Group 10-33 E-Health

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Written Report

Part 1: Identifying challenges from the Future Scenario

(Colour-coded: red = condition phrase, blue = why it is problematic, black = larger consequence)

Challenge 1 (presented as best researched challenge):

The future scene states that government hospitals these days are plagued with long queues, expensive healthcare costs, extremely limited bed space, and exhausted medical staff. This could be problematic in 2030 as this limits the government's capability to provide quality healthcare to the elderly, since they have limited manpower and infrastructure resources. As a result, the elderly may find it more difficult and inconvenient to get the healthcare they need, or may not even be able to get it at all.

Research for Challenge 1:

The percentages of people facing chronic illnesses like diabetes or heart diseases is expected to go up as the population ages with 610,000 people aged above 65 by 2020 (Khalik, 2016), leading to higher readmission rates especially among elderly with chronic conditions, also due to a lack of coordinated health care services for elderly (Yuen Sin, 2018). As a result, higher stress is placed on the health care system to provide primary and preventive care for elderly, especially those with chronic illnesses, leading to increased health care spending. More personnel will also be required.
Should there be insufficient personnel or funding, the situation may become as dire as Hong Kong's health care system, which faces a heavy patient load (Tsang, 2016). This leads to patients lying in hospital emergency wards waiting to be moved into a room, temporary beds filling up the corridors and every available space, nurses having to navigate congested accident and emergency units, bearing the brunt of anger from patients left waiting hours at times for treatment, and doctors are so busy that consultations are limited to three minutes and a 30-hour shift is not uncommon.

References for Challenge 1:

Khalik, S. (October 20, 2016) *30,000 more health care workers needed by 2020 to cater for Singapore's ageing population: Health Ministry* Retrieved from: https://www.straitstimes.com/singapore/health/30000-more-healthcare-workers-needed-by-2020-to-cater-for-singapores-ageing

Tsang E. (March 27, 2016) *Inside Hong Kong's public hospital crisis: temporary beds, angry patients, nurses and doctors stretched to breaking point* Retrieved from: http://www.scmp.com/news/hong-kong/health-environment/article/1931049/inside-hong-kongs-public-hospital-crisis-temporary

Yuen Sin (January 28, 2018) *Finding a cure for rising costs in health care* Retrieved from: https://www.straitstimes.com/politics/singapolitics/finding-a-cure-for-rising-costs-in-healthcare

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Challenge 2 (presented as most original challenge):

The future scene states that elderly these days are having far less interactions with other people. This is due to replacement of markets and cafes with drone deliveries, as well as their children having their personal busy schedules, hence making it difficult to visit them. Additionally, some elderly live alone, like the elderly Mrs Lee. This could be problematic in 2030, as decreased interaction and loneliness can lead to degeneration of the mind and eventually dementia, or causing other mental illnesses. As a result, an increased number of elderly would need support due to illnesses, putting a heavier burden on the healthcare system or volunteers.

Research for Challenge 2:

A study carried out in 2009 on 55 elderly people revealed a significant correlation between loneliness and depression (Singh, Misra, 2009). It also found that many people experience loneliness and depression in old age, either as a result of living alone or due to lack of close family ties and reduced connections with their culture of origin, which results in an inability to actively participate in the community activities. With advancing age, it is inevitable that people lose connection with their friendship networks and that they find it more difficult to initiate new friendships and to belong to new networks. In Singapore, in 2014, 42100 elderly people lived alone triple of what

the number was in 2000 (Tai, 2015), showing that the number of isolated elderly has increased, attributed to an ageing population. Isolation for elderly is particularly harmful, with research linking it to disabilities, cognitive decline, and increased mortality rate. (Graham, 2016)

References for Challenge 2:

Graham, J. (November 17, 2016) *Loneliness harms aging health. This new campaign aims to curb isolation* Retrieved from: https://www.pbs.org/newshour/health/loneliness-harms-health-new-campaign-aims-curb-isolation

Singh, A and Misra, N (June 2009) *Loneliness, depression and sociability in old age* Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3016701/

Tai, J. (August 17, 2015) *Old and home alone in Singapore* Retrieved from: https://www.straitstimes.com/singapore/old-and-home-alone-in-singapore

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Challenge 3 (presented):

The future scene states that companies have to bear escalating health care costs for employees, but that there are insufficient subsidies for elderly, and that equipment used to ensure their safety are extremely costly, hitting small companies the hardest. This could be problematic in 2030, as it could mean that elderly are unable to afford medical care that they require, and that there would be a heavy burden on their families to pay for it. As a result, paying for medical care may result in a heavy financial blow to families and the elderly, preventing them from accessing services they may need.

Research for Challenge 3:

Research: Health care inflation has been rising almost 50% above general inflation for the past decade, and fee charges have been rising ever since fee guidelines were removed, leading to escalating health care costs (Khalik, 2017). Government expenditure on healthcare is expected to reach at least S$13 billion by 2020. This increased cost will be shouldered by the working population through the introduction of new taxes and the increase of present taxes, as mentioned by Mr Heng in the Budget Speech in February 2017. This increase in the amount of taxes to be paid by

the working population will definitely put a strain on the working population to pay such taxes and at the same time, save enough money for personal use.
In addition, according to a report by Marsh & McLennan Companies' (MMC) new Asia Pacific Risk Centre, total health care costs for the elderly are likely to rise to US$49 billion annually by 2030, spending an average of $37,427 per elderly person (Huang, 2016).

References for Challenge 3:
Huang, C. (August 25, 2016) *Tenfold rise forecast in annual health care costs of elderly in Singapore by 2030* Retrieved from: https://www.businesstimes.com.sg/government-economy/tenfold-rise-forecast-in-annual-healthcare-costs-of-elderly-in-singapore-by-2030
Khalik, S. (December 27, 2017) *Battling costs, improving care* Retrieved from: https://www.straitstimes.com/singapore/health/battling-costs-improving-care
Khalik, S. (December 27, 2017) *Spending on Healthcare expected to rise sharply* Retrieved from: https://www.straitstimes.com/politics/spending-on-healthcare-expected-to-rise-sharply

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Challenge 4 (not presented):
The future scene states that tax rates are increasing as the population of seniors increased and the workforce shrank, placing more burden on adults like him. This could be problematic in 2030, as labour might become harder to find due to lower dependency ratio and as a result become more expensive, discouraging investors from continuing to invest in Singapore, resulting in a slower economic growth. As a result, standard in living may decrease as earnings drop and cost of living continues to rise.

Research for Challenge 4:
As a result of the ageing population and consistently low birth rates, the dependency ratio has been decreasing rapidly, predicted to fall to 2.1 by 2030, and according to statistics from the UN, 100 adults will have to support 95 children and elderly by 2050 as the proportion of elderly in the population increases (Siau, 2017). This trend has

worried experts, who warn of likely tax increases as the government has to spend more to provide services like health care for the elderly, and an increased financial burden on the working population (Wong, 2013). Companies may choose to pull out of Singapore if manpower needs cannot be fulfilled, leading to workers choosing to leave Singapore to find jobs elsewhere, shrinking the workforce and creating a vicious cycle (MoCaI, 2012).

References for Challenge 4:

Ministry of Communication and Information (October 29, 2012) *How does the shrinking local workforce affect Singapore's economy?* Retrieved from: https://www.gov.sg/factually/content/how-does-the-shrinking-local-workforce-affect-singapores-economy

Siau, M.E. (December 6, 2017) *Elderly to make up almost half of S'pore population by 2050: United Nations* Retrieved from: https://www.todayonline.com/singapore/elderly-make-almost-half-spore-population-2050-united-nations

Wong, T. (September 27, 2013) *Fast-ageing Singapore, fewer to support aged; Trend worries experts* Retrieved from: https://www.straitstimes.com/singapore/fast-ageing-singapore-fewer-to-support-aged-trend-worries-experts

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Challenge 5 (not presented):

The future scene states that many of the jobs in the future will be overtaken by robots, and that the devices placed in the elderly's home to monitor their safety made them feel like feeble people. This may be problematic in 2030 as it could lead to elderly in the future feeling irrelevant and useless to society, since they are unable to find work and as a result feel like a burden, especially given that many people in the future are likely to use technology, something some elderly are generally unable to keep up as well with. As a result, there is likely to be less meaningful ageing amongst elderly, leading to a higher rate of depression.

Research for Challenge 5:

73% of cleaners and labourers are above the age of 50, 66% of plant and machine operators and assemblers (Sohini, 2016). There is a worrying concentration of older

workers in labour intensive jobs, jobs that are likely to be replaced by machines in the new age of technology. Some elderly rely on this employment as a way to keep active and relevant, without which they may feel useless, bored or isolated.

Currently, a key reason why some elderly feel depressed or even take their own lives is often due to them feeling irrelevant to society, and them not wanting to keep being a burden to society or their families (Tai, 2015). Being unable to work may contribute to this feeling for some elderly, exacerbating this issue.

Some elderly currently also shun the newest technology, citing reasons like not knowing what the need for this was, not knowing how to use it, etc. In a world where technology is likely to become all the more important in everyday life, this may contribute to them feeling more and more irrelevant (Toh, 2017).

References for Challenge 5:

Sohini, C. (December 6, 2016) *Singapore's 'silver tsunami': how the city-state depends on its elderly workforce* Retrieved from: https://www.theguardian.com/cities/2016/dec/06/singapore-silver-tsunami-city-state-elderly-workforce-ageing-cities

Tai, J. (December 17, 2015) *More seniors in Singapore taking own lives* Retrieved from: https://www.straitstimes.com/singapore/more-seniors-in-singapore-taking-own-lives

Toh, E.M. (July 28, 2017) *The Big Read: Feeling lost in a digital world, some elderly shun technology* Retrieved from: https://www.todayonline.com/singapore/big-read-feeling-lost-digital-world-some-elderly-shun-technology

Part 2: Identifying a fundamental problem

(Colour-coded: red = condition phrase, blue = key verb phrase, green = purpose, black = future scene parameters)

(Fundamental problem is derived from problems 1, 3 and 4)

Given the inference we have made that the elderly in 2030 may not have easy access to quality health-care due to problems like increased health-care costs and health-care manpower shortage, how might we make health care more efficient and accessible so

as to provide quality health-care for the elderly in Singapore in the year 2030 and beyond?

Part 3: Identifying potential solutions to fundamental problem

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Solution 1 (presented as best researched):

The Ministry of Health will work with the Urban Redevelopment Authority to continue to build more hospitals integrated with technology around Singapore. This can include automated/self-service kiosks or online services (for administrative purposes), automated smart programs and artificial intelligence to help doctors/nurses complete administrative tasks, automated medicine dispensers, automated systems that provide food, water and other services to patients in hospital beds, etc. All this helps to reduce the need for manpower around the hospital, freeing up doctors/nurses to attend to patients who need it.

Research for solution 1:

Some technology that could potentially make healthcare more efficient and less labour intensive is being deployed in Singapore's Changi General Hospital, including robotic arms, smart bandages, automated guided vehicles and more (Khalik, 2015).

The upcoming Woodlands Health Campus, to be built by the next 5 years, will also feature a focus on technology, utilising technology like AI to automate backend logistical services, help doctors sift through large amounts of data to ensure higher accuracy and reduce medical errors, etc. (Lee, 2017).

Such technology not only helps to reduce manpower needs and streamline operations, but can also help make health care of higher quality. New technologies ensure better accuracy in diagnosis, reducing medical errors, reducing infections in hospitals, etc. (Meditek, n.d.).

References for solution 1:

Khalik, S. (July 23, 2015) *Hospitals turn to cutting edge robots and technology for health care assistance* Retrieved from: https://www.straitstimes.com/singapore/health/hospitals-turn-to-cutting-edge-robots-and-technology-for-healthcare-assistance

Lee, M.K. (April 18, 2017) *Smart technology, 2-in-1 hospital and gardens galore: 6 interesting facts about Woodlands Health Campus* Retrieved from: https://www.straitstimes.com/singapore/health/smart-technology-2-in-1-hospital-and-gardens-galore-6-interesting-facts-about

Meditek (n.d.) *Benefits of technology in health care and hospitals* Retrieved from: https://www.meditek.ca/trending-healthcare-technologies/

Solution 2 (presented as most original):

Set up mobile health care centres around the island that can move about within constituencies, and that are able to provide automated check-ups/preventative health care screenings for the elderly, then provide advice on what to do should a problem be detected, like which hospital to go to and what to do there, or lifestyle changes that need to be made, etc. Such a system would make the health care system more accessible for the elderly, guiding them to do what they need to do to get the health care they need.

Research for Solution 2:

In the USA, mobile health care centres currently are able to offer preventative health care screenings, initiate chronic disease management, and provide urgent care, as well as offer a range of specialised services (Stephanie et al, 2017). They serve as a starting platform to help patients navigate the sometimes confusing health care system, connecting them with medical resources available. This allows them to assist in delivering high quality health care, while reducing costs (Hill et al, 2014).

Such a system has already been deployed in Singapore albeit only on a small scale, whereby mobile clinics aimed at providing screening and treatment services for diabetes and high blood pressure exist, but only in certain parts of the island (Cheong, 2015). This scheme surely can be extended to the rest of Singapore, and expanded to increase the scope of problems scanned and treated, allowing the whole population to benefit.

References for Solution 2:

Cheong, K. (February 8, 2015) *Mobile clinic to benefit diabetes patients* Retrieved from: http://www.asiaone.com/singapore/mobile-clinic-benefit-diabetes-patients

Hill, C.F., Powers, B.W., Sachin, H.J., Bennet, J., Vavasis, A., & Oriol, N.E. (March 20, 2014) *Mobile health clinics in the era of reform* Retrieved from: https://www.ajmc.com/journals/issue/2014/2014-vol20-n3/mobile-health-clinics-in-the-era-of-reform

Stephanie W.Y.Y., Hill, C., Ricks, M.L., Bennet, J., & Oriol, N.E. (October 5, 2017) *The scope and impact of mobile health clinics in the United States: a literature review* Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5629787/

Solution 3 (not presented):

The Ministry of Health will invest in technology that helps in remote monitoring like an app or smart home system, allowing data to be synced to national databases. Monitoring technology can be inbuilt into wristwatches, clothing or smart devices around the house, before data from these devices are sent to the app. They will also subsidise this to make it more accessible for all households. This helps seniors to remain safe and healthy by monitoring them via several parameters like location, whether they have recently moved, etc. Such technology can also be used in helping elderly keep healthy by making sure they make decisions for a healthy lifestyle, ensuring that they exercise daily, take their medicines, etc.

Research for Solution 3:

With the rise of the Internet of Things, remotely monitoring and ensuring the safety and wellbeing of elderly is much easier. It is also possible to make monitoring technology much less intrusive (Satta, 2018), like putting them in soles of shoes, to the point where the elderly being monitored may not even realise that he/she is being monitored, allowing elderly to feel more comfortable around such devices.

Remote monitoring offers a security guarantee, helping ensure that seniors have no need of staying in nursing homes or hospitals (Eric, 2010). Preset parameters like location checkers ensure that seniors remain safe at home even without anyone there to check on them, and this could also be applied to health to ensure seniors remain active and healthy.

Smart speakers placed at home (as part of this network of technology) can also help to guide seniors in making choices for a healthy lifestyle, as has already been done with children as part of a pilot program by Boston Children's Hospital (Carla et al, 2018). Such choices could include when to visit the doctor for a check-up, reminders to take medicine, reminders to eat healthily and exercise, etc.

References for Solution 3:

Carla, E.S., Nigrin, D., Churchwell, K., & Brownstein, J. (March 7, 2018) *What will health care look like when smart speakers are everywhere?* Retrieved from: https://hbr.org/2018/03/what-will-health-care-look-like-once-smart-speakers-are-everywhere

Eric, A.T. (July 28, 2010) *The Technology for monitoring elderly relatives* Retrieved from: https://www.nytimes.com/2010/07/29/garden/29hometech.html

Satta, S.H. (March 12, 2018) *These Companies make Remote Monitoring for seniors less intrusive* Retrieved from: https://www.care.com/c/stories/14960/remote-monitoring-for-seniors/

Solution 4 (not presented):

Hospitals and clinics will utilise drones to perform house visits and provide emergency medical services. The drones are able to be operated remotely, but are otherwise fully automated. They perform functions like delivering medicine, reminders to take medicine, allow patient to perform basic screenings of themselves, such as to measure heart pressure or temperature, and can link to a video call for a nurse/doctor. Thus, this allows health care services mentioned above become more accessible to patients, reducing the need for them to commute to a hospital (especially if they are disabled). These drones can also serve as an emergency response service, working in tandem with monitoring services to deliver emergency medical services like AEDs if an emergency is detected, or even allowing a doctor to ride there.

Research for Solution 4:

In Dubai, rideable drones (or hovercrafts) are already being deployed for police forces (CNN, 2017). These drones can reach a top speed of 40 mph, and fly for about half

an hour before needing to charge. These drones, while slower than traditional vehicles, are useful for the police in Dubai's traffic, and can serve as a faster emergency response.

Prototypes for drones that can provide lifesaving health care services exist, with technology allowing someone to instantaneously call for a drone and drones which can provide AEDs (Tucker, n.d.). Drones which help provide medical assistance in disasters elsewhere already exist, and their functions could potentially be extended to help in making health care more efficient in Singapore.

In the future, drones could also be used to deliver medications and screening services to patients, allowing patients to access potentially all the services involved in a regular visit to the clinic right in their own homes, from diagnosis to treatment services (The Medical Futurist, n.d.). They can also be used in hospitals, delivering supplies between sections and floors, further reducing manpower needs.

References for Solution 4:

CNN (October 13, 2017) *Watch Dubai Police test its latest gadget -- a flying motorbike* Retrieved from: https://edition.cnn.com/2017/10/13/middleeast/dubai-police-hoversurf-flying-motorbike/index.html

The Medical Futurist (n.d.) *Medical drones will thrive in health care* Retrieved from: http://medicalfuturist.com/medical-drones/

Tucker, J. (n.d.) *Drones in health care* Retrieved from: https://www.dronesinhealthcare.com/

Solution 5 (presented):

The Ministry of Health, working with the Ministry of Communications and Information, will create a smartphone app that acts like a portal: listing and allowing you to access many different services, like checking if a wound is healing properly, taking cardiograms/mammograms to screen for cancer, taking eye tests, video-calling a doctor if something is off, etc. This portal, as it is on the smartphone, will be easily accessible to all, and its user interface can be made simpler and in multiple languages for ease of access. It can be used by both patients and doctors.

Research for Solution 5:

Some start-ups have recently begun designing medical technologies easily available on smartphones (Adiri, 2016.) For example, a start-up called Tissue Analytics lets you take pictures of a wound over time on your smartphone, allowing doctors to determine whether it's healing or festering, AliveCor lets you capture an electrocardiogram at home and alerts doctors if something is wrong with your heart, and Netra Labs lets you take eye tests at home using mobile technology.

Such medical apps make check-ups much more efficient and convenient, since everything can be easily done with a tap on an app (YML, n.d.). Such apps save doctors time, and patients money, by potentially in some scenarios able to completely replace a doctor's appointment. Medical apps also allow for greater patient safety, helping remind patients of which medicine to take and when.

Medical apps are not only beneficial for patients, but for doctors as well. Such apps allow doctors to easily and conveniently review patient data before a check-up, check disease information, treatment alternatives, assist in diagnosis, etc. (Reisenwitz, 2018).

References for Solution 5:

Adiri, J. (May 6, 2016) *The next revolutionary medical instrument? Your smartphone* Retrieved from: http://www.wired.co.uk/article/medical-devices-smartphones

YML (n.d.) The Future of Healthcare: *How Mobile Medical Apps Give Control Back to Us* Retrieved from: https://ymedialabs.com/future-of-healthcare

Reisenwitz, C. (February 8, 2018) *The Top 9 Medical Apps for Doctors* Retrieved from: https://blog.capterra.com/top-7-medical-apps-for-doctors/

Step 4: Creating a decision matrix

Criteria used:

Criteria 1: Which solution will cost the least such that the financial burden on the government is not too heavy?

Criteria 2: Which solution will reduce the amount of manpower required such that it will work with heavily limited manpower in an ageing population?

Criteria 3: Which solution will increase the efficiency and quality of health care such that elderly are able to receive quality health care? (Weighted x2)
(Solutions are ranked on a scale of 1-5, 1 being the worst and 5 being the best)

Solutions	Criteria 1	Criteria 2	Criteria 3: (x2)	Total
1. Medical apps	5	5	1	12
2. Monitoring technology	2	4	2	10
3. Technology integrated hospitals	1	3	5	14
4. Mobile clinics	3	2	4	13
5. Medical drones	4	1	3	11

Step 5: Creating an action plan

(Derived from solutions 1, 3)

We, the Ministry of Health, working with the Urban Redevelopment Authority and the Ministry of Communications and Information, will design and construct new technologically integrated hospitals if necessary, as well as renovate existing ones like Changi General Hospital, island wide, such that there is at least 1 hospital in each of the North, South, East and West areas of Singapore. Bids for contracts for designing and building the hospitals will be awarded by 2035, and construction should be finished by 2040s.

These hospitals will feature an extensive focus on technology, specifically automation and AI. This will be aimed at reducing manpower needs by replacing logistical or menial tasks with automatons, as well as reducing administrative workloads by utilising AI. Automated technology can be used to do menial tasks often done by nurses like giving patients food, helping them bathe, etc., freeing up nurses to attend to patients who require more help, whereas AI can help doctors automatically fill in medical information and complete administrative tasks like recording diagnosis and prescribing

treatments, freeing up doctors to consult with patients or even just take a break. Cutting edge medical technology can also be deployed to help make healthcare in such hospitals safer and better, helping save more lives by making hospital equipment more sterile, allowing for better treatment of chronic illnesses like diabetes and cancer, etc. Such technology includes gene therapy, laser-assisted surgery, new antibiotics/drugs to treat diseases like HIV/AIDs, etc.

Given the need for such new technologies, a section of the hospital should also be dedicated towards medical research. Areas for research include developing cures/vaccines/antibiotics to deal with illnesses, creating new innovative methods/technologies to do things faster, better and more efficiently, or researching new treatments that can help patients with chronic illnesses. Findings from the research department can then quickly be put into application/testing by the hospital, given that the two are closely linked.

An app and portal can also be created to be used with the hospitals. Such an app helps doctors to collect and review patient data, creating a national database of patient information across all hospitals, making it easier for the AI to do its job. Such an app can also feature information on symptom diagnosis and a symptom checker, allowing patients to check relevant medical information should they suspect they have a health issue. The app can also work with AI to assist in more accurate patient diagnosis. The app can also potentially offer rudimentary screening services like electrocardiograms, blood pressure monitoring, eye testing, etc., potentially serving as an alternative to health check-ups.

The app can potentially also be used as an emergency service, helping to automatically detect if something goes wrong with the patient (e.g. heartbeat slows or stops suddenly, patient falls, etc.) and contact emergency medical services as necessary, helping to save more lives in a timely manner.

Aside from the medical side of things, hospitals can also be made more sustainable and better for the environment by utilising renewable energy technologies like solar panels, and can feature a special recycling system that recycles waste water generated by the hospital for reusing. Current systems in the hospital can also be

renovated to become more energy-efficient (e.g. by changing operating table lights to make them less energy-intensive)

Step 6: Evaluating action plan

Effectiveness of Action Plan in solving fundamental problem/meeting criteria:
Our action plan is likely to be able to solve the fundamental problem in several ways, listed below:

1. Utilising automation and AI to reduce manpower needs, thereby making healthcare more efficient (more value out of each doctor/nurse → less manpower needed)
2. Automation and AI also helps make the healthcare process much faster and smoother → shorter waiting times, faster diagnosis/testing, shorter time taken to register/process administrative tasks
3. Harnessing smartphone technologies to make health screening more accessible to everyone at just a tap of your phone, allowing illnesses to be detected earlier for treatment
4. Newer treatments could potentially be much simpler, longer-lasting and cheaper: reducing medical costs of current long-term treatments like chemotherapy and dialysis by maybe treating the disease better
5. Sustainable energy and water technologies help to reduce costs by providing a source of renewable energy and water or by reducing usage of electricity and water, and also help make the environment cleaner
6. Medical research department is able to test things out quicker in an actual hospital setting: findings can be put to good use quickly to ensure maximum benefit in terms of reduced costs and increased productivity, testing of technologies is sped up

Our Action Plan also meets the criteria set above:

1. Sustainable technologies reduce overall cost in utility bills, and new medical technologies can help further reduce costs of treatment (criteria 1)
2. Reduction in manpower needs as automation is used to perform most menial or standard tasks, freeing up doctors and nurses; (criteria 2)

3. Use of automation and AI for administrative tasks means operations are streamlined and become more efficient; (criteria 2)
4. Utilising smartphone technologies to allow for more efficient patient monitoring and potentially earlier diagnosis, which in turn means better treatment; (criteria 3)
5. Cutting edge discoveries and medical treatments able to be tested out and put into operation quickly, allowing for better treatment for problems like diabetes and cancer potentially; (criteria 3)

Pros and cons of action plan:

1. Pros:
    a. Doctors and nurses have lighter workloads, less stress and burnout
    b. Patients are able to receive faster treatment and other services
    c. Patients with chronic illnesses are able to receive newer and better treatment
    d. Reduced costs of operation and treatment due to advancements in sustainable technology mean bills are cheaper for patients
    e. Specialised department for medical research is set up, medical technologies can have more advancements and advancements can be quickly put to good use
2. Cons:
    a. Likely to cost a lot of money to build such technology and fund medical research, as well as construct the infrastructure required
    b. Medical research takes time, advancements in technology required for large reduction in cost likely to take a long period of time
    c. Building infrastructure required will take time

Research for action plan evaluation:

Automation and AI have massive potential to revolutionise the healthcare industry, streamlining most operations and making them much more cost-effective. (Purkis, 2018) Automation and AI can bring about reduction of administrative workloads, improvement of the consistency of patient care, elimination of waste, enhancement of information exchange, better analyzation of data, and better monitoring of patients.

Records and patient data, once digitised, become massively easier to retrieve, analyse and review, or enter, making patient data more streamlined and valuable to clinics. Scheduling appointments and registering patients can now be done by an automated system, making things much more convenient and reducing the need to hire administrative staff. Automation therefore increases the amount of time healthcare professionals have available for direct interaction with patients, as well as giving them the ability to manage more patients at the same time.

As time goes on, new medical technologies that can revolutionise the way we treat people are being developed, and healthcare is on the cusp of a technological revolution. (Stoakes, 2015) Robots that could help surgeons virtually eliminate all human errors are already being developed, and companies like MC-10, Theranos, Scanadu, and Accel Diagnostics are offering simple and accurate diagnostic tools that can be used at home, instead of large, clunky diagnostic machines in clinics and hospitals. If our Action Plan can help push such developments into testing and deployment stages faster, we can help increase the exponential development of technology for healthcare.

Smartphone technologies, in particular, offer great potential for improving healthcare, given how mobile, convenient and accessible smartphones are. Apps that help healthcare professionals perform tasks like information and time management; health record maintenance and access; communications and consulting; reference and information gathering; patient management and monitoring; clinical decision-making; and medical education and training are being developed or already exist (Ventola, 2014), and could help further streamline clinical processes like retrieval of patient data, diagnosis and patient monitoring.

Making healthcare facilities more sustainable is something that is beneficial to them even in terms of healthcare, as maintenance downtime and energy cost is decreased. (Dahl, Blason, 2016) Essentially, by making healthcare facilities more sustainable, and reducing wastage of electricity and other resources in day-to-day processes as well as investing in preventative maintenance, healthcare facilities become more efficient and sustainable in the long run.

References:

Purkis, M. (February 12, 2018) *Automation is the future of cost-effective healthcare* Retrieved from: https://www.liquidweb.com/blog/automation-future-cost-effective-healthcare/

Stoakes, U. (September 15, 2015) *Health Innovation: Moving faster and slower than you think* Retrieved from: https://www.forbes.com/sites/unitystoakes/2015/09/15/health-innovation-moving-faster-and-slower-than-you-think/#6d41205d6185

C. Lee Ventola (May 2014) *Mobile devices and apps for healthcare professionals: Uses and benefits* Retrieved from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4029126/

Blason, K.M. and Dahl, P. (October 13, 2016) *Strategic steps to sustainability in healthcare* Retrieved from: https://www.healthcarefacilitiestoday.com/posts/Strategic-steps-to-sustainability-in-healthcare--13629