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Artificial Intelligence (AI), Precision Medicine and Healthcare in Singapore

There are numerous definitions of *Artificial Intelligence* (AI). At its simplest form, "AI is a field which combines computer science and robust datasets to enable problem-solving". ([IBM, n.d.](#)) On the other hand, "*Precision Medicine* is an innovative approach that accounts for individual differences in patients' genes, environments, and lifestyles". ([NIH, 2023](#)) The development of both AI and Precision Medicine is important for society-wide and individualised medicine to work. Without breakthroughs in computing (specifically computing power) and analytics, AI would not be where it is today, and society would not be able to process large amounts of data to offer personalised advice to each person. On the other hand, the progress of Precision Medicine can be broken down into two categories, (1) Technology such as wearables that allow the collection of vast amounts of data about a person's environment and lifestyle and (2) Sequencing technology and a deeper understanding of genotypes. Without (1), there will not be enough data to train AI models and profile a person at an individual level and (2) it will not be possible to predict a person's risk based on certain genetic markers without enough knowledge in genomics.

AI and Precision Medicine will help to improve diagnostic rates. There are fears and concerns about AI technologies replacing doctors and physicians. However, the term "Augmented Intelligence" coined by W.R. Ashby in the 1950s, suggests a different reality, an interplay amongst data, computation and healthcare providers, working together to improve healthcare standards. ([Ashby, 1956](#)) Friedman's fundamental theorem of biomedical informatics further elaborates on "Augmented Intelligence". The theorem stipulates that a person working in partnership with an information resource is "better" than that same person unassisted. ([Friedman, 2009](#)) In addition, an AI Framework can help determine the level of human involvement needed in AI-augmented decision-making. The three levels are Human-in-the-loop, Human-out-of-the-loop and Human-over/on-the-loop. (Figure 1, Retrieved from IS1128 Lecture) Currently, precision medicine relies on Human-in-the-loop, fitting together with Friedman's theorem. This will likely exist for a while, as patients would prefer the advice from a physician to one dispensed by AI software. Human-over/on-the-loop may apply to AI + robotics used in surgery, where the doctor intervenes only if necessary. Human-out-of-the-loop implies no human oversight and would apply to something with very low probability and low severity of harm, such as a Netflix movie recommendation system. It is unlikely that Human-out-of-the-loop will be used for diagnostic or predictive healthcare in the near future.
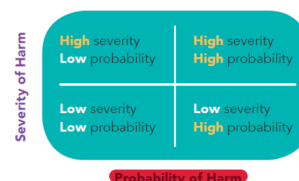

Figure 1

AI and Precision Medicine provide a new approach to identifying normality, given the shortcomings of the naturalist and constructivist approach. With improved data, the general society's "normality" may take a backseat with a focus on an individual's baseline and a move to individualised healthcare. AI and precision medicine would help not just with diagnosis, for example processing X-ray images to identify if someone is at risk of breast cancer. It will also help in predictive and preventive healthcare, looking at genetic markers and recommending lifestyle changes such as exercise or diet.

In the 2023 Budget, Singapore committed $16.9 billion towards healthcare, up from $3.7 billion in 2010. The alignment of AI and precision medicine holds potential for Singapore, with the ultimate goal of prevention and early detection of diseases, in line with the Healthier SG framework for preventive healthcare. This will reduce or at least slow the growth rate of healthcare costs in Singapore. Public funds saved can be distributed to other areas.

To conclude, despite the potential benefits of AI and Precision Medicine, Johnson et al. identified three challenges that need to be addressed - namely fairness and bias, socio-environmental factors and data safety and privacy. More data has to be collected and more research carried out before AI and Precision Medicine can be truly rolled out at a societal level, offering individualised healthcare.

Exploring Eastern vs. Western Medicine approach to health and disease

Alternative medicine, such as Eastern or Traditional Chinese Medicine (TCM), differs from Western Medicine given its lack of scientific rigour. The Chinese believe that the body is maintained by a primordial life energy or *qi*, and the flow of *qi* along the twelve major meridians affects a person's health and disease. This differs greatly from the Western view of cells, nerve pathways and energy in biological systems. (Allchin, 1996) While the West does not fully accept the view of TCM, the Chinese appear indifferent to the incompatibilities in theories. The Chinese focus less on theories and the Western commitment to causality. For example, Eastern and Western medicine are found in the same hospital in China. They could also account for new acupuncture points even though it doesn't fully fit into their model ("defined channels"). The difference in acceptance could thus be pinpointed on Chinese pragmatism and a greater emphasis on outcomes. I hypothesise that while *qi* has yet to be proven, our current scientific understanding may be equivalent to the pre-discovery of quantum mechanics. Classical physics states light exhibits wave-like behaviour. However, quantum physics introduced the concept of wave-particle duality and states that light exhibits particle-like behaviour. While this simplifies and ignores the personal subjectivity of *qi* and the lack of empirical evidence, further scientific exploration could prove that both the Western understanding of the body and the Chinese view of *qi* can coexist.

In Singapore, there are examples of both Western and Chinese medicine co-existing. For example, some people seek Western medical treatment for short-term relief from fever or flu but seek TCM for long-term treatment to balance the *qi* and "strengthen" the body. Anecdotally, Western medicine doctors have also referenced terms such as "heaty" which is a TCM concept. Further observation reveals that TCM has a greater belief in preventive healthcare by aiming to "strengthen" the body even when one is not visibly or noticeably ill, while Western medicine is reactive - prescribing medicine after one has fallen ill. Ultimately, while the Western model is more dominant in healthcare, one should not dismiss the value of alternative medicines.

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References

Allchin, D. (1996). Points East and West: Acupuncture and Comparative Philosophy of

Science. *Philosophy of Science*, *63*(S3), S107–S115. https://doi.org/10.1086/289942

Ashby, W. R. (1956). *An introduction to cybernetics*. https://doi.org/10.5962/bhl.title.5851

Friedman, C. P. (2009). A "Fundamental theorem" of biomedical informatics. *Journal of the*

American Medical Informatics Association, *16*(2), 169–170.

https://doi.org/10.1197/jamia.m3092

IBM. (n.d.). *What is artificial intelligence (AI)?*

https://www.ibm.com/topics/artificial-intelligence

Johnson, K. B., Wei, W., Weeraratne, D., Frisse, M. E., Misulis, K. E., Rhee, K., Zhao, J., &

Snowdon, J. L. (2020). Precision medicine, AI, and the future of personalized health

care. *Clinical and Translational Science*, *14*(1), 86–93.

https://doi.org/10.1111/cts.12884

NIH. (2023, April 25). *The promise of precision medicine*.

https://www.nih.gov/about-nih/what-we-do/nih-turning-discovery-into-health/promise-

precision-medicine#:~:text=Precision%20medicine%20is%20an%20innovative,grown

%20directly%20from%20biomedical%20research.