

SDGHI Perspectives Essay Series - COVID-19 A Year Later

Vaccines in Southeast Asia

Cold-chain facilities in Southeast Asia: Challenges and Opportunities

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The COVID-19 pandemic has highlighted the importance of high performing cold-chain facilities within a supply chain to implement safe and effective vaccination programmes. This essay seeks to compare cold-chain facilities in a number of Southeast Asian (SEA) countries, whilst identifying common challenges and opportunities.

Comparing cold-chain facilities

The SEA region is incredibly diverse in terms of economy, health care systems, health infrastructure, supply chains and cold-chain facilities, arguably leading to differences during the roll out of vaccination campaigns in different countries. This is particularly evident in the region, with Singapore's vaccination strategy looking promising, facilitated by their organised and efficient supply and cold chain facilities. Singapore is ranked number 1 out of 130 countries for having the most resilient supply chain, compared to other countries who do not have such stable supply chains, such as Myanmar, Timor-Leste and the Philippines [1]. The ranking is based on factors that include, control of corruption, quality of infrastructure, corporate government and supply chain visibility [1].

Arguably, with strong supply chains, cold chain facilities become easier to adopt as the cold chain system has a representative supply chain structure [2]. To expand on this, under the scenario of more stringent temperature requirements (as low as -80 degrees Celsius) Singapore, Thailand, Vietnam, Indonesia and Malaysia are relatively well prepared for ultra-cold chain logistics, compared to Cambodia, the Philippines, Myanmar and Timor-Leste, where studies have shown there is a lack of cold-chain logistics capacity [3].

The cold chain's main elements include cooling systems, cold storage, cold transport and cold processing and distribution [4]. In contrast to other countries in the SEA region, as a leading biopharma hub Singapore already had adequate cold-chain facilities in place for pharmaceutical goods of time-sensitive and temperature-controlled nature [5]. Such facilities include temperature-controlled transportation services, warehouse storage and rooms as well as airside temperature protection equipment in the form of thermal blankets [5].

Additionally, Singapore's Airport Terminal Service (SATs) is now playing an integral role during COVID-19. It acts as a ground handler and has 18 cold storage rooms with temperature settings spread over 8000 square metres, 12 land-side temperature-controlled truck docks, as well as active temperature-controlled containers to boost temperature storage [5]. Such cold chain facilities are crucial for the storage and distribution of temperature sensitive vaccines. Additionally, due to its size, SATs can act as a regional distribution centre for COVID-19 vaccines into other emerging markets – with vaccines already being distributed to different cities such as Jakarta, Mumbai and Beijing [6]. However,

emerging markets like Myanmar, Cambodia and the Philippines might prefer vaccines to be transported directly into their country as opposed to stopping in Singapore [7].

Singapore was able to improve upon its cold chain facilities during the pandemic by introducing temperature controlled cool dollies at its national airport. Cool dollies were designed for the movement of pharmaceutical goods within a secure temperature-controlled system [8]. This investment into the cold chain highlights high quality supply chain management as this infrastructure will prevent temperature sensitive COVID-19 vaccines such as Pfizer-BioNTech from spoiling.

The Pfizer-BioNTech vaccine was the first to be approved by Singapore in the SEA region; after the vaccines approval the country increased its production of dry ice [6]. Thereby ensuring that vaccine handling in the country will not be disrupted and safety will not be compromised because Singapore is able to produce its own dry ice, as opposed to relying on external sources. Such proactive measures emphasise the country's level of preparedness for its vaccine roll out amongst its population. With its adequate cold chain facilities, Singapore is well primed to achieve its goal of vaccinating its population by September 2021, as well as being a COVID-19 vaccine distribution hub for the region (despite concerns around this, as mentioned above) [9].

Similarly, Thailand is another country in the SEA region that has good quality cold chain facilities, due to cold chain logistics being integral to its economy [10]. Thailand have introduced the Brilliant Box (B-Box) cold chain packaging tool to ensure that their vaccine distribution programme is not challenged, as the B-Box keeps vaccines safe for use through temperature controls [11]. Additionally, the country has improved its cold chain by streamlining monitoring, storage and transport of vaccines with a vendor managed inventory (VMI) process compared to its conventional management and distribution model [12]. Even though this improvement to the cold chain occurred before the pandemic, it will prove to be very beneficial for Thailand's vaccine roll out, with studies highlighting relationships between vaccine quality and vaccine transport and storage [12]. The importance of having effective cold storage and transport capabilities was emphasised by a study that found the potency of oral polio vaccines to have decreased in Nigeria when transported from its national warehouse to health facilities [12].

Like Singapore, Malaysia has also secured Pfizer-BioNTech vaccines. However, there are concerns around cold storage requirements in the long-term. In response, the country purchased 55 freezers to store vaccines [13]. In contrast, other countries in the region have had to rely on external assistance to improve their cold chain facilities. Timor-Leste had cold chain equipment donated by UNICEF and Myanmar received a cold chain equipment optimisation platform from Gavi, The Vaccine Alliance to upgrade its cold chain infrastructure [14, 15]. Arguably, countries that are reliant on external assistance, might not feel the need to improve their cold chain facilities, causing their immunisation campaigns against COVID-19 and future pandemics to be slow.

Challenges and opportunities

Mass vaccination campaigns are a challenge in countries that do not have the proper cold chain equipment to store vaccines. This means that the delivery of COVID-19 vaccines could be lower, particularly in remote areas. The Philippines, Timor-Leste and Lao People's Democratic Republic (PDR) are faced with the ongoing challenge of accessing rural and remote communities due to poor infrastructure. Inadequate transportation has seen health care workers resorting to hiring transport to administer vaccines [3]. This could potentially lead to vaccine wastage as hiring transport in the form of motorcycles or bicycles into remote areas is time consuming and prevents active monitoring

of vaccine temperatures [3]. In Lao PDR, it was shown that rural areas have higher drop-out rates in vaccine campaigns than urban areas as a result of cold chain management issues [3]. Potentially, if populations in remote areas are not vaccinated on time or at all, it could have a profound impact on achieving immunity against COVID-19, which could slow down the global response against the virus.

Other infrastructural issues include the underdevelopment of power infrastructure. Refrigerators in health facilities of rural areas do not have a consistent source of power as seen in the Philippines and Myanmar, particularly Myanmar where they have the lowest electrification rate in the SEA region [3, 16]. Without a sufficient supply of electricity, this could affect cold storage leading to vaccine wastage. A way to overcome this challenge is by storing vaccines in solar or battery-powered refrigerators. Although both storage techniques have their own disadvantages, for example, batteries need to be replaced and solar technology is expensive the latter have been widely used in remote areas that lack appropriate cold chain facilities to store vaccines [17]. In South Sudan, the least electrified country in the world, solar powered fridges are being used to store vaccines safely, while solar powered refrigerators have helped increase child vaccinations in Congo's poorest rural provinces by 50 percent [18, 19]. In addition to this in 2015, solar powered refrigeration was piloted in remote areas of Indonesia, receiving positive feedback [20]. This could perhaps be expanded within the SEA region and adopted in other remote areas where electrification and infrastructure is inadequate.

Inadequate infrastructure has always persisted as a challenge for immunisation campaigns and its consequences during COVID-19 is no different. Previously, issues with supply chains due to infrastructure have impeded efforts to control and eradicate diseases such as measles and polio [21, 22]. The same challenges are occurring with COVID-19, including strains on healthcare services, especially in developing economies. Another important infrastructure consideration is strengthening of cybersecurity to protect the supply chain from cyber criminals. Internet-connected technology that has been adopted in many countries such as Singapore and Thailand increases the efficiency of the processes in the supply chain, however, it also makes the system vulnerable to cyberattacks. [5, 23]

SEA could focus on capacity building of cold storage infrastructure in countries that need it. Singapore's SATs already plays a vital role in transporting vaccines into other cities as mentioned above. It is clear that Singapore and other countries with adequate cold chain facilities have the opportunity to work collaboratively with the ASEAN region to share knowledge and help improve cold chain facilities for the successful implementation of immunisation programme through technology. Vaccine campaigns faced similar challenges during the Ebola epidemic in storage and transportation requirements, but this was overcome through technology. The Everbo Ebola vaccination required ultra-cold storage and the Arktek super-thermos was able to maintain the required temperature for up to a week without an external power source in the Democratic Republic of Congo [3]. Learning from the examples from South Sudan and Congo, perhaps, the Asian Development Bank or other ASEAN entities could help export technologies such as solar panels or battery powered refrigerated containers to countries in the SEA region that lack cold chain facilities.

Conclusion

This essay has highlighted that while there are differences in the level and quality of preparedness of cold supply facilities within the SEA region, they are all exposed to challenges and opportunities. Governments of SEA countries are aware of the capacity needs and gaps in cold-chain facilities and the current situation presents the opportunity to address them through cooperation and collaboration at national and regional levels.

About the author

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Aanisah Khanzada is a graduate in Global Health and Social Medicine from King's College London and has completed her Master of Public Health from Imperial College London. She is currently working in the Cyber Crime Unit of the National Crime Agency in the United Kingdom and volunteers remotely as a UN volunteer with the Cameroon Association of Action Youths (CAMAAY), as part of their COVID-19 vaccine advocacy and awareness raising expert advisory group. Prior to this, Aanisah was in Geneva, working as an intern at the World Health Organization within their Mental Health and Substance Misuse department. She also has experience within the tobacco control community through her time in the international tobacco control programme at Cancer Research UK. Aanisah is currently learning Russian with the hope of being exposed to working on pressing global health issues within the Eastern European region in the future.

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