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1. Abstract

Given the impact of COVID-19 on the healthcare sector, the spotlight was shone on the healthcare industry. The pandemic placed a tremendous strain on the healthcare system in Singapore and we are still reeling from its effects. [1] Coupled with the pandemic, a silver tsunami looms over Singapore. This poses challenges to Singapore's healthcare system and capacity.

We have chosen National University Hospital (NUH) as the target company for the assessment. This report seeks to explore how the medical industry and in particular NUH has been transforming through the use of technology both before and during the pandemic. It also seeks to highlight challenges in digital transformation as well as opportunities and the way forward.

2. Background

There are 2 key challenges confronting Singapore in the healthcare domain. They are **1.** The effect of COVID-19 on the healthcare sector, such as hospitals postponing routine elective services and reducing the workforce attending to non-COVID-19 related needs. [2] This results in an increased risk to medically vulnerable people, such as those with chronic disease. **2.** 1 in 4 Singaporeans are expected to be over 65 by 2030. [3] Seniors are more likely to have ailments and other chronic illnesses. These 2 issues highlight the importance of looking into healthcare as it will be a key challenge facing Singapore in the near future.

It is evident that the Singapore government places a heavy emphasis on healthcare. The government announced in Budget 2022 that it intends to raise the Goods and Services Tax (GST) by 2% over 2 years, starting from January 2023. [4] This is to cover the increase in healthcare spending. Singapore's healthcare spending has already tripled to \$11.3 billion in 2019, up from \$3.7 billion in 2010. [5] For Fiscal Year 2022 (FY2022), it is estimated that Singapore will spend \$19.3 billion on healthcare. It has taken over MINDEF and MOE as the largest spending by ministry. [6] (Figure 1) At the current rate, Singapore's healthcare spending is expected to balloon to \$27 billion by 2030. [7]

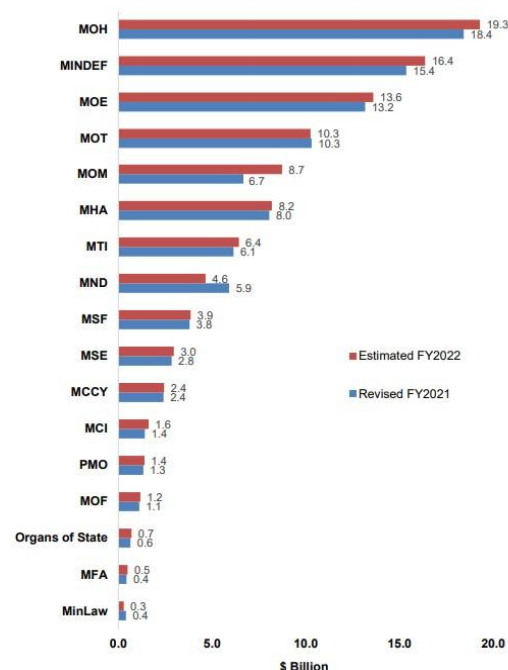


Figure 1

In addition, since the submission of our project proposal on 18th September 2022, the Singapore Government launched the Healthier SG White Paper on 21st September 2022. As it is a relatively new White Paper, many initiatives are proposed and still work-in-progress (i.e. The Bill has not been tabled in Parliament) but this report will attempt to capture some essence of them. Healthier SG is a long-term, multi-year strategy (8 - 10 years) that will transform the way Singapore delivers healthcare. [8] This would guide Singapore's healthcare strategy for the foreseeable future. Given such trends, there is a clear need to study the healthcare industry.

3. Research Motivation

1. Medical technology has greatly advanced by leaps and bounds over the years. In recent years, we have seen innovations in the healthcare and medical sector. For example, from mobile apps that encourage healthy lifestyle such as the Singapore's Health Promotion Board Healthy 365 - which encourages users to adopt a healthier lifestyle through gamification and rewards [9], to cutting edge-technology such as using AI to identify cancer and even robotic-surgery, the possibilities are endless.

Another example of medical technology is telemedicine. It is widely used in the medical industry, NUH included, to provide health-related information to their patients online instead of having them physically visit the hospital. During the period of 2017 and before the start of COVID-19 pandemic in 2020, there were only 1,947 patients who used the telemedicine service. However, by January 2021, the number of patients who used telemedicine has greatly increased to 36,000. It is evident that patients are embracing medical technology. [10]

With advancement in medical technology, we aim to see how public hospitals are leveraging technology to not only improve business workflow, organisation management, but also how some of these technologies are used to deliver state of the art healthcare to their patients.

2. Given National University Hospital (NUH) close geographic proximity with NUS Yong Loo Lin School of Medicine and their close collaboration with NUH, we want to study NUH to explore its synergy with NUS to aid in their goal of more effectively incorporating technologies in the medical industry and translating research into practice. There must surely be benefits to such academia-industry collaboration. The Punggol Digital District is one such example. It is "designed specifically to let industry and academia intermingle through the sharing of each other's work spaces and facilities. This physical integration facilitates the cross-fertilisation of ideas and nurtures collaboration in key emerging technologies." [11]

4. Introduction (Scope)

This paper will dive deeper into NUH as an organisation (i.e. Organisation structure, business model, etc.) We will then move on to the Business Competing Environment followed by exploring their Digital Transformation Journey (i.e. Benefits, Challenges etc.). We will also discuss trends, such as the Healthier SG Strategy laid out by the Singapore government, as well as the future of medical technology. Finally, we will highlight some of the best practices, rooms for improvement and the key takeaways from this study.

5. Research Methodology

We conducted an email Q&A with Dr Ling (Medical Informatics Assistant Director, Regional Health System, NUHS) and an in-person interview with Mr Forbes (Group Chief Digital Officer, NUHS). To supplement our research, we relied on open-source information, such as published documents by NUH and (National University Health System) NUHS. For the purpose of this study, we are using NUHS interview as a proxy to understand what NUH is doing. Lastly, we also referenced Singapore's parliament and ministry level documents (i.e. Budget 2022 & Healthier SG Strategy) to forecast trends for the next 5 to 10 years for the Singapore Healthcare industry, which will ultimately shape the operating environment for hospitals such as NUH.

6. Authors' Note

While we put our best efforts to conduct and ensure our research is as specific as possible, there are instances where the information obtained was about NUHS (Cluster level) as opposed to NUH (Institution level) specifically. We do not use the terms NUH and NUHS interchangeably. If there are clear examples from NUH, it would be specified, else we treat strategies and digital transformation plans implemented by NUHS as a direction which NUH would take lead from. An example is the rollout of the OneNUHS app.

7. Organisation

Singapore's public healthcare system is organised into 3 clusters: National University Health System (NUHS), Singapore Health Services (SingHealth) and National Healthcare Group (NHG). [12]

Each cluster serves different regions, with NUH and NUHS serving the western region. (Figure 2) Each cluster has general and community hospitals, various polyclinics and also a medical school. (Figure 3)

NUH is the flagship hospital for the NUHS cluster and is the largest hospital for this cluster. Being a vital component under NUHS, it serves two functions - operating as a general hospital as well as a medical school. Not only does NUH provide healthcare services for the public, it is also a facility that enables the