Summer Training Report

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MBA Health and Hospital Management

2019-2021

PART-1: Research Project

LITERATURE REVIEW: SOCIAL STIGMA AND FAKE NEWS DURING COVID-19

By: Sriram Suresh

ACKNOWLEDGEMENTS

This work would not have been possible without the support and guidance of various people at IIHMR University, Jaipur.

Firstly we would like to thank our mentor, Dr. Dhirendra Kumar who gave us the opportunity to do this project as part of summer training under his supervision. It is truly is an honour. Thank you for all the advice, ideas, moral support and patience in guiding me through this project. Thank you for your enthusiasm for the project. Thank you for giving us the opportunity to grow in the field of research.

We would also take this opportunity to thank our parents and friends for their unconditional love and support throughout the duration of the project, their enthusiasm motivated us to put our best efforts into the project and get to its successful completion.

Lastly a big thanks to the Corona Warriors, efforts of whom have kept us safe and we dedicate this study to these brave people.

TABLE OF CONTENTS

Introduction

A public health emergency of international concern-novel coronavirus disease (COVID-19) which is a respiratory tract illness resulting from Severe Acute Respiratory Syndrome Coronavirus 2 (SARSCoV-2) infection, outbreak in Wuhan, China on 31 December 2019, which has been spread to 213 countries and has infected 4,393,193 patients globally and a death toll of 295,445 deaths. (37,251 in China) by 13th May 2020. India had a total of 77,889 cases with a death toll of 2546 deaths. It was declared as a pandemic by WHO on 11th March 2020[1].

The outbreak of COVID-19 simultaneously caused a lot of misinformation and rumours that the authentic information is difficult to be communicated. Preventive practises like social distancing and hand washing are masked and spurious practises are leading to poor physical and mental health. For example, it was widely believed that it was a biological weapon created by China and coconut oil kills the virus. Regularly gargling with saltwater can help prevent infection [2]. One popular theory that 5G towers was directly linked to the spread of COVID 19 led to the burning down of those towers in United Kingdom. Misinformation often led to overreacting by hoarding goods in United States of America, thereby affecting the supply chain and its following impact on lower socioeconomic status and other vulnerable population or under reacting by deliberately engaging in risky behaviours and act as carriers of virus. In India, a father of three was reported to commit suicide upon hearing his diagnosis of COVID-19.Common beliefs also included that COVID only affects the elderly and the children and that virus could be killed during hot and humid climates. Also, communal rumours added were added to false allegations against Muslims, of purposefully spreading the virus. These messages appeared in April, after several members of the Tablighi Jamaat - an Islamic Missionary group, tested positive for the virus following a massive congregation in Delhi in March and as the number of cases grew, it was directly correlating with rise in number of COVID 19 cases [3]. Another example of hazards attributable to improper health communication can be drawn from Nigeria, where the health officials found several cases of overdose of Chloroquine (a drug used to treat malarial parasite) after the news regarding the effectiveness of the drug for treating COVID-19 spawned in the news media.

The increased rate of the spread of misinformation led to a rise in the number of fact checkers. According to BOOM fact checker, most of the false or misleading claims were circulated with videos (35%), there was also a significant number of text messages (29.4%) being shared with fake cures, treatments or quotes from celebrities, along with images (29.4%) that were either misrepresented or doctored. We also noticed a small number of audio clips (2.2%) going viral with false contexts. A few of these fact checks were on news reports (4%) by mainstream media organisations.[4]

In a study conducted by Gordon Pennycook, titled "Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy nudge intervention", he came to a conclusion that people share false claims about COVID-19 because they simply fail to think sufficiently about whether or not content is accurate when deciding what to share. Participants were far worse at discerning between true and false content when deciding what they would share on social media relative to when they are asked directly about accuracy. Furthermore, participants who engaged in more analytic thinking and had greater science

knowledge were more discerning in their belief and sharing and that nudging people to think about accuracy of information is a simple way to improve choices about what to share on social media.

Abstract

The corona virus disease 2019 (COVID-19) pandemic is evolving rapidly as an overwhelming burden on human health and health systems of many countries includes which includes countries like India. The country is facing several challenges to manage confirmed and symptomatic cases with limited administrative and logistic support, inadequate governance and widespread panic and stigma throughout the country. As the number of persons with COVID-19 and death are increasing there is a potential of heightened mass panic, stress and discrimination in coming days which can be predicted from recent protests in different parts of the country, spread of rumors and falsehoods, non-scientific information, limitations in governance and growing discrimination towards certain group of population and professionals. As World Health Organization (WHO) speculated this trajectory of pandemic is uncertain, this emerging body of stigma and discrimination needs to be addressed by proper authorities, infodemic[5] should be controlled by legal steps and mass awareness campaigns should be launched without further delays.

Methodology

This was a systematic desk review utilizing Google Scholar, PubMed, ResearchGate and Wiley searches to locate publications deemed to be relevant to the aims of this review, namely, to find social stigma and fake news during COVID 19. Article inclusion criteria was

(1) Social stigma

(2) Fake news

(3) COVID 19

Discussion

Social stigma in the field of health is negative association between people or a group who show characteristics of a certain disease. In an outbreak, this leads to people being stereotyped, discriminated against, separately treated or experience loss of status due to liking with the disease [6].

This can negatively impact the people with the disease, as well as their caregivers, family members and communities. People who only show some similarity in terms of characteristics and do not actually have the disease also suffer from stigma.

Recent outbreak has led to social stigma and discriminatory behaviour

Against people of certain ethnic backgrounds as well as anyone who is perceived to be in contact with the virus.

This stigma causes impaired social cohesion and social isolation of groups, which might contribute to situation where the virus impact is more and is likely to spread. This results in even more severe health problems and difficulties in controlling the outbreak.

As a result of this stigma:

- People tend to hide their illness to avoid any discrimination.
- Avoid seeking health care immediately.
- Discourage them from adopting healthy behaviors.

As stated by renowned Indian public health expert [7], "four sets of people are mostly discriminated during pandemic like situations. Firstly, CoVID-19 positive cases and families- then those in quarantine or isolation irrespective of their infection status whether positive or negative. Secondly, frontline workers like doctors, nurses, medical technicians, hospital cleaners etc. many of them are pressured by their landlords or society members to leave the homes as early as possible to minimize the risk of getting infected. Thirdly, police is considered as a source of infection due to the nature of their job. Fourthly, are those who have traditionally faced discrimination like domestic workers, garment workers, slum dwellers, public transport workers and in general poor population are discriminated and stigmatized.

One of the major reason behind this stigma and discrimination in India is very little knowledge about the novel virus. This is amalgamated by large amount of fake news and false information being circulated throughout the globe. WHO has labelled the spread of this fake news on the outbreak as an 'infodemic' and said that the non-scientific and manipulated information is spreading faster than the virus itself [8]. These majorly include considering regular flu symptoms as CoVID-19, virus eventually kills the infected, disease is of airborne nature, virus stays in the throat for a couple of days, high temperature kills the virus. The existing perception about the disease comes from social media propaganda, unauthentic reports claiming that the government is not ready to face the pandemic leads to a sense of

powerlessness in the population. The fear is of personal harm and loss of a loved one and the survival during the post crisis time.

The term fake news has been referred to as propaganda, deception, and manipulation, fabrication, and news satire and news parody. More specifically, we adopt the definition by as ‘either wholly false or containing deliberately misleading elements incorporated within its content or context’. It is usually circulated online and has a specific objective of using emotion to generate attention and viewing time toward aims such as messaging around populace or divisive themes; image tarnishing; and intimidating the press, shutting down and silencing dissent. While political marketers have long used the language of fear and persuasion in their messaging, the attention placed on fake news is increasing in intensity throughout the world. [9] .

Many conspiracy theories have also taken hold in the minds of the population such as, the virus originated in Chinese Laboratory, virus being a bio-weapon to cripple the world economy etc. can be heard in almost every household. This misinformation originated from social media accounts and websites with no credible evidence to support their claims. These posts have amassed over 20 million engagements, rising each day, and the theories continue to gain traction and following on the internet, despite scientists from multiple nations analysing the genome of COVID-19 and coming to the decisive conclusion that the virus originated in nature from an animal source[10] . If powerful and clear statements are not made denouncing and debunking these fabrications, then the impact on the populous has the potential to be devastating.

Later, as the government started health check-ups of every inbound passenger, the stigma shifted to all travellers coming especially from Italy, Iran, France and USA. Even at present people avoid meeting anyone who has come from abroad although they might have completed their 14 day quarantine [11]. The panic of contamination has increased so much that symptoms of seasonal flu are perceived as CoVID-19 and follow-up of regular cases, surgeries has become a challenge for physicians in government as well as private set-up. Reports of conflicts between public, doctors/ frontline workers, health administrators are emerging and could turn into a severe crisis where limited resources are already causing frustration among physicians [12].

The previous SARS outbreak showed that in order to contain panic in the population the spread of stigmatization has to be lowered. To prevent stigma and discrimination a full scale public campaign by the government with clear, complete and authentic information is required. Involving popular political, sport, entertainment personnel in this process might be useful. Good and proper communication is the key to eliminate the hysteric panic mass racial and class discrimination and stigmatization. A detailed analysis of pre-existing socio-economic conditions, risk factors is also required to understand such widespread panic and stigmatization.

Dispatching verified information from state authorities among the public is the most effective strategy in the fight against ‘infodemic’. Prompt legal actions and social media monitoring

are needed to fight against the propaganda, falsehood and conspiracy theories. Now, the whole world is using the same symptom checklist and prevention strategies regardless of ethnicity, gender, age or socio-economic group [13].

The combination of quick and targeted interventions oriented to delegitimize the sources of fake information is key to reducing their impact. Those users voicing their views against the conspiracy theory, link baiting, or sharing humorous tweets inadvertently raised the profile of the topic, suggesting that policymakers should insist in the efforts of isolating opinions that are based on fake news[14]. Many social media platforms provide users with the ability to report inappropriate content, which should be used.

Conclusion and Recommendations

It is evident that stigma and misinformation around diseases especially the once that are communicable in nature hampers the response. Need of the hour is to build trust in reliable health services and advice, showing empathy with those affected, understand the nature of the disease and adopt practical and effective measures so that people can keep themselves and their loved ones safe. An environment needs to be created in which people can get to know the disease and its impact openly, honestly and effectively [15].

Following are some tips that we recommend to address and avoid compounding, social stigma:

1. **Words matter: -**
   When talking about the disease, use of words like suspected case, isolated etc. may have a negative impact in the mind and lead to stigmatized attitudes. This leads to strengthening of false associations between disease and other factors, spread fear and panic and discrimination towards those who have the disease.
   There are many examples of how use of inclusive language and less stigmatizing can help control epidemics and pandemics like HIV, TB, and H1N1 Flu [16].

2. **Do your part: -**
   As responsible citizens it is our responsibility to prevent the spread of stigma, we need to be thoughtful when communicating on social media and other platforms.
   Here are some examples and tips

- Spread the facts: - social media is a powerful tool to spread information at a very low cost to large population. Insufficient knowledge about the disease, its transmission and treatment is the ground cause of the present stigma. Dissemination of accurate country and community specific information must be provided. One must use simple language and avoid using clinical terms [17].
- Engaging social media influencers for prompting reflection about people who are stigmatized and how to support them. The information should be well targeted geographically and culturally for the audience they seek to influence.
- Amplify the voices, stories and images of people who have experienced the new coronavirus and have recovered. Also a campaign to honor the caretakers and healthcare workers who may be stigmatized.
- The material being shared should show all the communities being impacted and yet working together to overcome it. Symbols, formats, typeface should not suggest any particular group.
- Link up: there are number of initiatives to address stigma and stereotyping. It is key to link up these activities to create a movement and a positive environment that shows care and empathy for all.

3. **Communication tips and Messages: -**

- We need collective solidarity and clear, actionable information to support communities and the affected people. Misconceptions and miscommunications cause stigma and discrimination which slow or hamper the efforts made by others in response to the situation [18].
- Correct misconceptions, at the same time as acknowledge that people's feelings and subsequent behavior are very real, even if the underlining assumption is false.

- Importance of preventive measures, early screening and treatment must be promoted. Collective solidarity and global cooperation are needed to prevent further spread of the disease [19].
- Stories that humanize the experience and struggles of people from different communities and groups must be shown, this will bond the community together instead of creating a divide.
- Facts, not fear will stop the spread of the novel coronavirus (CoVID-19) [20].

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PART 2: ONLINE COURSE REPORT

ARTIFICIAL INTELLIGENCE FOR HEALTHCARE: OPPORTUNITIES AND CHALLENGES

By: Dr. Sajal Baxi

PLATFORM: TAIPEI MEDICAL UNIVERSITY
(www.futurelearn.com)

COURSE INSTRUCTOR: Dr. Shabbir-Syed Abdul

COURSE DURATION: 4 WEEKS

STARTING DATE: 23rd March 2020

ENDING DATE: 20th April 2020

Description of the course

The course is about use of artificial intelligence in healthcare and opportunities and challenges in the field. The course is divided into weeks and every week focuses on different aspects of A.I. like Introduction to A.I, algorithms in A.I. and their application in the field etc.

1) Some key features covered in 1st week:

1.1) Current issues in healthcare.
1.2) My Health Bank, Taiwan.
1.3) Process of A.I. and how it analyses the data.

2) Some key features covered in 2nd week:

2.1) the development of A.I.
2.2) Problems of one-size-fits all approach.
2.3) how can A.I. help clinicians?
2.4) A.I. biases.

3) Some key features covered in 3rd week:

3.1) Machine learning.
3.2) Interpretability: explainable A.I.
3.3) Decision Making through A.I.
3.4) Privacy and A.I.

4th week is dedicated for an online test series where minimum 50% marks are required and submission of assignments that were given during the course.

Summary

Artificial Intelligence has already arrived in healthcare. Few doubt though, that we are only at the beginning of seeing how it will impact patient care. Not unsurprisingly, the pace of development in the commercial sector has outstripped progress by traditional healthcare providers – in large part because of the great financial rewards to be had.

Few doubt too that while AI in healthcare promises great benefits to patients, it equally presents risks to patient safety, health equity and data security.

The only reasonable way to ensure that the benefits are maximized, and the risks are minimized is if doctors and those from across the wider health and care landscape take an active role in the development of this technology today. It is not too late.

That is not to say doctors should give up medicine and take up computational science, far from it – their medical and clinical knowledge are vital for their involvement in what is being developed, what standards need to be created and met and what limitations on AI should be imposed, if any.

For AI to truly flourish, not only must IT be overhauled and made inter-operable, but the quality and extent of health data must be radically improved too. The workforce will need to be trained on its value and the need for accuracy and healthcare organizations will need to have robust plans in place to provide backup services if technology systems fail or are breached.

Table of Contents

1. **Introduction to A.I. for healthcare and key challenges**

All the invention in healthcare has been discoveries e.g.: X-rays that helps us to see inside our bodies were discovered in 1885. Then came the discovery of antibiotics i.e. penicillin by Alexander. What he did was culture some bacteria in a Petri dish and went on a vacation; upon his return he found that some fungi were killing the streptococcus. That is how age of antibiotics started. Thirdly, the use of information technology computers in healthcare, CT scanning, then came MRI and various sorts of diagnostic tools. However, the fourth revolution is about using the modern advances in the world of computing i.e. artificial Intelligence, Internet of things and big data analytics.

Human beings are the most complex organism in nature so far, and our brain is what gives this complexity. Even with the modern advancements in science and technology we have still not been able to figure out how the exactly is the brain functioning. During the million years of human evolution the things that have changed the most is the ability to use the brain that is nothing but natural intelligence. The way we start thinking and analyzing the information from our surroundings and working with it is what has made us change. This change brought us to the age of computers and now we want to make the computers work like our brains. Hence, comes in the concept of A.I.

Artificial Intelligence describes a range of techniques that allow computers to perform tasks typically thought to require human reasoning and problem-solving skills. ‘Good old-fashioned A.I.’ which follows rules of logic specified by humans, has been used to develop healthcare software since 1970s, yet the impact of the technology has been limited. In past few years there have been ground-breaking discoveries in field of machine learning and artificial neural networks, in which computers learn through processing examples rather than working only on programming.

‘Artificial Neural Networks’ are a machine learning technique, framework of which is based on how a human brain works. They improve their ability to accomplish a task by considering examples. Most basic example of A.I in daily life is the image recognition software's like “Google Lens”, it is taught to identify images that have been manually labeled as ‘face’ or ‘no face’. This over the period, with a large data base and powerful computers has got better at this task. It is now able to identify connections in the data.

How artificial intelligence works in computers?

The basics of functioning are derived from natural intelligence model. Like in our body all the information is passed from one axon to the other in form of electrical impulses and the brain process this electrical impulse and gives an output, similarly we put nodes behind nodes, notes behind notes, which are called as layers or convolutional layers(CNN) and we give some input variable to get an output variable.

For example, the image recognition software's that are used. The system is fed with millions of manually labelled images of a thing let's say, developmental phases of tumour. The system

breaks down each image into its basic components i.e. ‘the pixels’ and analyses the data and works to find out patterns in each of them. Equipped with this information now when the system is provided with a new image set, it will process it and will tell whether they show the features of tumour or not, based on which clinician can make decision regarding tests and interventions well in advance.

The healthcare system of today is highly advanced but has been slow to incorporate the technological advancements in the field of information and data informatics.

2. **Current Challenges in Healthcare**

Ignoring participatory healthcare.

It basically means empower the patient by providing him or her own health care to participate in management of their own healthcare issues. The government of Taiwan has taken a very innovative step in this direction by developing an app called “My Health Bank”, where patients are able to see their own health records. These records are stored in the data base of National Health Insurance Bureau, protected by passwords and security checks. By logging in people can see how many times you have visited the hospital, dental clinic, pharmacy etc. People can also add new information like new appointments, reminders for vaccinations or habits, how are you sleeping, blood pressure, blood sugar levels, how much physical activity did you do on a given day.

Another important feature of the app is that it gives you predictions about chances of acquiring of some serious diseases. As of now the app is programmed to predict Kidney diseases, hepatocellular carcinoma and lung cancer. These predictions are made by A.I. based on demographic information, medications you are taking, lab values of tests. By the analysis of the data it predicts the chances of developing the disease in next 3 to 10 years. The idea behind these predictions is to induce behaviour change in the people regarding their good health and lifestyle.

Once you go back to the clinic for a routine check-up even the doctor can see the graphs of things happening when you are at home. With early detection better treatments can be planned and undertaken reducing the morbidity and mortality significantly.

One size fits all approach.

Human phenotype is a result of interaction between genetic traits and environment. The genetic composition of every human is always different and so is the susceptibility to acquire a certain disease, even the same disease can show different forms or features in different humans. All this is due to the genetic variation. So the line of treatment cannot be similar for every person. This leads to the demand of personalization of healthcare were individual parameters can be assessed and a specific line of treatment can be undertaken. To meet this demand many IT companies have come up with various apps that according to the personal data suggest diet, amount of physical activity required, and predictions on future outcomes of a current behaviour.

Focus on curative care.

It is a well-known fact that, “ Prevention is better than cure” but modern healthcare system focuses more on curative part as the results are immediately visible and the treatment is more con formative, but this comes at a cost which many people are unable to bear. Whereas preventive aspect is cheap and it requires a long time for the results to be visible. For e.g.: with regular exercise the chances of developing heart conditions are greatly reduced, but a

person may never know If he can actually ever develop such a condition or not, even if he chooses not to regular exercise. This is the main reason why people also do not take active part in preventive health care.

A.I. can very easily predict the possibility of such events based on current routine and patterns drawn from previous data and help people to avoid getting such chronic diseases.

3. **Possibilities of Artificial intelligence in Healthcare**

Machine learning is the main building block of Artificial Intelligence, main goals of machine learning are

1) CLASSIFICATION: to identify what is what? And how to differentiate it from others.

2) PREDICTION: based on patterns formulated from the data set future outcomes of an event can be predicted.

3) OPTIMIZATION: to identify how much of input will bring the desired result in the current process.

In order to apply machine learning in healthcare, patients become the data points that exits in a multi-dimensional space and each dimension represents a feature or a variable such as blood pressure whether they're taking a medication or not. These variables can be used to determine what their diagnosis would include and the task would be to predict the outcome such as survival or death; response to a particular treatment or risk of using a formula. At many occasions it has been seen that computer systems have beaten doctors in diagnosing problems like diabetic retinopathy or skin cancers at very early stage.

There are places around the world where they have very few numbers of radiologists or ophthalmologists, this algorithm would be really helpful.

Artificial Intelligence requires data that is number one 'objective', number two

'The theories of a ground truth, but medicine are a subjective endeavour with less than clear-cut definitions of concepts, whereas in medicine ground truth is a moving target. e.g.:

How to take care of patients of myocardial infarction? (In 1978)

The patient should stay in bed for six weeks. They are not allowed to use toilets for two weeks. Avoid medications containing beta-blockers and not to take them to cardiac catheterization lab as they are too unstable. *-Harrison, Textbook of internal medicine.*

But in 2020, these recommendations are not followed. It is possible that the studies on which these recommendations were made are flawed, but it is also possible that, this was the ground truth back in 1978. But over the period of time description of patients who develop heart attacks would have changed and also with the advent of new tests and treatments, it's very possible that those guidelines are now obsolete in 2020. The key message here is that we constantly need to look at the models. We constantly need to repeat analysis to make sure that we are accurate.

4. Machine Bias

Computers have been thought to be objective, but if they are provided with biased data the output will also be a biased algorithm. There was a landmark investigative report that was published in 2016 on the software that are being used judicial courts across the United States where an algorithm is supposed to recommend that in parole what is the likelihood that the person will recommit a crime, it gives the judges advice about a reasonable amount of bail for a certain person waiting for trial and there are some courts in the US that follow the advice of the algorithm and some do not. This led to the findings that the algorithm would label some black defendants as future criminals twice the rate as white defendants. The white defendants were mislabelled as low risk more often than the black once.

Similarly in healthcare, algorithms that we run to see if a patient will respond to chemotherapy might be biased against certain groups and could suggest withholding the chemotherapy in them but they might actually benefit from the intervention.

This can also be seen in those ICU's where algorithms are used to determine chances of death for a patient but due to some bias it might recommend premature termination of treatment.

How A.I. bias happens

We often shorthand our explanation of AI bias by blaming it on biased training data. The reality is more nuanced: bias can creep in long before the data is collected as well as at many other stages of the deep-learning process. For the purposes of this discussion, we'll focus on three key stages.

1) **Framing the problem.**

The first thing computer scientists do when they create a deep-learning model is decide what they actually want it to achieve. A credit card company, for example, might want to predict a customer's creditworthiness, but "creditworthiness" is a rather nebulous concept. In order to translate it into something that can be computed, the company must decide whether it wants to, say, maximize its profit margins or maximize the number of loans that get repaid. It could then define creditworthiness within the context of that goal. If the algorithm discovered that giving out subprime loans was an effective way to maximize profit, it would end up engaging in predatory behavior even if that wasn't the company's intention.

2) **Collecting the data.**

There are two main ways that bias shows up in training data: either the data you collect is unrepresentative of reality, or it reflects existing prejudices. The first case might occur, for example, if a deep-learning algorithm is fed more photos of light-skinned faces than dark-

skinned faces. The resulting face recognition system would inevitably be worse at recognizing darker-skinned faces. The second case is precisely what happened when Amazon discovered that its internal recruiting tool was dismissing female candidates. Because it was trained on historical hiring decisions, which favored men over women, it learned to do the same.

3) **Preparing the data.**

Finally, it is possible to introduce bias during the data preparation stage which involves selecting which attributes you want the algorithm to consider? In the case of modeling creditworthiness, an "attribute" could be the customer's age, income, or number of paid-off loans. In the case of Amazon's recruiting tool, an "attribute" could be the candidate's gender, education level, or years of experience. This is what people often call the "art" of deep learning: choosing which attributes to consider or ignore can significantly influence your model's prediction accuracy. But while its impact on accuracy is easy to measure, its impact on the model's bias is not.

5. **Re-enforcement Learning in Healthcare**

Machine learning has three pillars 1) Supervised learning

2) Unsupervised Learning

3) Re-enforced learning.

1) Supervised learning

It is about learning the relationships between input data and output data i.e. supervised learning is function between x and y. two sub-types of supervised learning are regression and classification algorithms. e.g.: in a study published in *The Nature, 2017:-*

a computer software was as good as an experienced dermatologist as it could predict skin lesions with very high accuracy.

Here, the model was trained using labelled data like which lesions were cancerous and which were not cancerous. By processing this information the software could arrive at a diagnosis.

2) Unsupervised learning

It is where the computer learns about the structure in the data, but the data itself is unlabelled. While feeding the data into the algorithm there were no set categories. Most commonly used algorithms in unsupervised learning are clustering and dimensionality reduction.

3) Re-enforced learning

Here the objective is to learn an optimal strategy. Developing a strategy is often more complex than giving predictions. The idea behind re-enforced learning is very simple- 'rat in a maze'. The rat here is an agent and the maze is an environment. The agent can be in lots of different states that are represented by the cells in the maze. In every state the agent has a choice of going in any direction i.e. up, down, left or right and the objective of the agent is to maximize the reward as often as possible and to avoid cells that are associated with penalty. Here the actions that lead to rewards are re-enforced. When it comes to healthcare it can be visualized as follows:

We have a patient who can be in various health states and various clinical conditions, the objective of the clinician or the healthcare system is to take the patient from state to state in order to bring him home and not to the death bed. When a patient comes in the hospital with a with a presentation what doctors do is that they will be gathering data about this new patient examining them doing all sorts of assessment and examinations. Then they will use their

theoretical medical knowledge as well as their clinical experience meaning all the cases they have previously encountered. All this information will be integrated and will lead to a medical decision. The problem is that this is a very sub optimal approach for various reasons. A very important aspect is that humans are full of biases and cognitive biases in medical decisions are a very significant problem.

For many diseases, many clinical problems we don't have a physiological model or sometimes we lack theoretical knowledge, human doctors are not perfect they sometimes forget cases that they have encountered in the past sometimes the cases are so rare that very few people can even make a diagnosis sometimes we get the diagnosis wrong and practice variation is also a huge problem.

6. Medication decision as a re-enforced learning problem

To think about a system situation where someone or a computer would have complete knowledge about whole human physiology and the diseases is next to impossible as even now we do not have complete information related to these two aspects, but with the help of medical research this knowledge base is constantly increasing. For the time being, next best approach would be to imagine having at any point in time, a permanent and unbiased knowledge about a vast number of patients that are very similar to a new patients reporting into the hospital or healthcare system. If at the same time clinician could know which treatments all these patients received and what was their outcome, this would probably allow him to reduce the uncertainty around what medical decision is the most optimal for the new patient.

For this approach the clinician will have to follow policy classically called Pi. The clinician will act on the environment of the patient by giving drugs to the patient, the patient will react by switching states going getting better or getting worse sometimes, and if the new state is more desirable than a previous state, then undoubtedly the clinician will get a reward and the action that led to this beneficial transition will be reinforced.

Artificial Intelligence and Machine Learning have in recent years shown to be much better than many top players in video games like chess, Go etc. But the field of healthcare has not yet completely accepted it into their daily working. Following are the key reasons behind it:

1. Medicine is a high-risk environment, meaning that we cannot afford to deploy a bad policy that would be harmful for people.

2. Limited amount of training data. This highlights the importance of open data and making data publicly available.

3. In healthcare the information we have is vital signs, lab values, x-ray reports and so on. So this is this is like looking through the keyhole of physiology with the data that we have in healthcare, the environment is not fully specified. We don't have all the information available to make the best decision.

5. In healthcare it is impossible to learn by trial and error, an example of a classic computer science paper where analysts have been training virtual car, learning a virtual task of climbing a mountain. This is the Montaigne car problem and you see that they've used 20,000 trials to train the model, meaning that many of those trials ended up by the car crashing but as long as it's all virtual it doesn't matter. This is impossible of course in medicine where we could never afford to do this with human life.

7. **A.I. in healthcare: Data privacy and Ethical issues**

Big data has fundamentally changed the way organizations manage, analyze and leverage data in any industry. One of the most promising fields where big data can be applied to make a change is healthcare. Big healthcare data has considerable potential to improve patient outcomes, predict outbreaks of epidemics, gain valuable insights, avoid preventable diseases, reduce the cost of healthcare delivery and improve the quality of life in general. However, deciding on the allowable uses of data while preserving security and patient's right to privacy is a difficult task. Big data, no matter how useful for the advancement of medical science and vital to the success of all healthcare organizations, can only be used if security and privacy issues are addressed.

To ensure a secure and trustworthy big data environment, it is essential to identify the limitations of existing solutions and envision directions for future research. In this paper, we have surveyed the state-of-the-art security and privacy challenges in big data as applied to healthcare industry, assessed how security and privacy issues occur in case of big healthcare data and discussed ways in which they may be addressed. We mainly focused on the recently proposed methods based on anonymization and encryption, compared their strengths and limitations, and envisioned future research directions.

8. **Achievements of A.I in healthcare field**

8.1. Performing routine tasks.

As the industry strides ahead, the volume of data continues to increase at a staggering pace. While carrying out CT scans, X-rays, analyzing tests and carrying out other mundane tasks like data entry, AI can make the process simplified.
Particularly, in radiology and cardiology, the amount of data can be massive. AI integrated robots are being entrusted with these tasks to pacify the process. In future, radiologists and cardiologists will be looking into areas only where human supervision is necessary.

8.2. Managing data and medical records.

In the healthcare industry, compiling and evaluating information like history and medical records generally constitute the first step. Integrating digital automation and artificial intelligence can simplify data management to a great extent.
Presently, robots are used to collect, re-format, store and trace data in order to make the access to information faster and more consistent. Reputed IoT solution providers have been closely collaborating with the hospitals and healthcare providers in developing robust AI-integrated tools.

8.3. Treatment design.

AI systems have been developed and deployed to analyze information, so that the medical practitioners can select the accurate, individually customized path of treatment. The information required for processing may include the patient's medical files. Coupled with clinical expertise and external research, the AI-integrated apps help in designing the treatment course.

8.4. Digital consultation.

In the UK, apps like Babylon use AI to provide medical consultation to patients, based on common knowledge in medicine and personal medical history. The users simply need to report their symptoms, while the app uses speech recognition to compare the same against a database of ailments. Then the app recommends an action, based on the medical history of the patient.

8.5. Medication management.

The AiCure app, developed by the National Institutes of Health, monitors how a patient adheres to the medication guidelines. Artificial intelligence is integrated into the webcam of a Smartphone, confirming that the patients take the prescribed medicines at the right time. This enables them to manage the medical conditions better, as most of the users have serious health issues, or tend to go against the advice of physicians, participating in clinical trials.

8.6. Virtual nurses.

A digital nurse, Molly, has been developed by the start-up called Sense.ly that can monitor the conditions of patients and provide treatments as follow-ups, between the doctor's visits. Here, the developers have used machine learning to support patients who suffer from chronic illnesses.
In 2016, another app for Amazon Alexa had been developed by the Boston Children's Hospital that provides parents with advice and information to take care of the health of their children who were ill. The app has the ability to answer questions regarding medical conditions, detect symptoms and recommend whether a doctor's visit is required.

8.7. Precision medicine.

Genomics and genetics seek mutations and connections to disease from DNA information. AI has made it possible to spot vascular diseases and cancer early, so that the doctors can take timely action. On analyzing the genetics, it can predict the health issues that people may face.
8. Monitoring health.
Presently, many health trackers like Apple, FitBit and Garmin are used to monitor the activity levels and heart rate of the users. These are AI-integrated smart devices that send alerts to carry out the necessary activities and share them with the physicians.

8.9. Creating drugs.

The traditional process of using clinical trials for developing pharmaceuticals can take decades, and incur huge expenses. AI has already made this process faster and cheaper. During the recent outbreak of Ebola virus, an program was used for scanning the existing medicines, so that the researchers could redesign them to combat the disease. The program helped in finding two programs that would reduce the infectivity of Ebola for a day, while this type of analysis takes up to several months or years. This can eventually save thousands of lives.

8.10. Analyzing the healthcare system.

Across the world, efforts are being made to simplify the analysis of healthcare system using artificial intelligence. Presently, 97% of the invoices generated in the healthcare industry in the Netherlands are digital. A Dutch company examines data using AI to find the mistakes in treatments and inefficiencies in workflows. As a result, unnecessary hospitalizations of patients can be avoided.