

The Fourth Industrial Revolution: Healthy... or not?

Written report

Group 10-09

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Synopsis

This report will discuss the challenges that the healthcare industry will face in 2030 and possible solutions to them. We will also propose an action plan that can be taken for preventive measures.

Introduction

The Fourth Industrial Revolution will bring about unprecedented change across all industries. We are focusing on the healthcare industry in particular, as it has been projected to become an 8.734 trillion global spend industry in 2030. Locally, it is worth USD\$3000 per capita, with 540 million allocated specifically to spur technological advances. Thus, this industry could potentially face major disruptions.

Organisation studied: National University Hospital(NUH)

Public Survey

According to the survey results, the public demands empathy and “human touch” from doctors, with most not trusting a robot’s ability to express emotion like a human. More than half the respondents expressed worry over the efficacy of robots in the healthcare setting. These issues include biased programming or the responsibility should there be an accident.

Interview

We interviewed two doctors from NUH, an anesthesia specialist and a cardiology consultant.

NUH is Singapore’s first restructured hospital which focuses mainly on patient satisfaction and safety. It attends to more than a million patients yearly.

We chose to interview them because healthcare professionals understand the current situation of their industry better than the public. They know the upcoming developments as well as the issues with the current situation. Hence, they can provide us with deeper insight as well as theorize future developments.

We gained knowledge on HOSPI, four Panasonic Autonomous Delivery Robot are used to deliver fragile or bulky medicines, patient’s notes or medicine specimens. They are only accessible with specialised ID cards and have a map of the entire hospital programmed within them so they can avoid obstacles and find the shortest route to its destination. Another program to note is EPIC Systems, which is used to hold medical records. This system is meant to be more efficient but it will also cause the hospital staff to have to adapt to a totally new system interface. Lastly, there has been an automation of medicine packing based on the doctor’s order. This machine packs medicine which will then be sent to the pharmacy. This packing of medicine will ensure that the medicine is prepared for the patient already. However, the

pharmacy should still check to make sure the patient's medicine corresponds with the doctor's order when they are giving the medicine to the patient to avoid taking the risk of the robot packing the wrong medicine.

Our interviewees felt that Robot Surgery would benefit the industry in theory because humans are prone to error and robots are programmed so it would be safer. Furthermore, robots can access parts of the body that doctors cannot access. However, robots have been proven not to benefit surgery. Few surgeries carried out with the aid of robots have had clinical advantages. In theory, robots should benefit surgery accuracy and efficiency but practically, it has proven not to help at all. It will be a long time before robots actually help much in surgery but science is unpredictable.

Next, most hospitals are extremely worried about cyber security even if they have not been attacked before. Hence, they have taken many measures to prevent such an incident from happening. This paranoia causes staff to need to be very careful with their patients' information. Patient's records from other hospitals are not easily accessible is one of the results of these measures.

The interviewees shared that some people guard data very tightly but some do not. The government and public need to make a collective decision on whether they want to risk their security for efficiency. Whenever technology is implemented, certain regulations must be put in place, along with the required resources to carry them out. If robots are indeed going to be smarter than humans, there must still be certain regulations put in place. The public and government needs to know how to regulate technology.

About Robot Racism, the interviewees felt that anything is possible, it all depends on the inputs. Because AI is programmed to learn, it will be influenced by humans. Humans may influence it the wrong way and cause it learn some of our negative traits even though we do not mean for it to.

About Ethical Issues, the interviewees felt that this would come down to our comfort level with robots and the responsibility of robot malfunctions should be a collective decision by society.

Technological developments could possibly be slowed down by disturbances but it will still continue improving one way or another. Technology has evolved tremendously in the healthcare industry. These developments must be adapted to by the society. However, these developments must be carefully considered and slowly implemented. People on the ground would feel very rushed if they are rushed into making changes and this will cause the people to feel negatively about these technological developments.

Challenges

1. Safety of healthcare technologies

Health IT was related to patient harm in 53% of studies (2017, M.O. Kim, E. Coiera, F. Magrabi). So far, no safety regulations have been put in place.

With the 4th Industrial Revolution poised to replace high-risk jobs with technology, there may be a high chance of accidents happening. (Why)

Safety is defined in terms of personal information, and most importantly, lives.

Firstly, as Artificial Intelligence(AI) takes over various roles in the healthcare industry, patient data is needed to optimise analysis of patients' conditions. Also, deep-learning AI needs massive amounts of data to gather the learnings needed to be effective. Thus, a myriad of data will be needed to be collected in order to improve AI. This comes with a definite risk as many technological firms will be fighting for our information, and there is no clue as to how it will be used. One such example is The Royal Free Hospital in London. It had struck a deal with Google's AI firm allowing the company to gain access to the data of 1.6 million patients, but did not do enough to inform them about how that information would be used (Information Commissioner's Office,2017). (Research 1)

Secondly, there have been many cases of patient harm due to technology. However, we do know that robots do come with a risk of malfunctioning. A study by researchers at the University of Illinois at Urbana-Champaign, the Massachusetts Institute of Technology and Chicago's Rush University Medical Center revealed 144 deaths, 1,391 injuries and 8,061 device malfunctions were recorded out of a total of more than 1.7 million robotic procedures carried out between January 2000 and December 2013. (Research 2).

Other than that, it is recognised by professionals in healthcare technology that safety(cyber security) is an important issue, as it is ranked 1st in ECRI's top ten health technology hazards list. Such cyber attacks will render systems inoperative, compromise data, and in turn severely hinders the delivery of patient care and puts patients at risk. (Research 3)

2. Negative Social Acceptance

Based on a survey done on the public, 55% of public rated their acceptance for any robotic application at 5 or below. Additionally, there have been cases of technology induced unrest, as in the Luddite attacks on industrial machines and Captain Swing riots in industrialising Britain. (Observation)

While it may be less likely in Singapore, citizens can still have negative acceptance towards these technologies, particularly in healthcare. With a negative attitude towards these technologies, there will be a lack of trust towards this industry.(Why)

It is proven that both professionals and patients both have negative attitudes towards robotic applications in healthcare settings(K. Cresswell, S. Cunningham-Burley and A. Sheikh, 2018). This was mainly because of negative publicity due to movies and science fiction books, which present robots as potential apocalypse causes (Terminator, Avengers: Age of Ultron). However, many other factors also result in a negative attitudes towards implementation of robotic applications. Firstly, some people identified clinician-patient relationship and patient trust as aspects of care that were perceived to require human input. Secondly, robots are perceived threats to many medical roles. This resulted in many doctor, patient-unions and lobbying groups rejecting any implementation of a care provider in the healthcare scene. Lastly, a lack of exposure to robots also results in people becoming skeptical of its ability, and a fear of the "unknown", in which "unknown" refers to robots. (Research 1)

These may pose a problem to the healthcare industry, as a negative attitude frequently results in a slow and negative acceptance of these robotic applications (David et al. 1989). (Research 2)

Negative acceptance will result in large forms of protest and social unrest all over the world if technology is widely implemented in place of humans in the healthcare industry. Further backing of this possibility include classical economists, David Ricardo and Karl Marx, writing on the possibility of rapid technological change that would immiserise the working class and ultimately lead to social unrest.(Research 3)

3. Ethical Issues

Based on our survey and interview conducted with two healthcare professionals, we have discovered the possibility of many unethical issues occurring when robots are extensively used in Healthcare. More than 60% of the public think that these issues are inevitable. (Observation)

This is a problem as the bias that enters the coding for these technologies may result in impartial treatment of patients, which will result in public dissent. (Why)

Robots will almost definitely be impartial or offensive. For example: A few years ago, Microsoft had to shut down a genius AI project— *Tay*. In an effort to conduct research on conversational understanding, “Tay was a bot capable of telling jokes, commenting on images, etc. However, the most interesting task in Tay’s capacity was to repeat statements in her own language. Tay was capable of learning how to personalize her reactions to content, through a substantial amount of comedic improvisations.” However, Tay was not able to realise offensive comments, and this became a serious issue when she commented on Trump’s wall and Holocaust. These comments include “We’re going to build a wall and Mexico is going to pay for it” and “Hitler was right I hate Jews”. (Research 1)

Another example is a computer program used by a US court for risk assessment was biased against black prisoners. The program, Correctional Offender Management Profiling for Alternative Sanctions (COMPAS), was much more prone to mistakenly label black defendants as likely to reoffend – wrongly flagging them at almost twice the rate as white people (45% to 24%) (J. Angwin, J. Larson, S. Mattu and L. Kirchner, 2016). If robots have this mentality, they may accidentally say something wrong to a patient, offending the patient severely. They may also choose to treat patients of certain races more haphazardly and give the wrong medicine or even refuse to treat them. (Research 2)

With any new technology, artificial intelligence reflects the bias of its creators. (Will Byrne, 2018). Sascha Eder, COO and Founder of NewtonX, the world's first AI-powered expert network, states that algorithm bias is already pervasive in current society. With the arrival of the 4th Industrial Revolution, there is an even higher chance that bias will find its way into the systems of healthcare.

4. Loss of Jobs

Based on our interview with healthcare professionals, we realised that technology in the healthcare sector is already prevalent. (Observation)

With the arrival of the 4th Industrial Revolution, this may be a problem as it will result in many healthcare professionals being unemployed. This will result in decreased tax revenue and slow down economic growth. At worst, citizens may protest against robots taking over. (Why)

Many robots are already capable of doing jobs in this industry. For example, robots such as Renaissance allows surgeons to place screws in spines at 99% accuracy. Google's deep-learning algorithm can diagnose diabetic retinopathy with higher than 90% accuracy. Many technological companies, both large and small, are piling millions of dollars into these technologies. Health AI startups are exponentially increasing as the market is set to register a compound annual growth rate of 40% through 2021. (Research 1)

With all this advanced technology dominating over the healthcare sector, it is no surprise that many healthcare workers, including doctors, specialists and nurses, are at risk of losing their jobs. After all, the efficiency and accuracy of robots is much greater when compared to human doctors. Over a period of 6.5 years, doctors in Colorado alone operated on the wrong patient at least 25 times and on the wrong part of the body in another 107 patients, owing to mental error from surgeons and mishandling of information by nurses (Stahel PF, Sabel AL, Victoroff MS, Varnell J, Lembitz A, Boyle DJ, Clarke TJ, Smith WR, Mehler PS.). (Research 2)

As the Head of the Bureau of Planning at the Research, Technology and Higher Education Ministry Dr Erry Ricardo Nurzal said, "In this era, everything is replaced with machines inter-connected, and human energy and brains are no longer needed. Artificial intelligence begins to replace the function of human brains, including in decision making". Therefore, healthcare workers being replaced seems to be very much a possibility by 2030.

(Research 3)

5. High-risk investment

We have discovered the risk that robotic surgery and healthcare poses, in economic terms. (Observation)

The market for robotic surgery is a very niche market, and will stay so throughout the near future, until it is fully developed, and ready to be mass-produced. Investing too much, or putting too much faith in robotic surgery in the next 10 years or so, would be a grave mistake, both literally and metaphorically. (Why)

It would take a very long time for the technology for medical bots to be fully developed, and made fully autonomous, so that it is able to do everything by itself. As per Sanja Dogramadzi, professor in medical robotics at the University of the West of England's Bristol Robotics Laboratory, "I don't think there will be a fully autonomous system for the next, maybe, 20 years,

but in the years to come we will see subsystems gaining more autonomy in order to allow the surgeon to do things faster, better, and more precisely." It has been proven that the job of a surgeon is one of the least likely to be automated, (C. Frey and M. Osborne, 2013) which means that surgical robots can only work with a human surgeon driving them in the near future. (Research 1)

Investing too much into fully autonomous medical robots too early, could result in a economic flop. If a over-hyped "fully autonomous" robot is rushed, due to pressure to meet deadlines set by investors, it might not be good enough to be put into use at hospitals. There are a few ways that a flop could happen. Firstly, if it were to be rolled out at hospitals, and the systems makes mistakes or malfunctions, the system would obviously be deemed unsafe for use, and would be trashed. This would cause billions of dollars spent on research and the product itself to be wasted, and would affect the robotic healthcare sub-industry, and tarnish its reputation. Secondly, if the bot only saw minor usage and minor success, it might have problems getting more investors to help it through its next stages, causing the company to die early, causing a waste in effort and money; or it could pull off a bad initial public offering (IPO), causing millions of dollars in effort to be wasted, the company would receive next to no attention due to its bad stock offering, again causing it to die down.

Now, if we were to only put small investments in these robotic healthcare start-ups, just enough for them to make a few pilot tests, we are able to more appropriately help these companies, not overhyping them. This would be much safer in the short-term, as such technologies are still in its early stages of development, and if the technology were to flop, the amount of monetary loss would not be so great, and could save up to a few billion dollars, while still protecting the robotic healthcare industry.

Underlying Problem

By incorporating challenges 2 and 3, we crafted an underlying problem:

Given that there is a high probability of remarkable technological advances in medicine, it appears that there may be an exponential increase in AI involved in medical procedures and decision-making. How might we increase the societal acceptance to the implementation of AI in the healthcare sector, so that technology can be implemented into healthcare seamlessly in the years 2030 and beyond?

Potential solutions

1: Formation of the AITU (Artificial Intelligence and Technology Unit)

The Ministry of National Security Singapore would form a statutory board to check AI technologies. Review processes will be put in place for examining algorithms. This board would include a diverse set of people (Female, Races, etc.), and adopt an active approach in enforcing safety of AI through an AVA model. This allows bias to be eliminated, assuring the public that

the robots are unbiased, which will lead to societal acceptance. Also, the board can recognize errors, and make improvements to rectify them, which will lead to public assurance. This idea would begin testing in 2022, and be rolled out by 2025.

The Agri-Food and Veterinary Authority of Singapore(AVA), now reformed as SFA, was formed in the year 2000. AVA plays a very active approach in safeguarding public health by setting and enforcing food safety standards for all foods being imported from the point of production to retail in a series of comprehensive monitoring, surveillance, and enforcement programmes. This has resulted in Singapore scoring a perfect 100 in the 2018 Global Food Security Index, while also ranking first overall. There has been a steady increase in quality over a 7 year time period.

This committee, under the support of the government, will adopt a similar approach regarding intellectual property. Following the trend set by AVA, projecting this committee to be a success does not seem absurd.

Sascha Eder, the COO and Founder of NewtonX, the world's first AI-powered expert network, explains that biased algorithms are already pervasive today. Our biases show clearly in our programmes. He goes on to show that he is dealing with this problem by being highly intentional about hiring POC/Female/LGBTQ CTOs and other tech-side leaders in his company. This is similar to the idea of having a committee in charge of eliminating biases that show in our programmes. As we head into the 4IR, there will be an exponential increase in the amount of programmes which can learn how to be biased. To minimise the chances of this happening, adopting a similar strategy to that of the world's premier AI powered expert network seems feasible.

Lastly, and most importantly, a committee allows for a pooling of opinions and viewpoints. Thus, checks for safety will undergo a thorough consideration of all angles of the software. This would not be possible if softwares are brought into Singapore with only the buyer checking it. According to the Global Recruitment Trends 2018 report, 62% of employers are focusing on hiring for diversity as a means of improving company performance. Observing this trend leads us to believe that a diversity of people making decisions improves product quality and assurance. Thus, a committee would go a long way in improving assurance of the software coming into Singapore.

2. Development of an app, MediView

We, the Ministry Of Health will design an app for the public as well as healthcare professionals. This app will show upcoming medical improvements as well instructions to use current medical technologies. The app would even be a way to increase the efficiency of healthcare services, such as using QR codes to allow doctors to prepare patient's data the moment they arrive at the clinic or to give out medicine to patients. It would also be able to let patients type to the doctor their current symptoms and get a queue number virtually so they can plan their time better.

This app would benefit healthcare professionals by letting them know of future technological developments which would allow them to read-up and understand these technologies so that they can adapt well to these developments. It would also save time and potentially prevent human error if queue numbers, patient data and patient medicine were distributed using an app because the app would do these actions within a few seconds whereas it may take a longer time for humans to do it. This would prevent human error by making sure that all the data and inputs are carefully carried out with perfect accuracy so as to prevent a single error because in healthcare, an error could cause a heavy penalty.

This app would benefit the public as it would also get them ready for the future developments of healthcare technology and also convenience them in the same way that it conveniences healthcare professionals, however there could also be a forum for them to discuss these technologies with healthcare professionals so that they can gain advice from these professionals and even suggest better ideas on how to use the future technologies to these healthcare professionals.

The release of such an app would be paired with advertisements as well as courses to educate the public on how to use this app. These courses would be free and would be held at the community centers, places easily accessible to the public. With these advertisements and courses, we hope to publicize this app and allow the public to use it correctly and effectively.

There are already apps which can let patients know of their current health conditions and the best ways to treat these conditions, including alerting the patient to visit the doctor whenever necessary. According to mhealthintelligence.com, “Mobile health applications allow healthcare providers to connect with patients and staff more quickly and dynamically, reaching out to them on the device of their choosing and at their convenience. Apps designed for a smartphone, tablet, or even a smartwatch also allow users to access information when and where they need it, reducing time wasted searching for that data and boosting both engagement and satisfaction rates.” Since mobile health apps are for allowing healthcare providers and patients connect dynamically, an app that provides services such as healthcare news or online discussion forums would allow healthcare providers and patients all over Singapore to be more aware of the technological advancements made to the healthcare industry and can work together to optimize such technology. mhealthintelligence.com already provides news updates, trends in mobile health, remote patient monitoring and a few other services. If we can create an app that can compress all these functions: News updates, healthcare providers and patients connectivity as well as patients’ private data, we can reduce doubts and uncertainty towards technological advancements in the healthcare industry as well as make healthcare providers and patient’s lives easier.

3. Regulatory book, Artificial Intelligence Compliance Guide (AICG)

We, a Future Trends project work group, will work with AI Singapore to bring about stricter and new systems in handling A.I., in the form of a regulatory book. We will recommend a tighter data identification and protection system, and a system whereby A.I. is taught to have its own morals. This recommendation will not only result in added safety through strengthened cyber security, but also removed bias in treating patients with the A.I. having a strong moral compass. Consequently, the public will be at ease knowing that the robots treating them have little to no chance of hurting them, hence allowing the implementation of technology into healthcare to be seamless. This will happen between the years 2025 to 2030, to allow sufficient research and development to take place.

Multiple research studies have already shown that robots have potential to learn morals, which can thus help them not show bias when introduced to biased data. This is possible when data is slowly built up in a robot's system rather than imposed on it through a top-down approach.

For example, an extract from the World Economic Forum State Meeting states that by gradually building up data in A.I., it will learn to develop ideas based on evidence, and thus be more flexible when data from different perspectives are presented to it. (Research 1)

<<Hutson, M. (2018). How researchers are teaching AI to learn like a child.>> states that children do not recognise things, like a dog, by explicit rules, but more on using evidence and predispositions to learn and reason. These skills to recognise are not given to us, but put in the world in the form of evidence, for us to use as scaffolding to make informed reasonings. (Research 2)

Likewise, robots are the same. If they have data slowly built-up in their systems, their reasonings and ideas will be more flexible and unbiased despite the data coming from different perspectives. Therefore, it is highly likely that robots can learn morals through this method, and thus be less biased.

However, strong cyber security is also key in ensuring maximum safety when using robots and technology in healthcare.

For example, the SingHealth data leak caused 1.5 million Singaporeans personal information to be leaked, including ministers like Lee Hsien Loong. This happened due to weak passwords and delay in patching up the database. Luckily, no serious consequences happened, but if this information was used for evil intent, the whole healthcare industry could possibly come to a standstill. (Research 3)

Therefore, as protection of this information is of utmost importance, we want to recommend a stricter data identification and protection system, so that such incidents will not happen.

Solution 4: VirtualOp Campaign

We, AI Singapore, will organise multiple campaigns to educate and expose the public to AI in the healthcare industry. AI Singapore would organise a VirtualOp campaign to not only introduce various AI technologies in the healthcare industry to the public, but also prove to the public that the AI technologies are both safe and unbiased.

This will increase societal acceptance to the implementation of AI in the healthcare industry, as the various roadshows would help assure the public that the AI technologies are harmless, and actually beneficial to them. Hence, they would be open to the implementation of AI in the healthcare industry, which would thus allow the implementation of AI in the healthcare industry to be seamless.

This can happen during the time period 2020-2030. The campaigns would be organised yearly to showcase all the breakthroughs in AI technologies for that year.

Although today's age of digitalisation allows for online marketing, exhibitions have still proven to be equally useful. Campaigns "bring the company closer to its customers by facilitating a face-face interaction", which will thus increases the effectiveness of the marketing. For example, the Energy and Automation Yatra 2015 used roadshows to introduce their products to the public. Therefore, if AI Singapore does the same, and lets the public "experience" the AI technologies, the closer bond between the company and public would allow the public to be more open to the AI technologies. (Research 1)

A study has proven that the public is able to retain knowledge learnt from interactive exhibitions. A study which analyzed the public's awareness, attitudes and behaviors towards cancer before, and 2 months after a cancer awareness roadshow. Not only was the public able to retain their knowledge on cancer risk factors after 2 months, but they also gained correct attitudes towards cancer and even made efforts to prevent cancer. (Smith SG, Osborne K, Tring S, George H, Power E, 2016) This shows the effectiveness of educating the public through roadshow campaigns, hence making this solution very feasible for AI Singapore. (Research 2)

Another study observed the effects of an environmental campaign on environmental attitudes and behaviour in Poland. The campaign proved extremely successful, with home advisors observing an increase in recycled waste after visiting 687 households. This further proves the effectiveness of educational campaigns. (Research 3)

5: Code of conduct for usage of AI technologies, Artificial Intelligence Decorum (AID)

We, the Ministry of Health, will design a code of conduct for all medical professionals who are using any medical software, regardless of hospital or organization. This code of

conduct would be standardized across all hospitals in Singapore, regardless of the hospital's status (private vs public), and it will be a law for all hospitals to adopt this code of conduct. We will also be conducting mandatory classes for all professionals, which will be held once every two months; to teach them on the code of conduct, and let them have a chance to raise queries about the code, so that the code may be revised once again. The class will also teach them on how to handle certain situations where the professional, the AI and the patient all has conflicting views.

This code of conduct for proper usage of medical software or hardware will help to standardise the level of professionalism adopted by medical professionals, which help to ensure that no medical professional will overstep the moral boundaries set by this code of conduct, as it will be a punishable offence to do so. This will not only help increase public acceptance of AI into the medical world, through assuring the public that there is a code for the doctors to stand by, and that they will not be mistreated by the AI, or by the doctors using the AI; but will also help to remove bias in the usage of AI and the bias of AI itself, as the doctors will not be allowed to let the AI make big decisions for him, and must use his own power to be able to shut down the AI. Doctors will now have veto power over the AI and can choose to refuse the AI's decisions. The code of conduct will also be very carefully vetted by medical professionals and will ensure that there will be no grey area in the code of conduct, and everything will be very clearly defined.

This code of conduct can be rolled out by end 2020, and will receive a yearly update to the rules and regulation, with MOH reserving the power to make any sudden changes with the introduction of new technologies into the Singapore medical system.

A study has shown that codes of conduct can be extremely effective in keeping the professionals under it in line, as long as the code of conduct is extremely well-defined and clear in its objectives¹. As our proposed code of conduct for the usage of AI among medical professionals will be very well defined, with no space for any misunderstanding to occur, we can tell that the code of conduct will be quite effective.

Another study has shown that the simpler a code of conduct, the more effective it becomes in letting others understand it and follow it². As our proposed code of conduct will be easy to read, without much technical terms and almost zero usage of legal jargon. This allows anyone, with or without any medical or legal experience, to be able to just read and understand the code of conduct, and this will help increase societal acceptance, by being able to understand the conduct that doctors will exercise.

A third study has shown that for a code of conduct to be effective, employees must have a way for them to voice their issues and concerns, and must receive training that helps reinforce the code³. With our mandatory bimonthly classes part of the program for the code of conduct, this allows the professionals to raise any issues they might have, and they will learn more about the new revisions to the rule if any.

Criteria

Aligned with the context of Singapore in 2030, we crafted our 5 criteria in selecting the best solution(Weightage indicated in brackets).

1. Which solution will be the easiest for the citizens of Singapore to understand so that misunderstandings of the intent do not occur? (2)
2. Which solution will be able to be implemented with the most pervasiveness so that all possible scenarios can be covered? (1)
3. Which solution would be the most reliable so that it can be sustained over a long period of time? (3)
4. Which solution would be the most cost-effective for the government of Singapore so that it can maximise its resources to solve the problem? (5)
5. Which solution will be able to be implemented most quickly so that Singapore will be safeguarded against threats? (4)

Decision Matrix

	Criteria 1: 2	Criteria 2: 1	Criteria 3: 3	Criteria 4: 5	Criteria 5: 4	Total:
MediView	4 - 8	2 - 2	3 - 9	1 - 5	3 - 12	36
VirtualOp	5 - 10	1 - 1	4 - 12	2 - 10	5 - 20	53
AITU	2 - 4	5 - 5	5 - 15	3 - 15	1 - 4	43
Robot Rules	3 - 6	4 - 4	2 - 6	4 - 20	4 - 16	52
<<AI Affairs>> book	1 - 2	3 - 3	1 - 3	5 - 25	2 - 8	41

Action Plan

After putting our solutions through the criteria, the best action plan was the VirtualOp Campaign.

Outline

We, AI Singapore, will work with the Government Technology Agency to kickstart a campaign named VirtualOp. The main form of increasing understanding will be an exhibit. This exhibit will be free to all Singaporean Citizens and Permanent Residents. The main exhibition would be built at Science Centre but Community Centres all over Singapore could hold such exhibitions too. The main attraction of this exhibition will be a Virtual Reality Experience where visitors can observe behind the scenes how technology to be implemented in healthcare were tested, and also a live example of a surgeon robot operating on a dummy. VR has been shown to increase learning, as compared to normal teaching "lessons". Additionally, there will be nurse robots rolling around the area and interacting with visitors. The exhibition will include only robots, with technicians behind the scenes in case of technical difficulties.

Many resources will be needed for this large scale event. Firstly, we will need manpower to set up the exhibition. Secondly, we will need funds to cover the cost of setting up this exhibition.

This campaign aims to increase the public's understanding towards technology to be used in healthcare. This would help assure the public that the AI technologies are harmless, and actually beneficial to them.

Real-life interaction with these technologies increases understanding of such technologies. A study analyzed the public's awareness, attitudes and behaviors towards cancer before, and 2 months after a cancer awareness roadshow. Not only was the public able to retain their knowledge on cancer risk factors after 2 months, but they also gained correct attitudes towards cancer and even made efforts to prevent cancer. This shows the effectiveness of real-life experience in educating the public and increasing understanding.

Acceptance or tolerance cannot come before understanding. Hence, through this campaign, the public would understand and accept these technologies(KVP).

After accepting these technologies, the public will have a better attitude towards these technologies. There will no longer be any significant action or protests against implementing these technologies. Thus, they can be implemented smoothly into Singapore's healthcare system.

Implementation Schedule

Firstly, the planning for this event will begin in 2021. Design, testing and production of technology to be used in the exhibit will start. These include robots that will work at pharmacists, hospitals, etc and VR technology. Holograms will also start development then. Next, in 2029, we will roll out posters and advertisements to increase the pervasiveness of the exhibition. The first exhibition will be held in 2030, showcasing new technologies in healthcare. This will be a biennial affair afterwards, with the same goal: to showcase new and upcoming technologies in healthcare to the public.

Evaluation of Action Plan

1. Lack of Interest in exhibition

There may be a limited interest in the exhibition, resulting in only a fraction of the public accepting these technologies.

We can solve this by making interesting advertisements through different platforms such as television, radio, online, etc. This would ensure that almost all Singaporeans would be notified of this exhibit. Additionally, we could make the exhibition even more enticing by having interactive holograms as a preview to the robots to be exhibited placed beside bus stops(where normal posters are). This would increase their interest in visiting the exhibit.

To do this, we would work with various radio stations or television companies, like MediaCorp to advertise the exhibition. With just a 30 second advertisement on these media platforms, we can reach out to the masses, and spark their interest towards this exhibition.

As for the interactive advertisements, we would approach FXMedia Singapore, which specialises in mixing advertisement with advanced technology. With their help, we would be able to roll out a series of high-tech and attractive advertisements that would engage the public.

2. Technical Difficulties

There may be some technical difficulties during the exhibition itself. For example, robots may malfunction/VR simulation may crash. This would only achieve the opposite effect, causing the public to be even more skeptical about such technologies.

We can solve this by ensuring that the technologies on exhibit have gone through many rounds of testing. Technicians should do another round of checks on the technologies before the opening of the exhibition. During the exhibition, we can have some technicians from AI Singapore stationed there to solve any difficulties.

We can also acquire assistance through either working with the Complete Production Services group, (CPS) and using their Exhibition Equipment Hire and Technical Services, or by working with an event managing partner, GES for audio-visual support in exhibitions. These companies would help us ensure the exhibition runs smoothly without any technical difficulties.

3. Public abuse of AI

There may be some people who would want to boycott the exhibition due to a strong objection to AI. They may hack the system or even cause chaos in the exhibition itself. This would result in a failed exhibition and public may distrust AI even more.

We can solve this problem by ensuring that the system has strong cyber-security, and install futuristic protection systems. Additionally, we could have law enforcers and security checks on scene for the safety of the public.

To accomplish this, we would seek the help of Ephraim Security Singapore, which has a team well-trained to secure and handle large-scale events like our exhibition. With such tight security measures put in place, the safety and security of the exhibition would not be compromised.

Conclusion

Through this solution, we will prevent any objection to this new technology being implemented in Singapore. The technology, which will then be implemented seamlessly, is key to our nation's development in technological applications in healthcare systems. This will be an even more pressing issue as our population ages rapidly. The number of citizens aged 65 and above is expected to increase to 900,000 by 2030(Kelly Ng, 2015). This solution ensures that such developments will take place smoothly so that the citizens can reap the benefits of improved healthcare services through technology.

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