Name of the committee: World Health Organization
Issue: Guaranteeing patient privacy, autonomy, and quality of care while developing AI technologies for healthcare
**Name of the chairs:** WANJIRU MUIGAI Hanna, COURT Rémy

Unprecedented challenges require unprecedented solutions: this is the reasoning behind the overall theme of FerMUN 2020, "ICTs for SDGs". Information and Communication Technologies (ICTs) have the potential to accelerate progress towards every one of the Sustainable Development Goals (SDGs), and the role of the International Telecommunication Union (ITU) is to maximise this potential. FerMUN 2020 is a chance for young people from across the world to come together in support of this mission.

Guaranteeing patient privacy, autonomy, and quality of care while developing AI technologies for healthcare

1. Introduction

A few years ago, Facebook launched a controversial "feature" on their site : an AI that prevents suicide. This brand new software scans posts of users, searching for patterns of suicidal thoughts. The Artificial Intelligence can later, if necessary, send mental health resources, or contact friends of the user. Even though the principle seems helpful, the means used to achieve it are quite questionable : the posts of the users are read, stocked and used as a database without their consent. Moreover, database leaks are not so rare with Facebook. This story illustrates well the issue with AI in healthcare. How much autonomy should we let to the machine ? And, taking into account the huge amount of data treated, how can we guarantee the quality of care while preserving the patient's privacy ?
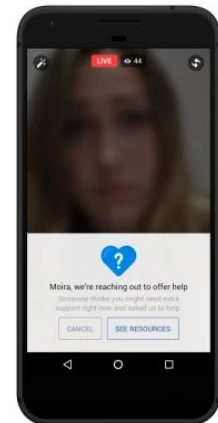
a. Keywords

- **AI**: AI stands for Artificial Intelligence. The aim of AI is to produce "intelligent" machines which acquire experience by trials and errors, in order to execute human-like tasks. However, AI is a vague term that regroups several technologies, such as neural networks and machine learning, amongst others.

- **Neural networks**: Neural networks, or neural nets, mimic the human brain. They are composed of thousands, even millions, of processing nodes connected together. When an input is taken, each node performs mathematical transformations, then passing data to other nodes. Thereby can the machine produce an output.

- **Data**: This is information in a digital form that can be processed or transmitted. Data can be anything : your age, your birthday, your favourite band... All these pieces of data are stocked and can be sold. Big digital companies like Google or Amazon have built their empire on data business.

- **Data privacy**: Data privacy is part of how to handle collected data . It concerns its storage, the sharing of it with third parties, and all the associated regulations imposed, such as the General Data Protection Regulation (in U.E) , or the HIPAA (in the U.S.A). For example, the Facebook AI mentioned earlier has not been deployed in U.E, because of the GDPR. This handling of data is important,for example, in healthcare for avoiding the violation of medical secrets.

- **Hardware/Software:** The term hardware defines all electronic devices which can be physically touched (a computer monitor, a motherboard). Software is the set of all the programs, protocols, procedures on a computer or other electronic device (Windows, Chrome, Notepad…).

   The two work together, the software telling the hardware what to do to . For example, when you are saving a file on a computer, the software (Windows/IOS/the file manager) tells the hardware (the hard drive) what and how to save.

- **Autonomy:** autonomy is the capacity or state of self-governance and/or moral independence. For A.I, the level of autonomy is defined by how much the human acts on a given digital task. The A.I in surgery, for example, doesn't currently have full autonomy, a human expert always coordinates the task.
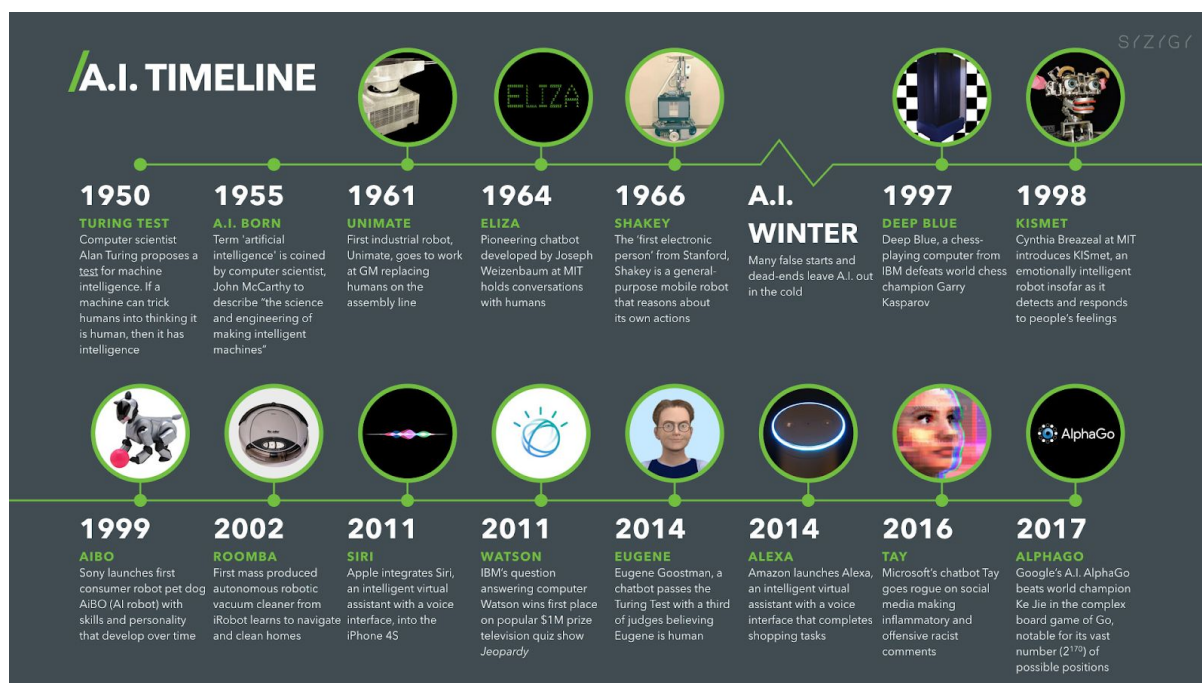
2.Overview
a. Origins of the issue

To explain the issues caused by A.I, we need to retrace its history and its implementation in healthcare

i.Quick history of AI

The concept of A.I is, of course, recent, but the logic and the maths behind it have been refined for a long time. Aristotle was the first to contribute in 4th century B.C, with the invention of the first deductive system. There were not so many improvements, except for some mathematical discoveries, until the 16 century. There has been much mechanical progress, such as the first digital calculating machine or The Leviathan, and famous philosophers continued to improve the notion of "intelligent machines" (Leibniz improved the calculating machine by adding multiplication and division).

But the real improvement of A.I took place in the 20th century. Books and theories about logic and "machine intelligence" emerged. The most famous actor of A.I in the first half of the century is, without doubt, Alan Turing. After breaking the secret code of German soldiers during WW2, he presented his version of "A.I", the Universal machine of Turing.

The term Artificial Intelligence appeared for the first time in 1956 from John McCarthy. With the development of stored-program electronics computers, the discoveries and inventions in the A.I field increased exponentially: Programs that mimic dialogues, chess-playing algorithms, new chemistry results produced by a machine. A.I was gradually implemented into various domains, to automate or simplify tasks. A.I has therefore a interesting potential in healthcare.

A.I. TIMELINE

1950 — TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955 — A.I. BORN
Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961 — UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

1964 — ELIZA
Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

1966 — SHAKEY
The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER
Many false starts and dead-ends leave A.I. out in the cold

1997 — DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998 — KISMET
Cynthia Breazeal at MIT introduces KISmet, an emotionally intelligent robot insofar as it detects and responds to people's feelings

1999 — AIBO
Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time

2002 — ROOMBA
First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes

2011 — SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S

2011 — WATSON
IBM's question answering computer Watson wins first place on popular $1M prize television quiz show *Jeopardy*

2014 — EUGENE
Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human

2014 — ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks

2016 — TAY
Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments

2017 — ALPHAGO
Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

ii. The implementation of AI in healthcare

Healthcare was first implemented in the early 70' with the aim of automating diagnostics. Unfortunately, despite the interesting results, doctors did not trust the machine. Nowadays, A.I is used everywhere in healthcare: cancer detection, image analysis, and even in robotic surgery. Its strength resides in its learning process : the machine analyses a huge amount of data to teach itself. Therefore the results can be surprisingly accurate. Moreover, a robotic arm with an artificial intelligence is more precise than a human: no nervous shake or imprecise hand movements.. A.I does have a very real function in healthcare.

iii. And the issues provoked

Although the positives aspects presented earlier, A.I does raise major issues that can balance his usefulness. .

The first one has already been mentioned. Doctors and patients do not trust the machine. For sure, a human face reassuring you before the operation is way more pleasant than a silent machine waiting to process data. This is understandable, but will probably disappear in future generations, with a change of mentality.

A second issue is the handling of data. To produce serious and accurate diagnostics, the machine needs some information about the patient. With these pieces of data, a comparison with other cases is possible, and thereby an improvement in the diagnosis. But how is this data stocked ? How can we prevent data leaks ? When we see companies like Google or Facebook who made their wealth selling data, we can only imagine a world where data like our DNA or blood-type are traded and used without our consent. Insurance experts are already sounding warnings. Moreover, regulations which are responsible for data handling are in disagreement, complicating exchanges.

Finally, there is the ethical question: how much power do we give to the machine. The fear of being dominated by our own creation persists. What if, instead of removing a tumor

cell, the machine begins to cut a vital organ ? That is why A.I only assists in operations. Doctors do not want an accident due to a faulty calibration of the robotic arm. Furthermore, electronics components can easily be damaged. The ethics and the limitations of the machine must therefore be determined.

b. The impacts on different scales

At first sight, this issue seems to be rather local, concerning only a specific aspect of society. However, implementation of A.I in healthcare has an impact on society, economy and governments.

i.Society

The first impact is in society. The arrival of A.I has generated a lot of reactions, and not all of them have been positive. For sure, an engineer who studied artificial intelligence for years will see the benefit of it, but laymen not necessarily. For them, A.I is a collection of complex technologies associated with even more complex words: deep learning, neural networks, cognitive computing. Not so appealing for a revolutionary invention. But nowadays A.I is everywhere: from our phones to our cars, each electronic device seems to possess a form of intelligence. But for healthcare, this is different. In an environment where a small mistake can lead to severe injuries or death, the idea of letting a machine do an operation appeared more than risky. That is why A.I is only slowly implemented into healthcare, allowing for a change in understanding and attitudes, both for patients and the people working in the medical profession.

For these people, the implementation of A.I is quite frightening and seems to be a big step: the smiling surgeon is not necessarily better than a machine. However, for the people of the medical profession, the consequences are more significant: they have to learn to work with A.I to be more efficient even if the increase of A.I in healthcare will possibly reduce healthcare employment.

ii.Economy

In order to use A.I in healthcare, we need to develop and implement some new types of equipment designed especially.. Therefore, a new sector of business and industry will emerge, that could help to reinforce the economy. The health AI market size was worth 600 million dollars in 2014. The forecast for the year 2021 is around 6 billion dollars. A.I will therefore create jobs for programmers and engineers . On the other hand, that could pose a problem. With A.I applied in healthcare, employment will potentially decrease. Moreover the jobs produced by the A.I will need higher qualifications. A.I could thereby improve the economy, but we need to find the balance.

HEALTH AI MARKET SIZE 2014-2021

Acquisitions of AI startups are rapidly increasing while the health AI market is set to register an explosive CAGR of 40% through 2021

$600M $6.6B

11x

2014   2021
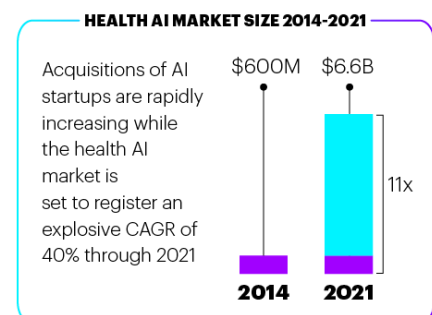
Source: Accenture analysis

iii.Laws and policy

As the use of A.I in healthcare is revolutionary, the laws and policy are unclear about it. However, regulations for data already exist: the U.S have the Health Insurance Portability and Accountability Act (HIPAA), and the E.U has The European Union's General Data Protection Regulation (GDPR). These control all types of data, including the ones used by the A.I. These specific pieces of information are generally considered as sensitive.

Nonetheless, Artificial Intelligence use in healthcare is quite recent. The details about data storage are vague . Is the data stored ? Transmitted ?

The use of A.I could also impact the terms of the conditions of employment. Maybe it will create minor changes like a slight change in workflow or maybe it will result in a reduction of jobs. The conditions of employment will have to be scrutinised in relation to this matter.

c. The issues with A.I in healthcare

A.I provides an undeniable support in healthcare. However, with all the good features, technology brings also several issues that could counterbalance the benefits.

i.Trust issue

First, the most evident. People do not trust A.I. On reflection, that is not a childish reaction. Every day we see people who are masters in their field (chess, Go, poker...) being defeated and humiliated by a machine. When we see the progress and the superiority of artificial intelligence compared to humans,we can feel a little bit worthless. Furthermore, stories and films about the domination of the machine, humans overwhelmed by their creations are very common nowadays. Series which portray a dystopian world with technologies like *Black Mirror* are popular, and the episodes seem often disturbingly real. The feelings about A.I are therefore not so surprising.

The lack of human agency of A.I is maybe the most threatenings side of it. We have been accustomed to having a real surgeon with a lot of experience who explains precisely his approach. The switch to a silent machine which reflects his experience with millions of pieces of unknown data may be brutal.

However, it is not the first time that people are sceptical about brand-new techniques of medicine. Ambroise Paré, for example, was a French surgeon of the XVI era. He discovered how to treat gunshot injuries, democratize the use of surgery and invented the first implants. Yet, he has been criticized for his methods, although he saved many lives. It was only with the passage of time that his work has been acknowledged. And it will probably be the same with A.I. We do not accept it because of his novelty, but after a few years, when his efficiency and his safety will have been confirmed, we will be used to it.

ii. Data handling

The most controversial aspect of the A.I is probably the data handling. We live in a world where data transmissions is king. With the popularity of social media, we spend our time sending or receiving data. However these are generally kept and stored by the company. They can even sell it to other companies, for publicity purposes (it is written in the terms and agreements when you sign up). This policy often poses problems and special regulations have to keep an eye on this activity.

A.I, for example, uses this data. The basic principle by which artificial intelligence functions is in fact the analysis of tonnes of data which it uses to teach itself.. For example, the A.I that prevents suicide takes its

knowledge from suicidal posts. And this is where the issue begins. The companies cannot simply take information and use it at their will. They have to follow the law. Sometimes restrictions may differ depending on the country. If the A.I is really the future of medicine, it needs to be international. Therefore A.I has to respect the patient data. However, the treating of the data by the A.I are unclear. Is the data reused ? Sold ? Deleted ? One thing is for sure, this data is sensitive, and needs different processing than more mainstream data on social media. Maybe it has to be precise on the terms of utilization of the A.I. Or maybe the patient has to be aware before any use can go ahead. But for sure, this has to be clarified.

d. Hopes and future of the A.I

Despite all the drawbacks mentioned before, artificial intelligence still has a bright future. It could, in fact, have a positive impact and improve healthcare.

The quality of care would be raised to higher standards. Everyone has heard or read about a surgeon who missed a surgery, often by inadvertence. With a machine guided by an A.I, this kind of misadventure has less chance of happening. The A.I, when booted, will do its job, and would not be distracted by a colleague speaking to him. Moreover, A.I will follow a strict protocol elaborated with thousands of examples, when a surgeon can fall prey to blackouts. However, A.I will NOT execute its task alone. Even if the machine could be extremely precise, there must be someone in case of hazard (a powercut for example).

Another positive impact would be on the economy. As said earlier, the actual impact on the economy is huge, and could increase with the issues solved. Investors would then be much more confident about A.I future and would buy shares, powering the international economy.

A.I have therefore a bright future in healthcare.

3. Cases Studies

a. Intel: a development towards A.I

Intel doing A.I for healthcare may sound like a surprise. The company is generally known for its micro-processors, motherboards… And yet they decided to innovate in A.I for healthcare. A bold move or calculated choice ?

First of all, Intel is not a newcomer in A.I. The company proposes on their websites several tools, elaborated by them, to program and create A.I. Among them we can find tools and libraries for developers. In programming, a library is a collection of codes, pre-compiled, that can be used in any program. For example, when you type in Python:

>>> **print**(*"Hello World"*)

the function **print** (which displays the message written inside the parenthesis) came from a library. The development of an A.I is tremendously more complicated than the code up here. That is why some people write these libraries. With that, the A.I's developers can use pre-made code, to simplify their work and speed-up.

So, what is the gain for Intel ? They write code and even tutorials for developers ? When do they see a benefit ? The answer is at the level of the hardware. A.I is, by definition, resource-intensive. Therefore the machine needs to be well-equipped. That is why Intel propose processors and special hardware to those who want to build their A.I.

With this method, Intel makes the research progress while it still makes a profit.

In conclusion, Intel has found an innovative way of leading research. By providing tools and tutorials, they open doors to thousands of talented developers. Intel seems to trust the potential of A.I in healthcare and make available all their tools to make the research progress.

b. Bryce Olson: the fight of a life

Bryce Olson describes himself as a "regular man". However, he leads a particular fight.

The story began in 2014. Bryce Olson, 45 years old, was diagnosed with prostate cancer. This type of cancer is current for the men, around 1 man in 9 will be touched by this type of cancer in his lifetime (source: cancer.org). His was a stage 4. His chances of survival during the fives years were at 28%. He begins therefore the traditional approach: surgery, chemotherapy and radiation. The treatments stopped temporarily his cancer. But it was only a matter of time before his tumor started to develop again. The therapy was a failure and Bryce was gradually losing hope.

But then he learned about the existence of genomic sequencing. Genomic sequencing, or Whole-Genome-Sequencing (WGC) is a relatively new method that doctors are starting to use on patients with cancer. Each cell on the human body contains the genetic code, or DNA of the person (the genetic code of a person is also known under the name of the genome). 4 majors groups (called nucleotides)compose the DNA: Adenine, Thymine, Guanine and Cytosine. The WGC allow scientists to spell out each 3 billion of nucleotides of an individual. With that, they can search and find variants and special patterns. Then doctors can personalize diagnostics and treatments, for a better success rate.
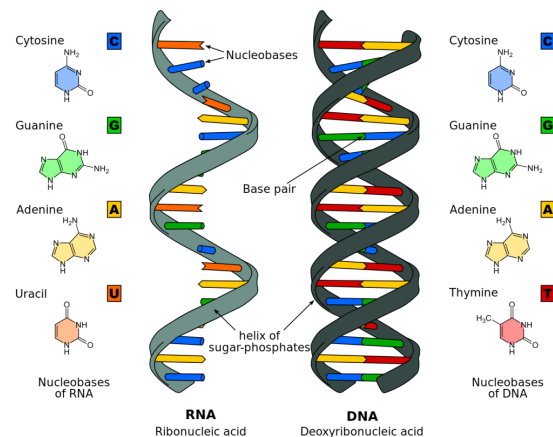
With the development of A.I, WGC could be way faster and therefore cheaper. But, for developing an A.I, you need data. A lot of data. That is why Bryce Olson launched **Sequenceme**, a website to encourage people to get sequenced and pass the word. The more people sequenced, the bigger the database. The A.I could therefore produce results more quickly and more accurately. Bryce feels that he has a mission to help people with cancer. He is still working with scientists to find the right treatment that could eradicate his disease. His work certainly helps his therapy (he is a global marketing director at Intel), but he does not want to keep his results for himself. For him, technology and A.I are undoubtedly part of the healthcare of tomorrow. And we have the opportunity, all of us, to make it progress.

"If it(my cancer) does take me down, I'd like to think that my efforts are accelerating personalized cancer care opportunities for others. This experience is showing me and my family how critical new technology and gene analysis are to our lives."
Bryce Olson

c. Sebastian Thrun: the man behind the machine

Sebastian Thrun has such a brilliant life trajectory: born in Germany, this former professor of Stanford founded Google X. Google X is a company which belonged to Google and is an affiliate of Alphabet Inc. The company works on ambitious projects, often revolutionary, therefore their research is not so well-known.. With this company, Thrun launched several projects (Google Glass for example). He also founded the Google self-driving-car team after winning the DARPA Grand Challenge (a competition for autonomous cars). In brief , Sebastian Thrun is into anything that can make science or society progress.
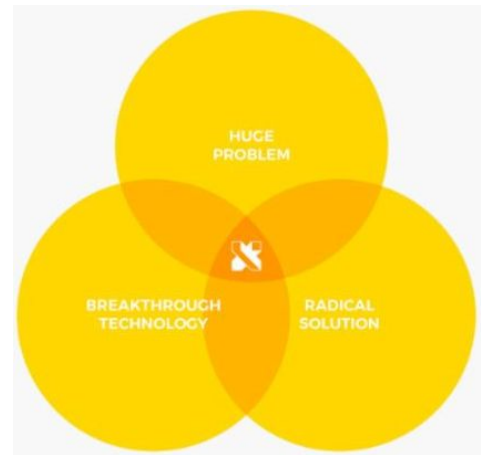
It seems therefore natural that our man has done research on healthcare. His mother died at forty-nine years old of breast cancer. She didn't have any symptoms, like most of the patients. He wondered if we could detect cancer earlier, and if a machine-learning algorithm could do it. He then began to research and design an A.I. At this time, there was already some kind of artificial intelligence used including in mammography. However, the accuracy and the efficiency were not the best. The A.I was a rules-based system : that means the machines follow rules implemented beyond the machine and does not learn by itself. Problems and medical errors were obviously current.

Thrun worked on an A.I that implemented the machine-learning process : the more cases the machine treats, the better it becomes at the task. For that, he used a neural-network, a well-known method in A.I which try to mimic the structure of a human brain. As an adjunct professor at Stanford, Thrun enrolled two of his students to help him : Andre Esteva and Brett Kuprel. Together, they began by do some research on skin cancer, and especially its detection. It turns out that dermatologists often use a rule-based method to detect skin cancer : diameter, color, symmetry... (this method is often learned with the mnemotechnic ABCD). Nevertheless, cases which do not follow any of these rules exist, and are even not so rare. That is why Esteva and Kuprel did not implement the ABCD rule in the machine , nor any rules in general. They just trained the A.I with images found online.

They have tested their A.I alongside dermatologists with some classified cases. The A.I guessed right with a 72 % rate, and the dermatologists with a 66 % rate. Further tests have proved the superior accuracy of the A.I. However , Thrun admits that there are some issues. In some pictures, the skin has been marked by a yellow disk, which has been cropped out by Thrun team. Otherwise, the machine would have associated yellow disk with cancer.

Images and , in general, data have to be accurate enough to make the machine

progress. Inaccurate data could lead to A.I with disappointing or even dangerous results and consequences. In March 2016, Microsoft implemented a chat-bot named Tay on Twitter, who was supposed to represent the thoughts of a teenager. The chatbot was an A.I, therefore she learned from other Tweets. In less than a day, Tay became racist, anti-semitic, negationist… that is why Microsoft removed it from Twitter. The causes ? Violent tweets that have « taught » Tay were often written by trolls who just want to make the A.I crash. Just for fun. A.I will certainly play an important rôle in future technologies, but we need to be careful when creating them to avoid a case like Tay.

Thrun's A.I is a good case to illustrate the impact on medicine that A.I could have. With a database and some training, the A.I could even have more accurate results than a certified professional. But with that came the inevitable question of autonomy. Should we trust solely the machine, or a professional who has been formed during several years ? And, if the two show different results, which one do we choose ? These questions must be clarified, in order to ease the implementation of A.I in healthcare. When we see the outcome of poor data, the idea of an A.I with a full control seems oddly less appealing.

d. 23andMe: a genetically connected world ?

23andMe is a company founded by Linda Avey, Paul Cusenza and Anne Wojcicki (the current C.E.O). Their products are kind of unusual and revolutionary. You basically buy a kit

on the Internet in order to find your origins. A few weeks later, the kit arrives and you file your saliva in a small tube. You send back the tube and the results are communicated during the next weeks. With the DNA, scientists can retrace your origins and even your health condition if you buy the premium kit (99$ for the normal kit and 199$ for the premium one). All the process, the scientific protocol, the meaning of the results are well detailed on their website. The company seems to be very clear with their customers.

But which technologies are they using to decrypt our origins ? No need to poke around on the Internet, 23andMe explains all the procedure on their website. To analyse the DNA, they use genotyping, a similar method to sequencing. Genotyping however focuses more on the variants on individual' s DNA rather than determine his whole genome sequence. Genotyping is then faster and cheaper than sequencing, and is widely efficient for

the needs of the service. Information about genotyping is not so easy to find on the internet, but we can assume that, like sequencing, genotyping may use computer medium, and therefore a kind of artificial intelligence. Furthermore, 23andMe propose digital coach for diabetic, weight loss... These coaches are A.I trained to help peoples diagnosed with some health issues.

But here is the problem. As you may have guessed, when you are sending back this tube with your saliva, you are giving to strangers the full composition of your identity. All your genetic composition is contained in DNA. On second thoughts, people will maybe hesitate to send this precious data to the company that can do whatever they want with that. That is why 23andMe explained in detail their policy on their website, in order to reassure potential customers :

-We will not share your data without your explicit consent

-A federal law (GINA) provides protects from employer and health insurance discrimination based on your genetics

-We do not provide information to law enforcement unless we are required to comply with a valid subpoena or court order [...] (extract from 23andMe website)

They also mention the security of the data collected. The handling of the data is still blurry and generates a lot of questions. When asked about this on a radio podcast, the C.E.O Anne Wojcicki replied :

« Since the early days of the company, there is a group called the Ethical Legal Social Community that has actively followed 23andMe, and what we're doing, and what our consequences are.», meaning that their handling of data is highly supervised.

However there is more to this than meets the eye. First of all, 23andMe is not legally recognized as a healthcare service. Therefore all the strict jurisdictions associated with healthcare does not apply here. When you are sending your saliva to the society, you are agreeing that they, meaning the society and their contractors, will analyze your DNA. And, unless notified otherwise , they can keep your DNA up to 10 years. They can naturally sell their data (like your D.NA) to pharmaceutical enterprises. They have recently signed a deal of 300M$ with GlaxoSmithKline (a pharma-giant). GSK has therefore access to all the data of 23andMe.

Finally, there is the ethical question. The premium kit can tell you the risk of having several diseases. A useful information, that could cause problems. Insurance companies could use this predictive test to charge customers with higher premiums. Furthermore, some diseases are statistically prevalent in certain demographics. As mentioned before, a badly-trained A.I which belongs to insurance companies, for example, could lead to sexist and racist results.

In conclusion, the main idea of 23andMe is quite original and could please certain customers with doubts about their origins. However, their handling of data is more than blurred. The A.I which will use these kinds of data must be protected and well-trained/programmed to avoid racist or sexists results.

4.Possibles Solutions

As we have seen, the implementation of A.I poses several issues that could hinder its own development : data handling and other controversial ethical aspects. Therefore it would need some improvements or solutions to be considered as a good addition to the healthcare tools. Here are several ideas that could possibly help its implementation :

- *A transparent policy on data*. The principle of A.I is based on the idea that it learns from the data it treats. We cannot change that. So, users need to be aware of the process. There must be an official paper from your hospital informing the public and users about how A.I will operate and all the type of information it needs. Then you would have to sign the document to approve its use. That could reassure patients to know what is going to happen and to see how their privacy details will be treated. Nevertheless, it may be like the classic *terms of uses* on websites, where everybody approves without reading it.

- *Give a choice*. Even with clear and simple explanations, people would simply not want it. And we cannot force them. Take the elderly. Some of them are confused by new technologies. They are also accustomed to a classic health service where machines are very discreet. Now imagine their reaction when they discover that their diagnoses have been made by an A.I, or that a robotic arm controlled by an A.I will operate on them. They would not trust it. For cases like this, it is probably better to perform a more« «human » treatment, to ease a medical transition. However, proposing two methods would require more infrastructure and healthcare personal.

- *Update regulations and laws.* These are often outdated and go against A.I. For example, DeepMind, an A.I created by Google was deployed in the U.K to prevent acute kidney injuries. But after investigations, it appeared that the A.I was currently breaking the law. In order to fully implement A.I in healthcare, laws should be re-read and adapted to the use of A.I. But we need to be careful and find the right balance : soften the law to allow A.I in healthcare, but also specify special regulations about data (like GDPR or HIPAA) to define the rights and limitations of A.I and their developers, in an effort to protect data.

- *Educate the population.* as the poet Ralph Waldo Emerson said , « Fear always springs from ignorance ». If we want people to accept A.I, they need to know a little bit more about this technology. Obviously not all the subtlety but at least the basic principles. It could be in the form of an educational or awareness campaign in schools. That way present and future generations would be aware of new technologies and could therefore understand the medical procedure better.

- *Keep the human in the center.* With all these new technologies, healthcare personnel and patients would maybe feel overwhelmed by machine. This is why it is important to keep a "human side" to healthcare. This patient waiting for his diagnostic is not a dataset : it is a human with feelings, hopes and fears. A disease could be due to his blood type, but also to his personal life. Both patients and healthcare personnel should be in the center when setting the autonomy of the machine.
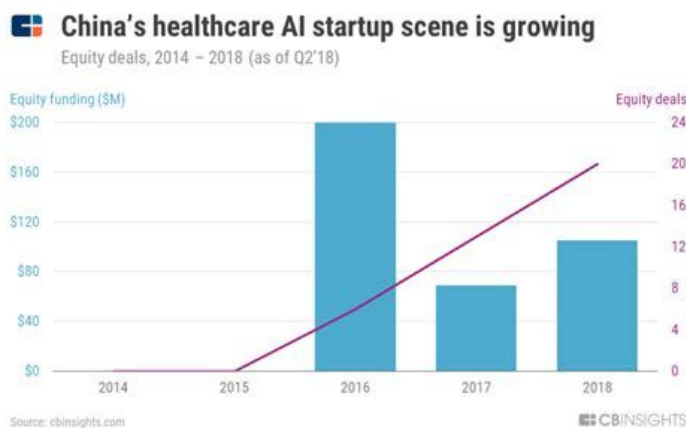
5. Main International Actors

There are several NGOs linked to health. But the most famous is, without doubt, the World Health Organization (WHO) . The WHO is an agency of the United Nations created the 7th of April in 1948. Its purpose is to deal with international public health. They are currently collaborating with the ITU, another UN NGO, (International Telecommunication Union) to ease the implementation of A.I in healthcare. We can also mention The Global Fund, an international financing institution having as its goal to save as many lives as they could. They support research for new treatments, distribute material. But they do not use or promote A.I. There are many other NGOs focused on healthcare like The Global Fund but only a few of them take A.I as a main development goal. Why ? Because A.I cannot do everything. It cannot donate money to finance research, or realise awareness campaigns. Maybe it will accomplish that in the future. But for the moment, A.I is not the priority for them. However, some scientific NGOs use and develop A.I.

Many countries are developing A.I for healthcare, and some of them have made considerable progress. China, for example, uses it very frequently: from treatment plan assistance or quick preliminary diagnoses, A.I has an important role in healthcare . As a result, the "A.I health market" value jumped from 13,7 billion yuan to 21 billion yuan. Singapour is also, along with China, one of the leaders in the field. Used principally in administrative tasks related to healthcare, scientists feel that developing it more seriously could have a great impact and could possibly reduce the mortality rate. However, they are not alone: Saudi Arabia has begun developing A.I in healthcare , as well as the USA. The E.U is also using A.I, and several startups specialised in this field are based in Europa. The potential of A.I is slowly being exploited around the world, allowing the improvement of quality of care. The countries where A.I in healthcare is not yet exploited yet are less -industrial ones , where simple healthcare is still complicated.

There are also international companies like Google or Intel. They are implemented in several countries and work on A.I or tools (as seen before) that could help the implementation of A.I in healthcare. Finally, we must not forget all the regulations around data (GDPR, HIPAA), that set laws, restrictions and permissions. They are, in their own way, participating in the development of A.I around the world.

In conclusion, we can see that there are many international actors working on A.I. It may clarify the growing potential of it. This is a relatively new technology, but in hindsight, it could definitely level-up the rapidity and the efficiency of our medicine.

6.Guidelines

Some guidelines for your research:

-"What is Artificial Intelligence ?"

-"What problem the implementation of A.I in healthcare cause"

-"What is privacy?" and "Why does it cause problems with A.I?"

- "What does autonomy mean for A.I?"

-"What could be done to preserve both patient privacy and the quality of care?"

-"Why do so many parties want to use A.I in healthcare ?"

7.Bibliography

Here are links and annexes that helped throughout the redaction, and that could help you too !

- Article about Facebook A.I that could prevent suicide:
  https://techcrunch.com/2017/11/27/facebook-ai-suicide-prevention/
- a "brief" history about A.I, very complete, retrace the whole history from B.C to today:https://aitopics.org/misc/brief-history
- History of the implementation of A.I in healthcare, as well as the possible future of A.I:https://rowanalytics.com/blog-post/ai-in-medicine-a-historical-perspective/
- Intel website. This is the section about A.I in healthcare, with all the tools and the services they propose: https://software.intel.com/en-us/ai/healthcare
- A very good article on actual threats of A.I in healthcare and reflexions for the future: https://www.lexalytics.com/lexablog/ai-healthcare-data-privacy-issues
- John McCarty's website. He is one of the pioneer in A.I, and his website contains a lot of useful informations about it (Warning: certains terms and concepts could be difficult to understand): http://www-formal.stanford.edu/jmc/whatisai/node1.html
- An affordable article to understand the basic principles of A.I: https://www.innoplexus.com/blog/how-artificial-intelligence-works/
- Definition and article about the inportance of data privacy: https://www.varonis.com/blog/data-privacy/
- Point of view of a radiologist about A.I in healthcare: https://www.forbes.com/sites/paulhsieh/2017/04/30/ai-in-medicine-rise-of-the-machines/#3e0a209aabb0
- Example of how can we use A.I in healthcare: https://www.forbes.com/sites/bernardmarr/2018/07/27/how-is-ai-used-in-healthcare-5-powerful-real-world-examples-that-show-the-latest-advances/#c0b61505dfbe
- Article about impacts of A.I in healthcare and the challenges it may overcome:https://medium.com/@Unfoldlabs/the-impact-of-artificial-intelligence-in-healthcare-4bc657f129f5
- (Small) Graph about the investment in A.I for healthcare: https://www.accenture.com/us-en/insight-artificial-intelligence-healthcare

- Some judicial details about A.I in healthcare:
  https://www.natlawreview.com/article/transformational-artificial-intelligence-prioritizing-ai-healthcare-while
- difference between hardware and software:
  https://www.diffen.com/difference/Hardware_vs_Software
- Some explanations about genome sequencing:
  https://smithfamilyclinic.org/what-is-whole-genome-sequencing
- Bryce Olson's website: https://sequenceme.org/
- Great article (a bit long) about AI in healthcare:
  https://www.newyorker.com/magazine/2017/04/03/ai-versus-md
- Sebastian Thrun's website:http://robots.stanford.edu/personal.html
- Article about the chatbot Tay deployed by Microsoft:
  https://money.cnn.com/2016/03/24/technology/tay-racist-microsoft/index.html
- An radio podcast about 23andMe. The guest is Anne Wojcicki, the company's
  CEO:http://freakonomics.com/podcast/23andme/
- The official 23andMe' s website:
  https://www.23andme.com/?myg01=true&myg01=true