

In this article, we give an overview which techniques are the biggest contenders for turning the healthcare industry upside down. First the phenomena of the ageing population across the world are reviewed and we discuss the enormous market we are dealing with. Subsequently, we will dive into the specific techniques that will transform the healthcare industry. The genetic sector will give us insights on what kind of possibilities lay ahead in altering our DNA. Finally, other disruptive technologies such as 3D Printing and the impact of wearables on the healthcare industry are discussed.

Aging population

According to the United Nations, the global world population is aging. There were 610 million people above 60 years old in 2015, this was more than double the amount in 1990 as back then there were 328 million people above 60 years old globally. The group of above 60, is again expected to double in 2075, rising to 2.04 billion people and this is a low expectation as some sources claim that the 2 billion people over 60 will already have been reached in 2050. The over-80 age group will triple over the next 35 years from 1.7% of the global population to 4.5% of the population in 2050[1].

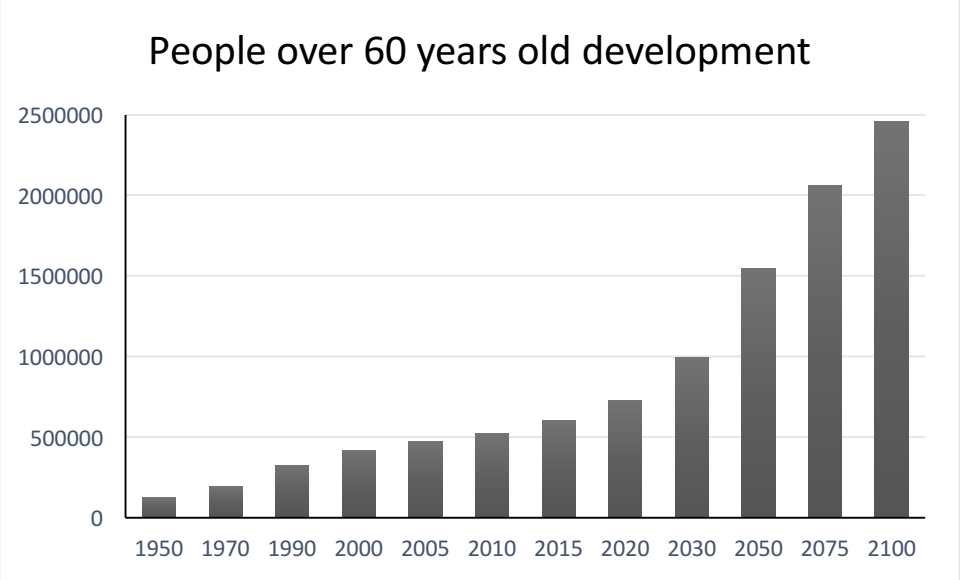

Figure 1. Amount of people 60 years old or over, from 1950 to 2050[1].

There are three main factors that influence aging as a population. First, a reducing fertility rate of individuals especially in developed countries, causing less births, this has a few main causes. Woman, give birth later in life, on average around the 30 years old; this is due to the access of birth control, high quality of female education and the wealth of developed countries.

The second factor that influence an aging population, is the life expectancy has increased; as on average a baby that is born today has a life expectancy of around 93 to 100 years old in many developed countries. The average global life expectancy has risen from 49 years old in 1955, to 72 years old in 2016 and the gap between emerging markets and developed markets is getting narrower.

What is the cause of this increase in life expectancy? There are several factors that influence this. First, people are smoking less, decreasing the chances of lung cancer, heart diseases, tuberculosis, and other chronic diseases. Secondly, the global population is also fed better, due to an increase in income and availability, and has a healthier life style. In addition to that the accessibility to healthcare has also improved a lot recent years, this is due to development of technology, such as telehealth, drone delivery of medicines to remote places and other devices that allow remote analysis of patients, more will be discussed later in this report.
Keeping in mind the fact that the global population is aging, think of how the healthcare market may change. Especially in the developed markets there will be growth of tools that will make life more comfortable for elderly people as these people can afford these tools. There will be more elderly homes and nursing homes. According to The Business Research Company the market of nursing care, that includes nursing homes is expected to grow from 1010.1 billion USD in 2019 to 1374.9 billion USD in 2023 globally, of which 40% will be in the United States[2]. In addition to that, according to Fortune Business Insights, companies providing living aids (such as stairlifts, walk-in showers, hearing aids, wheel chairs, etc.), will see growth as well. As people in general live longer, our bodies keep slowly degrading, in which mobility equipment will be immensely helpful tools to live with. This had a global market size of 23 billion USD in 2018 and is expected to grow with 5,5% per year to over 35,5 billion USD in 2026[3].

Genetic Industry

With the ever-increasing average age of the world population, the genetic industry has the best viable solutions to remedy the associated diseases that most elderly face. Especially cancer that is currently the second biggest cause of death in the world according to the WHO[4]. The genetic industry is an extraordinarily complex industry with many different sub-sectors. We identified the following four key areas it can be divided into:

- *DNA sequencing* involves figuring out the four bases elements that make up the DNA molecule. These building blocks are adenine (A), guanine (G), cytosine (C) and thymine (T), assessing their sequence allows scientists to understand what type of genetic information a section of DNA holds.

- *Genetic testing p*inpoints changes in chromosomes, genes, and proteins to diagnose a genetic disorder. There are a wide variety of genetic tests available, such chromosomal genetic tests, molecular genetic tests, and biochemical genetic tests.

- *Gene therapy:* Gene therapy is method that uses a person's genes to treat or even prevent diseases. There is a diverse set of techniques for conducting gene therapy, getting rid of a mutated gene that is not working properly and even introducing a new gene into the body to fight off diseases.

- *Genomics:* is the study of the complete set of person's genes, and how those genes interact with each other and surrounding environments. By understanding the complete set of our genes (also called genome) scientists can discover secrets embedded in our DNA.

The genetic industry got a boost from The Human Genome Project that took about 10 years and $3 billion to map the first human genome[5]. It was the first attempt to decode a whole genome. Today, we can map a person's DNA in only a few hours for about 700 USD. And the costs will decline even further in the future to an estimated 100 dollars per research of ARK Invest[6]. Clearly Wright's law is in function here. Wright's Law aims to provide a reliable framework for forecasting cost declines as a function of cumulative production. Specifically, it states that for every cumulative doubling of units produced, costs will fall by a constant percentage. Wright's Law has successfully forecast cost declines in more than 60 technologies, ranging from solar power to televisions, and from semiconductors to ovens[7]. While a Moore's Law style forecast would have forecast a significantly less accurate cost decline in the technology as shown in figure 3.

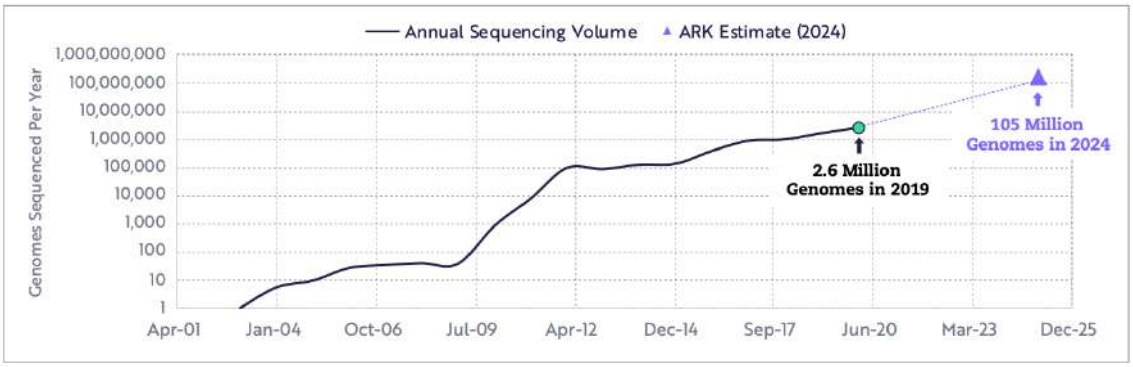

Figure 2. Forecasted Genome volume sequenced in 2024

Lower price points of decoding a whole genome are vital for the adoption rate of genomic sequencing. The Next Generation Sequencing (NGS) enormous growth that took place in the recent years can be explained by: increasing clinical applications, technological advancements in the tools of NGS, a growing interest in personalized medicines and use it for diagnosis in an early-stage cancer. This growth will accelerate since costs will drop to a level that this technology becomes the standard of care in oncology. Ark estimates that due to clinical adoption the DNA volume will increase from 2.6 million in 2019 to 100 million in 2024. This would result in a staggering 110% annual volume growth rate. They believe that the revenues in this industry will grow 43% at an annual rate from 3.9 Billion in 2019 to 21 Billion in 2024[8]. Drug development can also be boosted by the impact of cost declines in the NGS market. Especially when artificial intelligence and CRISPR-Gene editing is conversing with this technology. When these three technologies come together it results in: Fewer failures in the development of drugs, shorter development timelines and lastly more cures for chronic conditions. An increase in clinical trial success rates and at the same time an increase in trial throughput and the premium pricing afforded to curative therapies could result in notable higher industry returns. It is estimated that Improvements in R&D efficiency depending on the reduction of the failure rate could add 5-9 Trillion to the market capitalization of therapeutics companies during the upcoming 5 years[8].

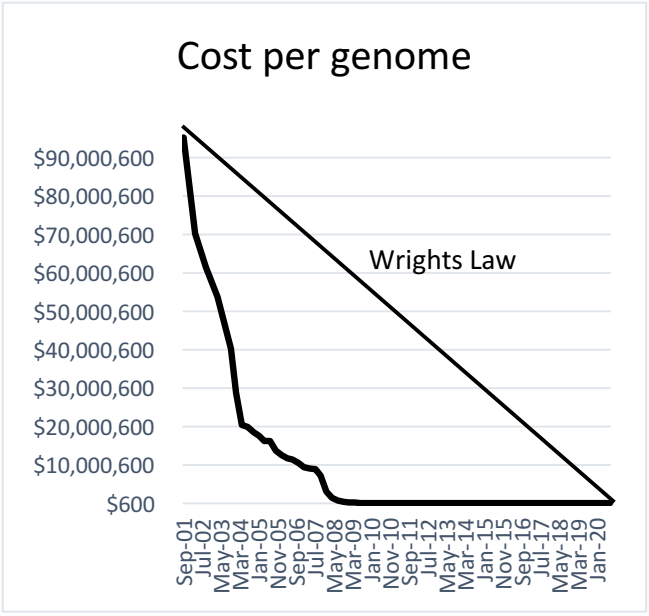

Figure 3. Cost of sequencing a whole genome in the last 10 years

3D-Printing

This sector has not recovered from the consumer-3D printing hype that took place in 2013-2014. Until recently 3D printing stocks have suffered from a lack of interest, creating a big mismatch between the valuation of public and private companies in the space. However, the interest in 3D printing is back alive and for good reasons since the technology has a lot of applications.

3D printing could simply be described as; "using 3D models or computer-aided design (CAD) to create three-dimensional objects through a layering method, a variety of materials can be used for the layering, plastics, silicon or using living cells. It is sometimes also referred to as additive manufacturing. When it is used for creating tissue it is often called bio printing. The global 3D bio printing market was valued at 1.7 billion USD in 2021, and will grow to 4.4 billion USD in 2028 according to Grandview Research[9]. This has several reasons, as there is an increase in demand and economies of scale is happening. For example, specialized 3D bio printers used to cost approximately between 150.000 USD and 300.000 USD. Recently, however, there have been startups that already create 3D bio printers for approximately 15.000 USD.

Next to that, the cost of biomaterials which is used for the printing has decreased. For example, the cost of three commonly used materials for printing have sharply decreased; collagen, which is the main component of connective tissue, a protein which makes up 30 to 40% of all the proteins of the body, it is in our muscles, bones, etc. has dropped significantly in price. From approximately 7700 USD per 500mg in 2010 to approximately 4300 USD in 2020. The second commonly used material is Polycaprolactone, this is a biodegradable polyester, often used as a material for implements. This material also has decreased greatly in costs from 600 USD per 500g to about 240 USD in 2020.

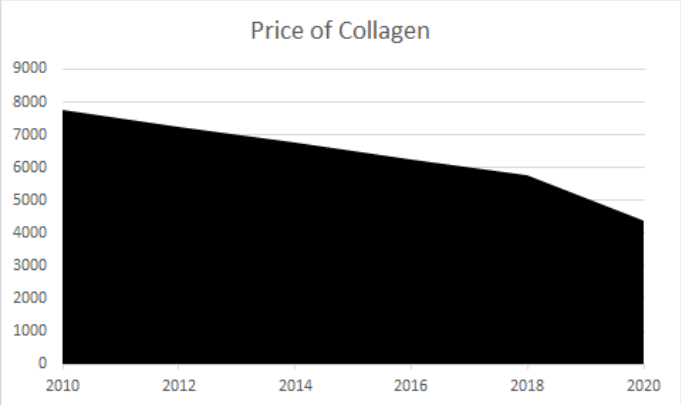

Figure 4. Price development of Collagen

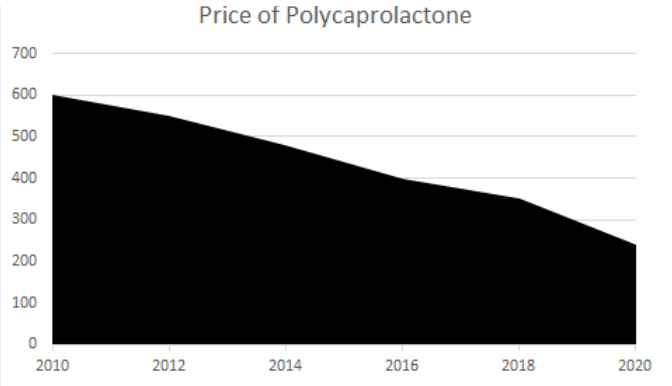

Figure 5. Price development of Polycaprolactone

Lastly, the price of growth cells, which is simply a mix of cells hydrogel, used to grow artificial organs have dropped in recent years from 168 USD per 500ml in 2011, to approximately 140 USD in 2020.
By approximately 2030, 3D printing a new organ such as a kidney, will become economically feasible compared to an actual transplant of a kidney. As transplanting a kidney cost approximately 80.000 USD and a new 3D printed kidney will cost less than 120.000 USD by that time. So, in a sense, there is still a difficult road ahead, the technology still has to develop further. Since it is still rather difficult and expensive for researchers to 3D print blood vessels.

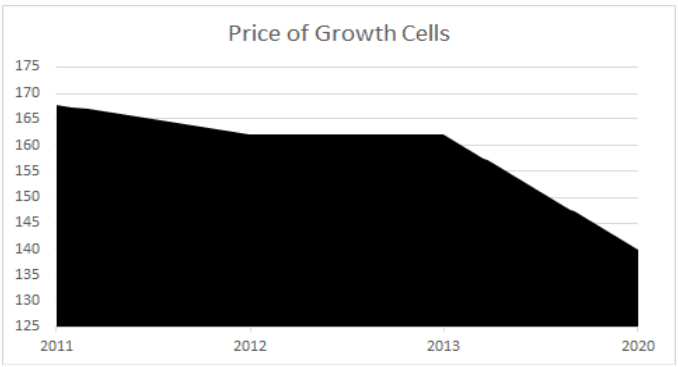

Figure 6. Price development of Growth Cells

However, other less complex and already feasible applications of using 3D printing in healthcare include using it to create customized and well fitted prosthetics and braces. It could also be used to create personalized medicine and to create cartilage. This has several benefits, it reduces costs, because there is an optimal use of available materials and it increases productivity. Furthermore, it reduces bodily rejection of for now small implants such as cartilage, as cells of the patient can be used to grow the replacement. It also reduces side effects in terms of the personalized medicine.
Ways to take advantage of this new disruptive technology, is for example investing in companies that provide the rather cheap 3D bio printers and/or 3D printers, or organizations that are researching possibilities for creating artificial organs. In addition to that, a good investment would be in organizations that 3D print already feasible applications such as braces and prosthetics.

Internet of things – Wearables

The internet of things can be separated in lots of categories. In this article we will focus on the wearables. A wearable is a small and lightweight piece of hardware and is worn on the body, to monitor vital signs such as temperature, heart rate and breathing rate. There are many different devices which can be worn; wrist-wear, neck-wear, eye-wear and head-wear, body-wear, foot-wear, and others. However, wrist-wear has the biggest market share with 45% of all devices being wrist-wear[10]. In the past wearables were used a lot by athletes to gain insights about their health. However, an increasing number of individuals with health awareness, such as obesity, chronic diseases etc. are using

it. In addition to that, the cost of manufacturing has decreased a lot recent years and the technological advances, such as interacting with social media, ease of payment, and other multifunctional applications have been added to wearables. This all is causing a growing demand for wearables and is generating a booming market. This market was valued at approximately 32 billion USD in 2019 and will be worth over 104 billion USD in 2027 according to Grandview Research[11]. Insurers and companies are now considering how supplying wearable health technology to their consumers and employees can be beneficial. Insurers can reduce the rising cost per patient by using wearables as a means of increasing customer life value. Wearable technology incentivizes behavior of people to live healthier that reduces hospital visits. Around 75% of users agree that wearables help them engage with their own health. Companies also see the benefits of offering wearable healthcare technology to employees. Per Insider Intelligence, healthier employees reduce employee turnover. The employers who offer five or more well-being 'best practices' had an average turnover of 18%, compared to 29% for those that offer two or less[12]. Currently there are many innovative devices including; ultrasounds, ECG monitors and dermatoscopes that can analyze your skin and blood pressure monitors that can be plugged into a smartphone. There are even smart health devices and wearables to track your lung health and medication usage for asthma patients[13]. Although the wearable market is growing rapidly there are factors that still limit the adoption of these devices. One of the main factors holding people back from purchasing one of these high tech gadgets is cost of ownership. The devices consist of batteries, chips, sensors, and other accessories that need periodic replacement. When added up to the life cycle of the devices, the costs of these accessories lead to a higher cost of ownership.

Concluding the Opportunities

The healthcare industry is facing rising costs and demands for higher quality of care. The supreme goal is to improve patient value, and the best way the healthcare industry will achieve this is by embracing the innovative technologies we described in this article. All the techniques that have been addressed are transforming the way healthcare is carried out and have enormous implications on people daily lives. You as an investor can profit from these multi-trillion dollar opportunities by seeking for individual stocks that take advantages of these technological innovations. At the Zilveren Rijder we are constantly seeking for appealing investment opportunities and are therefore open for conversation to discuss the companies that capitalize on these trends.

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