How will the 4th Industrial Revolution affect the Industry of Healthcare?

Written Report

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PROBLEMS

1)Based on survey results, we feel that AI might reduce empathy in hospitals, affecting the Industry of Healthcare. We interviewed users of various hospitals and found that some dislike the potential replacement of staff by AI-controlled Robots.(Observation) The 4th Industrial Revolution will lead to more staff being replaced by robots/AI And the consumers of the hospitals might feel alienated when faced with these machines. There will also be a different environment as the patients will be taken care by robots instead of human staff. AI is considered to be incapable of relating to humans and this may cause fear when visiting the hospital. This fear may cause health problems. This fear might also reduce consumers as they would rather go to another hospital which uses human staff. This is detrimental for the development of the industry and the health of consumers as hospitals using the AI will lose business while consumers may not get proper treatment, causing their health problems to escalate even more.(Problem) A new study published in JAMA (The Journal of the American Medical Association) found that smartphone assistants are fairly incapable of responding appropriately to users who complain of depression, physical ailments, or even sexual assault. This piece of research shows that current AI are not able to empathetically react to human behaviour. Fear weakens our immune system and can cause cardiovascular damage, gastrointestinal problems such as ulcers and irritable bowel syndrome, and decreased fertility. It can even lead to accelerated ageing or premature death. This piece of research shows the detrimental effects fear can have on our bodies.

2)Based on our survey, we think that the possible problems with AI might cause data breaches in hospitals. Some survey respondents felt that technology was insecure and this might include AI. There have been cases of hacking of medical databanks (e.g. Singhealth data leak) Some people think AI makes hacking easier, since it is not fully developed. Data leaks cause invasion of privacy for patients.(Observation)AI is used for data storage/collection and when there are insecurities, the data of patients might be leaked. This will affect both the patients and the industry as there will be trust issues between the staff and patients. This may lead to patients to lie to staff to protect their privacy and this may cause health problems if the wrong treatment is administered.(Problem)According to www.corephp.com/blog/cyber-security-important-healthcare-industry/ Criminals can use leaked information to sell on the black market which, in turn, can be used for identity theft, Medicare fraud, and for other financial gains. Also, preventing cyber attacks helps keep patient information confidential, which is important for legal reasons.There was also a recent data leak where Singapore Singhealth databank hack-hackers stole the personal particulars of 1.5 million patients. Of these, 160,000 people, including Prime Minister Lee Hsien Loong and a few ministers, had their outpatient prescriptions stolen as well.

Their non-medical personal data that was illegally accessed and copied included their names, IC numbers, addresses, gender, race and dates of birth. According to https://cahsonline.uc.edu/resources/mhi/articles/the-importance-of-health-care-it-security-and-privacy, one of the largest consequences of data breaches is the exorbitant fines the healthcare industry is faced with. According to Becker's Hospital Review, health care breaches cost nearly $6.2 billion every year, with the average data breach amounting to $4 million across all industries. Health care organizations spend nearly $610,000 on compliance personnel to detail the information that was breached and clean up the mess(Research).

3) Based on our survey, we think that with increasing use of nanobots in healthcare,possible malfunctions might cause health problems.Some survey respondents feel technology may have problems and is not reliable and this may include nanobots.(observation)Nanobots are currently being tested to be used in high-risk surgeries and they might be used more and more in the future. These nanobots might malfunction and this may cause health problems. For example, if the nanobots get stuck in the respiratory system, they might cause respiratory problems like asthma, pneumonia, etc.(Problem) According to https://www.ft.com/content/57c9f432-de6d-11e7-a0d4-0944c5f49e46 a new prospect for cancer treatment opened up last month, when researchers for the first time successfully used tiny, nanometre-sized robots to treat cancerous tumours in mice. According to https://interestingengineering.com/nanobots-will-flowing-body-2030 in the next 10 or so years, your blood will probably be streaming with tiny nanorobots there to help keep you from getting sick or even transmit your thoughts to a wireless cloud. They will travel inside of you, on a molecular level, protecting the biological system and ensuring that you have a good and long life. The future is closer than you may think. This proves the high probability that nanobots could be used to treat humans in the near future. However, according to https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(07)60538-8/fulltext nanomaterials, such as metal oxides and carbon nanotubes, could theoretically behave like quartz dust or asbestos particles and result in similar damaging effects on the respiratory system. Studies to date show that the human body's normal defence mechanisms treat nanoparticles like microorganisms but nanoparticles could link together to form fibres that are too large to be engulfed by macrophages. This piece of research further shows the damage nanobots could do if they malfunction in the human body.

4)Based on research, we think that technology could largely replace staff working in medical facilities. Now of days, more AI are used in hospital to do diagnosis, and machines are also used to manage visitors instead of humans at counters. (Observation)The improvement of technology will make technology more efficient than humans and as such, humans may no longer be needed to operate the facilities as they can be easily managed by modern technology. Because of this, the staff will be unhappy because of their job loss and may feel stressed because of a lack of a stable job. Though they will be relocated, they may not be able to handle their job scope as well as they may not have the necessary skills to manage, probably causing further stress on them. These staff may also overwhelm the other companies as there might be a sudden influx of low-skilled workers finding jobs. This might cause companies to have to change to adapt in order to allow these workers to contribute in their companies, decreasing the efficiency of the companies.(Problem) According to https://healthmanagement.org/c/healthmanagement/IssueArticle/will-robots-take-your-job-in-healthcare , empowered by the vast amount of health information available online and on apps,

and by the vast array of health and fitness wearables, many people are much less dependent on their doctors for advice. Chatbots are also being used to revolutionise communication within hospitals and patients. This shows the usage of technology in healthcare which might be increased in the future.

5)Based on our research, 3D printing technology can be used to print human organs for transplant. 3D printing has already been used to print bionic limbs but they have not been perfected yet to the point where they can be transplanted.(Observation) Although this will lessen the need for human donors, this will also allow anyone to change parts of themselves that they deem unfavourable. This is very unethical as people can change their whole physical appearance if they wanted to. These 3D printed organs could also be used for human enhancement. For e.g., 3D printed heart to pump more blood so more oxygen can be taken in for runners. This might lead to unethical usage of 3D printed organs. Criminals could also use this technology to escape the authorities. Criminals can easily change their physical apprearance using 3D printing and it will be very hard for the authorities to apprehend them.(Problem) According to https://all3dp.com/2/5-most-promising-3d-printed-organs-for-transplant/, Organovo, a San Diego-based bioprinting company, has already demonstrated that it can 3D print human liver tissue patches, implant them into mice and be functionally beneficial. These liver patches are currently as thick as a dollar bill and are used to extend patients' lives until they can receive proper transplants. These partial liver transplants are currently targeted for human trials in 2020. This shows that 3D printed organs are already being developed and will be introduced into the healthcare industry soon. According to https://www.abc.net.au/science/articles/2015/02/11/4161675.htm, If the technology can be used to develop replacement organs and bones, couldn't it also be used to develop human capacities beyond what is normal for human beings?
For example, should we consider replacing our existing bones with artificial ones that are stronger and more flexible, less likely to break; or improving muscle tissue so that it is more resilient and less likely to become fatigued, or implanting new lungs that oxygenate blood more efficiently, even in a more polluted environment? This piece of research shows the ways people could abuse 3D printed organs for further enhancement.

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FUNDAMENTAL PROBLEM STATEMENT

Given the inference we have made that the users of advanced technologies in healthcare might not trust these 4th Industrial Revolution technologies, how might we increase the trust of the technology that the consumers have such that the consumers will use advanced technologies in the healthcare sector confidently by 2035 and beyond?

SOLUTIONS

1) The Cultural League of Technology (CLoT) will invent a microchip. This will contain information on humane, ethical behavior. When put inside the Technology, the Technology can behave ethically and will have a human-like sense. They will also behave like how humans interact with each other normally, and would speak in the

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language the patient speaks in a conversational tone, making the patient feel more comfortable and feel as if they were talking to a human. This will improve the Trust levels since an aspect of trust is ethics. Some reasons for the lack of trust could be due to the lack of ethics of technology. This microchip will show proper ethical behaviour for the technology, making people realise that technology is ethical and trustworthy. By behaving like a human, the microchip reduces the alienation the human feels, making the human feel more comfortable. (Solution). According to https://www.ethicalsystems.org/content/trust,Ethics and trust are inextricably linked. We are interested in ethics in large part because we are concerned, even obsessed, with the question of who we can trust is a world where there is risk and uncertainty. According to https://leadingincontext.com/2014/06/18/ethics-and-trust/ When it comes to leading ethically, trust is not a nice-to-have, it's a "must have." If we lead ethically, that lets people know they can count on us, and being able to count on us builds trust with individuals and within the group. These two pieces of evidence show the link between ethics and trust.(Research)

2) The Advanced and Future Technologies Republic (AFTeR) will host a holographic Technology Show. This can be held frequently, and this will increase transparency of the Technology companies. This is because the Technologies, including those used in the Healthcare Industry, will be showcased. In this way, the public will understand the capabilities of such machines and will know to what extent the technologies might malfunction Because of this, the public will feel safe with these technologies as they know the specifics of the technologies and will not fear them. For eg, a 3D printer can be showcased such that the public will know how it prints things.(Solution) According to https://www.strategy-business.com/blog/Transparency-Is-Key-to-Building-Trust-in-Business?gko=64859, if technology is to help drive transparency, companies must be willing to share these types of results — good or bad — with their stakeholders and explain how they're acting on them. According to https://fierceinc.com/blog/why-trust-requires-transparency-and-how-to-create-both, If trust somehow exists without transparency, this so-called trust is nothing more than an illusion because it's based on what *isn't* real. Transparency is a precursor, and it's an essential ingredient for creating and maintaining trust. When practiced regularly, certain types of transparency will inevitably build relationships and entire cultures of trust. These pieces of research show that transparency and trust are linked.

3) The Schools in Singapore in the future will teach students to trust the technologies through the use of AR, to show them how the Technology works. An AR headset will be used so that the students can be fully immersed in the experience as if they were doctors. They would then proceed to operate the machinery so that they will get used to it and will learn that there is nothing to worry about. This will reassure the students that the Technology is safe and trustworthy. Therefore, the Future generation of Adults will trust the Technology. However, this is a long-term project, as the current working generation are not affected.

4) The Holographic Institution (HI) will create a holographic Child-friendly mascot. This will be the mascot for the Tech Companies. The mascot will not only boost the popularity

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of the Technologies, but it will also help transparency, since it can explain the Technology a lot better than using videos as it is a first-hand experience. The boost of popularity and transparency will also increase levels of trust. According to a 2015 US study by V.I. Kraak and M. Story (https://www.ncbi.nlm.nih.gov/pubmed/25875469), when a brand had a mascot, children tended to buy more food from that brand, and mascots also affected what products children bought. According to Eric Schlosser's book, namely Fast-Food Nation: The Darkside of an All-American Meal, 96%of American Children could recognize Ronald McDonald (McDonald's mascot), a recognition topped only by Santa Claus. This shows the great popularity and reach of mascots, especially with children.

5) The Line of Sight Technologies (LoST) Company will invent an AR headset. This can be used to show the public the construction process, usage and security of Technologies. This can be made public by placing them in strategic locations such as outside MRT Stations. This increases transparency, and when the public see with their own eyes the process of the Technology, their trust levels will increase.

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Criteria:

1. Given that the Healthcare Industry is fast changing with the interruption of the 4IR, which solution would be the fastest to be implement such that least people would be affected?

Evidence: Simultaneous revolutions in biology and technology, especially computer science, have created new devices, such as biometric sensors, that will disrupt the existing healthcare system along four major themes: speed of care, ability to manage illness, role of patients, and the relationship between healthcare and stakeholders. By. (n.d.). Transforming Health in the Fourth Industrial Revolution. Retrieved June 27, 2019, from https://www.diplomaticourier.com/posts/transforming-health-in-the-fourth-industrial-revolution

2. Given that the Healthcare Industry will have much technology in use, including AI, which solution is the most effective so that people can be least affected?

Evidence: Healthcare changes dramatically because of technological developments, from anesthetics and antibiotics to magnetic resonance imaging scanners and radiotherapy. Future technological innovation is going to keep transforming healthcare Thimbleby, H. (2013, December 01). Technology and the future of healthcare. Retrieved July 1, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4147743/

3. Given that the 4IR will be very expensive to implement, which solution would be the most cost-effective such that less medical institutions would spend less money on it and have more money to treat patients?

Evidence: New medical technology is expensive and we are introducing it in services in an unplanned manner. A significant proportion of our resources are wasted through inefficiency in the selection and production of health care strategies. Anand, L. C. (2017, June 26). NEW

MEDICAL TECHNOLOGY AND COST EFFECTIVENESS. Retrieved July 1, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5530383/

4. Given that the public plays a big role in the way the 4IR will be administered to healthcare facilities., which solution would be the most publicly accepted?

Evidence: Socio-psychological determinants of public acceptance of 10 (controversial) technologies are reviewed. The results indicate that there has been an increased interest in and focus on public acceptance of technologies in academia. Risk, trust, perceived benefit, knowledge, individual differences and attitude were found to have been a focus of research in 60% of articles. Gupta, N., Fischer, A. R., & Frewer, L. J. (2012, October). Socio-psychological determinants of public acceptance of technologies: A review. Retrieved July 3, 2019, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3546631/

5. Given that the Healthcare Industry is a tertiary industry that provides services to consumers, which solution is the most Humane?

Evidence: Humane in that it provides appropriate care and support to those in need, whether those needy are elderly, the poor, the sick, etc. Humane doesn't mean everyone has the right to eat filet mignon, drive a sports car and receive on-demand knee replacement surgery but it does mean everyone has the right to a decent life.
Friedman, H. S., & Friedman, H. S. (2017, December 07). Being Humane and Being Fair. Retrieved July 3, 2019, from https://www.huffpost.com/entry/being-humane-and-being-fa_b_5467893

STEP 5: Criteria Matrix

Solution/Criteria	Fastest	Most effective	Cost effectiv e	Public Opinion	Most Humane	To tal
Microchip	5	4	2	4	5	20
Tech Show	2	5	3	2	4	16

Education	1	1	5	1	1	9
Holographic Mascot	3	3	1	5	2	14
AR Headset	1	2	4	3	3	13

Step 6: Action Plan

In the year 2035, the Cultural League of Technology (CLoT) will invent a microchip to be used in all hospitals' robots and AI. When put into the technology, it will alter its code and make it behave in an ethical and humane way. They will start to implement this as soon as it is verified to be ready for commercial use and will be constantly improved so as to increase customer satisfaction. How the microchip works is that it records every way to talk and interact with the patient in a way such that is ethical and is human-like in expression and body language. It will also talk in not a robotic voice but in a slightly feminine voice that, albeit monotonous, still sounds like a human. This will make the patient feel more secure and comfortable when interacting with the technology, as it no longer has the robotic feeling when they interact. this will thus increase the number of healthcare patient using the technology. This solution benefits both parties as the healthcare providers can spend less money by using the robots while still receiving lots of patients.

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