What are the impacts of applying CDSS in clinical medicine?

Future medicine could be considered as sophisticated and abundant with artificial intelligence (AI). For example, the 2015 budget for AI in medicine was over 1.1 billion dollars, and this sum will likely increase (Executive Office of the President, 2016). It is widely recognised that numerous advantages of AI, such as enhancing the clinical level. This essay will focus on the practical application of AI in medicine and exploring its impacts. AI benefits from analysing vast and complex data in a short time while it is impossible for humankind's brains. However, it is necessary to consider the negative impacts attached to AI. As stated by He (2019), there is a possibility of lack of training and several ethical issues to consider for AI in medicine. This essay will first introduce the Clinical Decision Support System (CDSS), a support system that helps doctors diagnose and analyse data to realise personalised therapy. Then, it will list the merits of the computer system. Next, the essay will give a view that CDSS has deficiencies in terms of data. Finally, the discussion of ethical issues linked to CDSS, primarily when implemented in the therapeutic process, would be included. After evaluating these, this enquiry finds that CDSS could avoid medical malpractice and enhance the medical development of remote areas, but it should be improved because CDSS's accuracy dependence unduly data's amount and exaction. In addition, the ethical problems caused by applying CDSS need to be solved by the government.

It may be impossible to remember all medical knowledge and consider all cases for doctors when they need to diagnose. According to the research of Dumitrescu and Ryan (2014), 35 out of 38 medical personnel have made or experienced medical errors. It is likely that medical errors are not trivial. Thus, some scientists tried to ameliorate this problem by AI. As we have known, AI can deal with generous data rapidly, and the database could store more knowledge than the brains of humans. It seems that AI could investigate particulars according to corresponding algorithms and medical knowledge. Hence, AI is beneficial to helping the doctor to estimate better treatment plans for their patients. CDSS is a type of AI system. As written by Delory (2020): CDSS are computer systems designed to avoid medical errors and assist the doctor make a diagnosis according to each patient's condition. It could be considered an assistant that processes and presents relevant patient data assisting in initial doctor

assessments that feasibly decrease human error. The most important thing for CDSS is accuracy. Hence the design of it must be based on proper theory:

> The foundation of Clinical Decision Support Systems is mathematics and data. It is developed based on the Bayes theorem, Boolean logic, probability and set theory. In addition, it demands the data structure of computer science to handle data regularly. The vast majority of CDSS used data mining, statistical pattern recognition, neural networks and decision trees to implement it. (Berner, 2016)

The principle of CDSS is intricate so that it cannot be implemented that composing these foundational theories simply. To develop a splendid CDSS, it needs experts of Medicine and Computer Science to interact with each other:

> The experts of medicine know intimately medical knowledge of the domain. They resolve which knowledge and materials should be added into CDSS, their extent of importance and how they should be linked. Then, experts in Computer Science need to develop the system with their specialised knowledge. (Patel and Shortliffe, 2014)

Compared with the consultations of doctors, CDSS could run more independently to get its verdict. As the work of Scarlat (2012), firstly, it needs medical test results and data for analysing; then, all the records will be disposed of the computer system, and then the report which is provided by the system will be furnished with doctors.

Clinical trials of CDSS that developed directed at diverse diseases have been launched and its merits and demerits has been shown. Cardiovascular disease (CVD) is a frequent sickness. According to the report of Go (2012), CVD is one of the leading causes of death. Doctors need to confront numerous CVD patients. Thus, it is a general requirement of clinicians to have a tool to help them analyse the conditions of invalid and subhealth people. The CDSS designed for CVD is conducive to gauge the factors that making patients at risk and relevant clinical tests while it would give a report comprehensively analysed by the anamnesis and physical signs (Njie et al., 2015). The effect of surveying physical signs is evident, as Roumie (2006) stated, the blood pressure of patients who would be reminded and educated if their health data overstep standard criterion is generally lower than the patients' who would not be warned. It would substantially abate the hazard of CVD if each patient could be nursed carefully. However, the remuneration of medical personnel with professional knowledge is costly. Due to this reason, it is possible that partial patients would abandon health care, but if the computer could replace them, the expense would be

less. It may be mentioned as a ground-breaking idea. CDSS should be confirmed as competent, but it required veritable experiment results and data to sustain it. Sequist and his team (2005) proved that about 76% of physicians considered that CDSS helped enhance nursing quality. One hundred forty-eight control experiments estimated from health care procedure, clinical results and disbursement have shown that CDSS is instrumental in clinical treatment (Bright et al., 2012). Both studies strongly indicate that it is possible to implement CDSS in clinical therapeutics for CVD, and it could be a sterling tool for clinical staves.

CDSS is not only experimented with in the CVD field; it also is applied to diagnose other diseases. The neurosurgery department is a medical realm which demands that doctors have highly-level special skills. It will cause irremediable consequences if doctors could not strictly judge the situation of patients for neurosurgery. Thus, it is secure to have a credible computer system to assist doctors to decide the best surgical program. In Rashidinejad and his team (2020) paper, they develop a CDSS that could analyse the intracranial pressure morphology according to patients' personal situation; the average accuracy of the system is about 90%. It has major significance for neurosurgery because it signifies that there could be an assistant who warned and reminded the surgeons if the operation program is not appropriate. It would decrease dependence on sawbones so that it could lessen the possibility of medical malpractice caused by medical personnel. It also provides a new idea that lets experts, clinical doctors and CDSS cooperate. It was proved that the idea is feasible by Antoniou and his colleagues (2020), the precision of the system which is used to diagnose attention deficit hyperactivity disorder (ADHD) could attain 85%; and it could be raised to 95% if experts of ADHD could provide support when the schemes of CDSS and attending physician are divergent. It seems that this idea tries to utilise think-tank resources to improve the quality of remedy. If the doctors of the backward area could reference the programme of CDSS so that they would realise that their plan was not circumspect, then they could seek help from experts. It maybe will contribute to increasing the medical level of the less developed area. In addition, the number of experts is finite so that it is more rational that let experts deal with the problematic problem instead of basic diagnostics. It is possibly considered a knotty problem if the diagnoses are markedly different. It is generally accepted that expert sources could be fully used in this way.

The advantages of CDSS are not only these; it also would promote the development of personalised therapy. Personalised medicine is a new concept that was advanced currently because the expectancy of medicine has been raised (Jameson and Longo, 2015). It fully utilises individual biological information such as genes, distinct probability of disease risk and absorptivity of a drug (Donev and Alexopoulos, 2016). The data which contains all information of the human body is too tremendous to manage by brains. It needs computers to analyse it. Thus, CDSS is essential to burgeoning it.

CDSS could not replace medical personnel entirely due to it only makes judgements according to its algorithm. It seems that CDSS could give a therapeutic schedule like a doctor. There was an idea which purposing that substitute doctors with CDSS. The system can finish reiterated work for the nurse, and then doctors could consult it, but it could not diagnose independently. The computer system is designed based on mathematics; thus, the quantity and amount of data should be extremely reliable. As states by Michael et al. (2019) and Kruse et al. (2016): the data may not be exact for uncontrollable reasons, such as patients could not describe precisely, missing details of previous treatment; CDSS is challenging to handle this situation, it usually dependences the experience of the medical professions. According to Kawamoto et al. (2005), the accuracy rate is 75% when the system flashed a warning at doctors. However, it is incapable of providing an effective therapeutic schedule when medical officers solicit suggestions from CDSS. It means that CDSS is an auxiliary tool of the medical profession instead of a robotic doctor. The computer system has additional insufficiencies as well. The amount of data has a minimal limitation; the foundation of accuracy is ample data: the accuracy could achieve 50% if the system possessed adequate data. However, it would be less than 40% if lack of data (Jaspers et al., 2011). This relation between the amount of data and accuracy caused partly because the algorithm of CDSS is based on probability theory. For example, the Bayesian theory would lead to multiple spurious correlations with few data quantity, according to Cristian and Giuseppe (2017). Spurious correlations would influence CDSS's calculations likely. Hence, data is one of the determining factors of accuracy so that it is a critical point which applying CDSS in clinical. Scientists are working to break this restriction.

Ethics is another problem that CDSS needs to conquer. One of the ethical issues is belief. Doctors are the most reliable ones in patients' view (Shaw, J., Sethi, N. and Block, BL, 2021). It is a challenge that making patients believe CDSS. Owing to CDSS is a new tool in hospital, its ability has not been generally accepted, thus maybe it would cause these problems: should doctors use CDSS when they judge the state of illnesses; should doctors inform patients if they use it; who is responsible for the fault of the system. These are controversial matters. Poon (2021) suggested that the final decision should be rested with doctors because they would consider more things than AI, such as ethics and patients' willingness.

The second ethical issue is privacy. As stated above, data is one of the essential things for it. It is worth considering how to protect the personal privacy of the users. It could not be controlled by the data owners whether to provide their data to a third organisation. As the news reported by Information Commissioner's Office (2017), "Google's DeepMind and the UK's National Health Service did not comply with data protection law." AI is a new field in which its current law is incomplete so that it lacks an effective supervision mechanism. It is a frequent suggestion that safeguarding privacy is a tough problem. It could not finish with a single effort; it needs moral and legal restraints. Pope Francis of the Catholic Church (2018) proposed that AI should serve humanity instead of getting society into trouble. Maybe a complete legal system could restrain unhealthy phenomena. Some governments have begun to legislate to protect privacy for society. General Data Protection and Regulation (GDPR), a law promulgated to protect privacy in the big data era, has been implemented in Europe (Publications Office of the European Union, 2016). Despite partial countries having designed relevant legislation to prohibit misconduct, how to ensure relevant laws being enforced is another problem that governments should consider. It should be solved while CDSS proliferates. Otherwise, it may cause fateful consequences if these ethical problems do not be settled.

This essay has shown how CDSS is applied in clinical medicine and demonstrated its positive and negative impacts, respectively. CDSS is a potential computer system designed by mathematics theory and logical algorithm. It also has been tested and verified that its accuracy could reach 95% if it was trained strictly, according to

Rashidinejad and his team in 2020. CDSS may become a powerful tool for medical personnel in the future. To some extent, it could provide a credible proposal to doctors so that it would reduce medical errors. In addition, it would upgrade the medical capacity of less developed areas without adequate experts if CDSS is implemented widely in these districts. Although the vista of the system is anticipated, it would be governed by its defects and ethical problems at present. The accuracy of the current system relies on the quantity and amount of data. This defect causes an ethical problem: how to protect privacy because of lacking complete law when data's demand is enormous. It is reassuring that some governments have attempted to enact relevant laws, such as Europe. Another ethical issue that has been discussed in the essay is how to make patients believe CDSS. It is possible to be solved by improving the analytical skills of the computer system. The original intention of developing CDSS is to help doctors diagnose more precise and make patients recover from the disease. Hence, scientists hope that CDSS make less mistakes. As stated by Kim (2018), the number of articles focused on CDSS in Computer Science in 2017 was over five times more than 2000's. It could indicate that more and more researches would be pursued in CDSS. Maybe most of the problems will be solved. In general, CDSS could be of benefit to clinical medicine, although it has its faults.

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