

OPPORTUNITIES IN THE LIFE SCIENCES SECTOR IN SOUTH EAST ASIA

PREPARED FOR VEDP

AUGUST 2020

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1.0 INTRODUCTION TO SOUTH EAST ASIA

Table 1: Key statistics

	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
GDP (USD Billion)	1,119	364	377	372	544	262
GDP Per Capita (USD)	4,136	11,415	3,485	65,233	7,808	2,716
Consumption (USD billion)	746	261	323	172	360	195
Industry (including construction) value added % GDP	38.9	37.4	30.2	24.5	33.4	34.5
Services value added % GDP	44.2	54.2	61.0	70.4	58.6	41.6
Imports of Goods (USD Billion)	171	205	113	359	240	271
Exports of Goods (USD Billion)	167	238	70	390	245	318
Total Population (million)	270.6	31.9	108.1	5.7	69.6	96.5
Urban Population (%)	56	77	47	100	51	37
Median age (years)	29.7	30.3	25.7	42.2	40.1	32.5
Total Area (sq km)	1,811,570	328,550	298,170	709	510,890	310,070
Currency	Indonesian Rupiah (IDR)	Malaysian Ringgit (MYR)	Philippine Peso (PHP)	Singapore Dollars (SGD)	Thai Baht (THB)	Vietnamese Dong (VND)
Average Annual Exchange Rate per US dollar (2019)	14,147.67	4.14	51.80	1.36	31.05	23,050.24
Official Language	Bahasa Indonesia	Malay	Filipino, English	English, Mandarin, Malay, Tamil	Thai	Vietnamese

Source: World Bank, UN Comtrade, Worldometer

Note: All monetary amounts are in current USD.

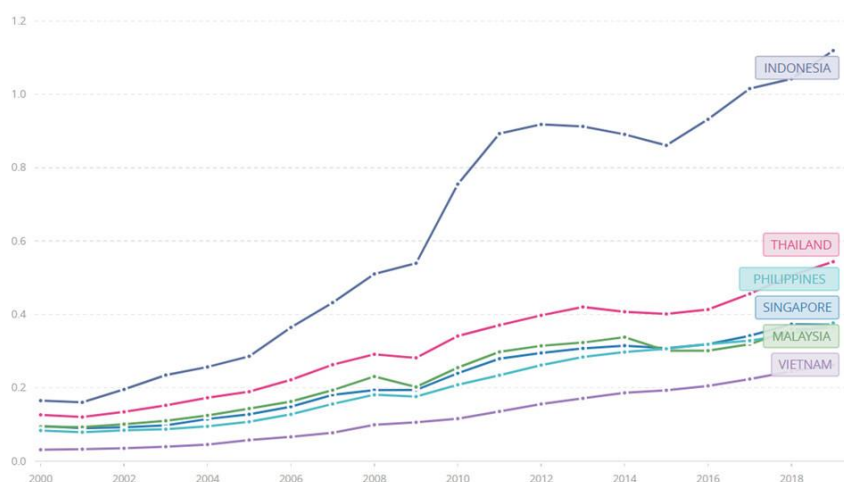


Figure 1: GDP in current USD trillion

Source: World Bank



The six major countries in South East Asia – Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam – have a combined population of 582 million and GDP of USD 3 trillion. If it were a single nation, it would be the third most populous country and the fifth largest economy in the world. It would also have the eight largest consumption expenditure globally.

The region is among the fastest growing in the world, with ASEAN (Association of Southeast Asian Nations) having witnessed an average annual GDP growth of 5.3% between 2000 and 2018, supported by an increasingly well-educated workforce, abundant natural resources and favorable geographic location at the heart of the Asia-Pacific region.

The region's population has a median age of around 30 years, providing an ample labor pool to support growth in the coming years. This youthful demographic profile also translates into receptivity to new technologies.

Between 2019 and 2022, 50 million new consumers are expected to join the ranks of the middle class in Indonesia, Malaysia, the Philippines, Thailand and Vietnam by 2022. The middle class will expand to include 350 million people and continue on its upward trajectory, propelled by greater access to the flourishing digital economy and aspirations to better lives for themselves, their families and their communities.

The above makes ASEAN a key export market for the US. In 2019, it was the fourth largest export destination for the US, after Canada, Mexico and China, receiving USD 108 billion worth of exports originating from the US.



2.0 IMPACT OF COVID-19

2.1 COVID-19 Situation

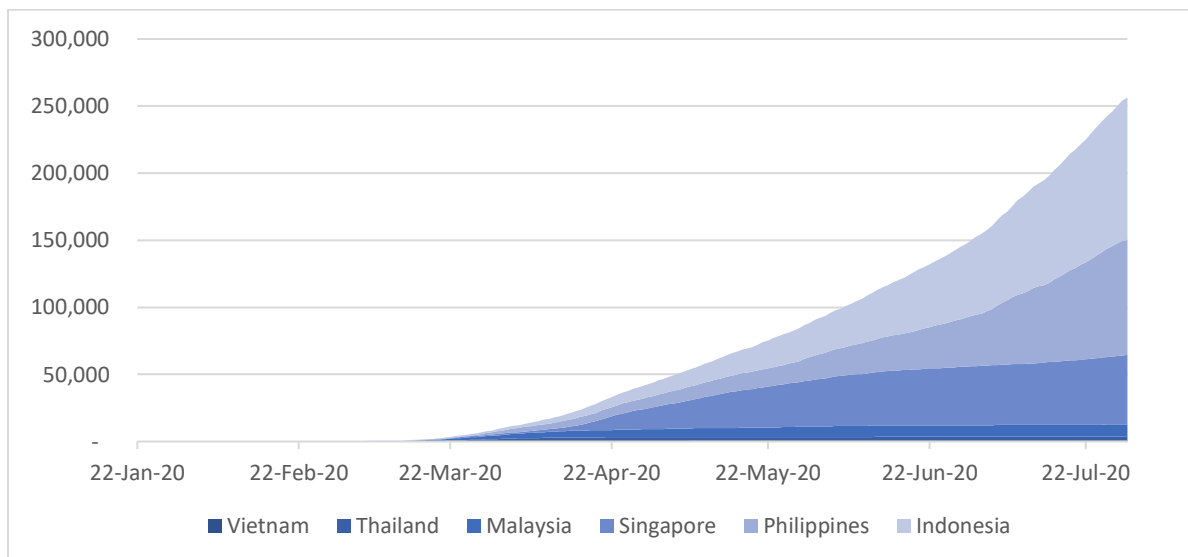


Figure 2: Cumulative confirmed COVID-19 cases from 22 January 2020 to 30 July 2020
 Source: Johns Hopkins University Center for Systems Science and Engineering (via United Nations Office for the Coordination of Humanitarian Affairs)

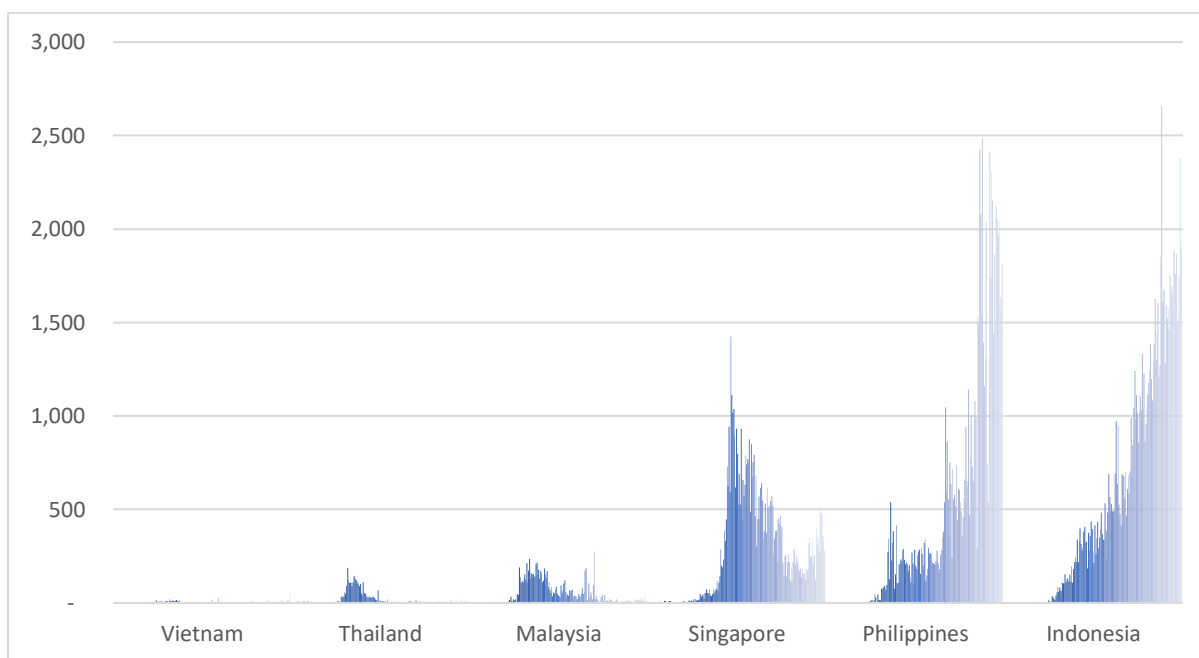


Figure 3: New COVID-19 cases from 23 January 2020 to 30 July 2020
 Source: Johns Hopkins University Center for Systems Science and Engineering (via United Nations Office for the Coordination of Humanitarian Affairs)



Table 2: COVID-19 status in 6 major South East Asian countries (statistics as of 29 July 2020)

Country	Total Cases	Total Deaths	Cases in July 2020	Deaths in July 2020
Indonesia	102,051	4,901	48,041	2,147

Indonesia has the highest number of cases and deaths in South East Asia. Instead of imposing a nationwide lockdown, the central government allowed regional governments to restrict the movement of people and goods in and out of their respective localities. The capital Jakarta introduced Large-scale Social Restrictions, starting on 10 April, and this was followed by many other provinces and cities. On 4 June, Jakarta announced entry into a transitional phase, underpinned by the gradual reopening of several essential services sectors. On 14 July, Jakarta officially extended the transition phase by another 14 days.

Malaysia	8,943	124	309	3
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Malaysia started easing its restrictions in May and from June 10, nearly all social, economic and religious activities restarted, while adhering to safe distancing principles. This current phase supposed to last till end-August and is supposed to be a recovery phase. Local cases started to spike again in the third week of July and on 26 July, the minister in charge of managing the coronavirus outbreak said that the government will reimpose a lockdown if the number of new COVID-19 cases surpasses 100 a day.

Philippines	86,673	1,947	48,218	703
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Quarantine measures to contain the virus vary across the Philippines, with different degrees of restrictions, but the strictest and longest lockdown was in Manila, starting from mid-March. The city began to reopen at the beginning of June with limited public transport and offices permitted to have skeleton staff. Since then lockdowns have been re-imposed on several neighborhoods as cases jumped. Overall, cases have continued to rise throughout the country. On 31 July, the president extended restrictions in Manila until mid-August because of the continued high number of coronavirus cases.

Singapore	51,197	27	7,738	1
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A large number of the cases in Singapore are from foreign worker dormitories. Phase 2 of the country's reopening started from June 19, with the resumption of most activities, subject to safe distancing principles. Singapore expects to enter a new normal in Phase 3 at a currently unspecified date, where all activities would be permitted to resume, with restrictions on gathering sizes and strict safe management measures at businesses involving crowds or close contact. Singapore expects to remain in this state, until an effective vaccine or treatment for COVID-19 is developed.



Country	Total Cases	Total Deaths	Cases in July 2020	Deaths in July 2020
Thailand	3,298	58	135	0

Thailand ended its lockdown period on July 1, allowing all businesses to resume operations. But a state of emergency is in place to maintain control of movements into and outside of the country and for state-run quarantine and tracking. On 31 July, Thailand extended its state of emergency by another month to the end of August 2020, to reduce the risk of a second COVID-19 outbreak, as it opens its doors to select foreigners, including migrant workers from neighboring countries. Medical tourists, foreigners participating in international conferences and trade fairs, foreign film production crews and Thailand Elite cardholders (those with long-term residence visas and multiple-entry residence visas) are among those allowed to enter the country.

Vietnam	446	0	91	0
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Vietnam was the first South East Asian country to lift its lockdown, on 22 April. Through a centralized quarantine program and an aggressive contact-tracing system, Vietnam had managed to keep its coronavirus tally to the lowest in the region and avoid any deaths. However, on 25 July, the first locally transmitted COVID-19 infection in nearly 100 days was reported from the central city of Danang, quickly followed by several others taking the total of new cases to 30, as of 29 July. Around 80,000 tourists were evacuated from the city and all transport to and from the city was suspended. Danang has been locked down and the government has warned that every province and city in the country is at high risk of coronavirus infections.

Total	252,608	7,057	104,532	2,854
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Source: Johns Hopkins University Center for Systems Science and Engineering (JHU CCSE), Center for Strategic & International Studies, multiple media outlets

According to the International Air Transport Association, as of 29 July 2020, with certain exceptions such as relatives of citizens or individuals with long-term residency permits, foreigners are not allowed to enter any of these countries. Thailand has started allowing select foreigners to enter, such as those participating in international conferences and trade fairs and foreign film production crews.



2.2 Economic Impact

Economies in the South East Asian region have suffered due to the global impact of COVID-19, driven by decline in consumption, investment and trade. Movement restrictions imposed by governments to contain the outbreak constricted economic activity in all countries.

Table 3: GDP growth rates

Year	Indonesia	Malaysia	Philippines	Singapore	Thailand	Vietnam
2019	5.0%	4.3%	6.0%	0.7%	2.4%	7.0%
2020f (ADB)	-1.0%	-4.0%	-3.8%	-6.0%	-6.5%	4.1%
2021f (ADB)	5.3%	6.5%	6.5%	3.2%	3.5%	6.8%
2020f (World Bank)	0.0%	-3.1%	-1.9%	NA	-5.0%	2.8%
2021f (World Bank)	4.8%	6.9%	6.2%	NA	4.1%	6.8%
2020f (IMF)	-0.3%	-3.8%	-3.6%	-3.5%	-7.7%	2.7%
2021f (IMF)	6.1%	6.3%	6.8%	3.0%	5.0%	6.5%

Source: ADB, IMF, World Bank

Note:

2019 actuals are from World Bank

f=forecast

The more open trade-dependent economies of Malaysia, Singapore, Thailand, and Vietnam were also hit by slumping global trade and demand. In addition, tourist arrivals plunged in response to stringent travel restrictions and quarantine requirements, hitting the aviation, hospitality, and retail industries. Most countries in the region have relaxed restrictions, at least partially, but business uncertainty and weak consumer confidence may hinder economic recovery.

Moreover, external demand is expected to remain muted for the rest of 2020 due to global economic contraction. However, all of these economies are expected to rebound during 2021, as seen from the projections by the Asian Development Bank (ADB), the World Bank, and the International Monetary Fund (IMF). While the variation in the projections reflects the high level of uncertainty due to the rapidly evolving COVID-19 situation, the common trend in expectations is indicative of the strong macroeconomic fundamentals in the region.

Indonesia

- Indonesia saw growth in Q1 of 2020 drop to 3.0% year on year, its slowest pace since 2001. Domestic consumption growth fell to 2.8% as households reduced discretionary spending, though public consumption picked up gradually. Growth in fixed investment decelerated to 1.7% as investment in buildings and other structures wound down and investment in machinery and equipment contracted. Meanwhile, sustained demand for palm oil and metal ores partly countered contraction in exports of services and oil and gas.



- The government has announced a fiscal stimulus package of USD 48 billion but less than 20% of this had been spent at end-July 2020. A new National COVID-19 Mitigation and Economic Recovery Committee was established on July 21 to resuscitate the economy.
- The country's COVID-19 cases still have not peaked and economic recovery will depend upon success in bringing virus situation under control and effectively roll out existing assistance schemes to help both the public health sector and ordinary Indonesians.
- The country's economic growth in the longer term is contingent on the ability of the government to renew its pre-COVID agenda to build infrastructure, invest in human capital, and pass structural reforms to reduce bureaucratic hurdles and increase private investment. The President has instructed the country's provincial governments to make preparations to grab opportunities from corporate migrations out of China, while the central government has been intensively lobbying US and Japanese decisionmakers to win their backing in making Indonesia a corporate relocation hub. At the end of June, seven foreign companies, including from the United States, Japan, and other countries, committed to transferring production out of China to Indonesia.

Malaysia

- Growth in Malaysia fell to 0.7% y-o-y in Q1 of 2020, compared to 3.6% in the previous quarter. As the COVID-19 pandemic affected global supply chains, exports of goods and services shrank by 7.1%. Investment also declined as public investment fell by 11.3% and private investment by 2.3%. Consumption remained a bright spot in the economy, growing by 6.5% as stronger public consumption offset weaker private consumption. However, domestic consumption is expected to have contracted in Q2, due to movement restrictions. External demand is likely to be similarly weak as trade partners continue to grapple with the effects of COVID-19. With the outlook having deteriorated since ADO 2020, the Malaysian economy is expected to contract by 4.0% in 2020 before recovering to 6.5% growth in 2021.
- Initially government response was hampered by an abrupt change of government in February 2020. But since then, the government appears to have controlled local transmissions. It has also issued four stimulus packages worth a combined USD 68 billion dollars. In addition to wage subsidies and tax deductions, SMEs are receiving grants and soft loans to hire, retrain and upskill the unemployed and the youth. The government is also looking at this crisis as a catalyst for optimizing the usage of new technology, business digitalization and e-commerce platforms.
- The economy is beginning to show signs of recovery. An index of leading economic indicators rose by 0.6% y-o-y in May 2020, after rebounding from a fall of 5.7% in April 2020. The Industrial Production Index (IPI) surged 18.2% in May 2020 as compared with the previous month, though it was still 22.1% lower y-o-y. Improvement in domestic consumption and growth in manufacturing production and sales are expected to support economic recovery going forward.



Philippines

- The Philippines contracted by 0.2% year on year in Q1 of 2020 as border restrictions slashed tourism receipts and quarantine measures depressed domestic demand. Growth in household consumption, comprising three-fourths of GDP, was flat, and investment slumped by 18.3%, as outlays for machinery and equipment went down. However, government consumption rose by 7.1% y-o-y. Exports and imports fell, as external demand weakened and supply chains were disrupted. On the supply side, all major sectors decelerated. Growth in services slipped from 7.1% in Q1 of 2019 to 1.4% with weakening transport and accommodation, food services, and trade. Industry dropped by 3.0% with lower construction and manufacturing, and agriculture fell by 0.4%.
- Going forward, the contraction in the global economy will continue to impose a drag on external trade, tourism and remittances (9.3% of GDP in 2019). Domestic consumption and business confidence could be boosted by the virus being brought under control.
- The government is relying on big-ticket infrastructure projects to counter the effect of the pandemic. In May, media outlets reported that the government was reviewing infrastructure projects from the 'Build Build Build' infrastructure plan (which entails USD 160 billion to be spent between 2017 and 2022) to identify projects with high and immediate economic impact and prioritize them.
- In June 2020, the House of Representatives passed a USD 26 billion stimulus package to help the economy recover from the coronavirus pandemic in the next four years. It is seeking to offer various forms of assistance to micro, small, and medium enterprises (MSMEs) and other key sectors affected by the COVID-19 crisis, while at the same time rebuilding consumer confidence. It is expected to generate some 1.5 million jobs through infrastructure projects and financial assistance for small businesses between 2020 to 2023. But as of end-July 2020, the bill is still pending in the senate. On 24 June, the administration announced that it was seeking a USD 85.9 billion budget for 2021 to support the economic recovery from the pandemic.

Singapore

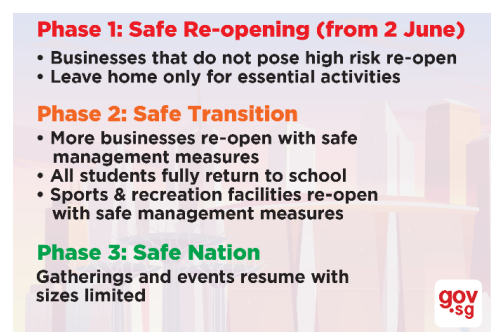


Figure 4: Singapore's three phase reopening plan
Source: Government of Singapore



- In the second quarter of 2020, Singapore's GDP contracted by 12.6% on a y-o-y basis, following a 0.3% y-o-y contraction during the first quarter. The manufacturing sector continued to grow, expanding by 2.2% y-o-y primarily due to a surge in output in the biomedical manufacturing cluster, though it slowed down from 8.2% during the previous quarter. Weak external demand and workplace disruptions during lockdown weighed on output in the chemicals, transport engineering and general manufacturing clusters. Services declined by 13.6%, as tourism and air transport sector came to a standstill and sectors such as food services, retail and business services were affected by the lockdown. Meanwhile, the construction sector contracted by 54.7%.
- For the rest of the year, construction is expected to suffer as it grapples with interrupted supplies of materials and migrant labor. External demand and trade will be affected by supply chain disruption, but the impact may vary by industry. Oil and electronics will continue to drop, but biomedical manufacturing and precision engineering may see positive demand arising from the pandemic in the short term.
- During the first four months of 2020, the country secured USD 9.5 billion in investment commitments for the next few years, from companies such as Micron and Thermo Fisher Scientific, reflecting the sustained confidence of foreign investors in Singapore.
- The government has released four stimulus packages worth a total of USD 66 billion, to support workers and businesses. In June 2020, the government set up an "Emerging Stronger Taskforce" to establish industry coalitions to spark job growth and prototype ideas in areas such as robotics, e-commerce, environmental sustainability, digitalization of supply chains and the built environment.

Thailand

- Thailand's economic contraction in 2020 is projected to be the worst by ADB. One reason for that is the high contribution of tourism to GDP, accounting for more than 20% in 2018 and reliance on exports, with merchandise trade at around 100% and export of goods and services at 59.7% of GDP.
- Thailand's GDP declined by 1.8% y-o-y in Q1 of 2020, as consumption and investment slumped, the public side of both categories shrinking as the budget was delayed. Private investment was hampered by weaker domestic consumption and business sentiment under the COVID-19 pandemic. On the supply side, merchandise exports grew moderately, but were constrained as declines hit exports of rice, rubber, vehicles, and chemical and petrochemical products. Service exports dropped in tandem with a significant fall in tourism receipts.
- The government expects the economy to recover gradually after hitting bottom in the second quarter. Thailand's economy improved during June from the previous month due to the gradual relaxation measures implemented in Thailand and abroad, supporting the resumption of economic activity. The Bank of Thailand (BoT) said the value of merchandise exports excluding gold, private consumption and private investment indicators, and manufacturing production contracted at a lower rate.



- The Thai government has issued two stimulus packages worth USD 70.7 billion. The Thai cabinet has also approved a USD 3.2 billion budget for projects targeted at boosting consumption and tourism and 92 public-private partnership projects worth USD 3.3 trillion are being planned to stimulate the economy. In addition, the government is planning to set up an economic recovery task force led by the prime minister, to allow SMEs (small and medium enterprises) to gain greater access to state procurement projects. State agencies may be required to buy SMEs' products or services for at least 30% of their procurements each year.

Vietnam

- Growth in Vietnam decelerated to 3.8% y-o-y in Q1 of 2020 but recovered partially in May since the lifting of social distancing. Agriculture stagnated under lower external demand for agricultural exports and prolonged drought. Growth in services was halved from 6.5% in 2019 to 3.2% year on year in Q1 of 2020. A strong uptick in domestic tourism in May was not enough to offset a 98% drop in foreign tourists compared to May 2019. The trade surplus in January to May declined significantly as demand from the economy's principal export markets plunged. Growth is forecast to continue to decelerate in 2020 due to sharp fall in external demand. The country is highly reliant on trade, with the highest merchandise trade to GDP ratio in South East Asia at 215% in 2019, and the global slowdown will have an unavoidable impact on exports.
- Notwithstanding the slowdown, Vietnam is expected to outperform its regional peers in 2020, with GDP growth remaining in positive territory. Vietnam relied on early action, targeted testing, extensive contact tracing, effective government communication and widespread public buy-in and compliance to control the outbreak. Being the first country in the region to control the pandemic and reopen the domestic economy has given the country a head start in its economic recovery journey. The government stimulus package is the smallest in the region at USD 3.8 billion of fiscal measures and delayed collection of an estimated USD 7.6 billion in value-added tax, corporate income tax, and land rent, but the economic impact has also been the smallest.



Figure 5: A COVID-19 fight poster in Hanoi, Vietnam
Source: Asia Power Watch (Credit: Reuters / Kham)

- Vietnam's suspension of non-essential activities lasted only 22 days, significantly shorter than many other countries, easing some of the downward pressure on consumption. Domestic spending has been a key engine of growth for Vietnam, accounting for 71% of GDP in 2019.
- Vietnam is well-positioned to attract companies seeking alternative manufacturing locations. Even before COVID-19, Vietnam was one of the principal beneficiaries of manufacturing facilities relocating out of China, leveraging its strategic location, relatively low labor costs and membership in multiple free trade agreements. In its 2020 ranking of locations for global manufacturing among 48 countries in Europe, the Americas and Asia Pacific, Cushman & Wakefield assessed Vietnam to be the second most cost-competitive manufacturing hub in the world, after China. Once the world economy begins to recover, Vietnam will be able to fully reap the benefits from this shift.



2.3 Key Business Trends

While nearly every sector in the six major South East Asian countries have been adversely affected by the outbreak, the virus is also creating opportunities by realigning supply chains, accelerating digitalization and automation, and driving medical sector innovation.

Corporate executives in the region are also planning their future beyond the crisis and using this as an opportunity to address issues such as technology adoption. According to a survey by consulting firm Ernst & Young that was published in May 2020, companies are taking steps to effect change in their global supply chains (50% of survey respondents), digital transformation (27%), speed of automation (SEA 33%), and management of workforce (48%).

- COVID-19 has spurred academic institutions and research organizations in the region to work together to manufacture medical equipment and kits such as negative pressure units, face shields and masks, as well as robotic transporter units. The demands imposed by the pandemic have also acted as a positive catalyst in the rapid emergence of local technologists in these fields as well as greater collaboration, such as that between medical and engineering schools and between academia and the private sector.
- The pandemic is prompting a rethink among MNCs to make their supply chain more resilient by boosting inventories and enlisting suppliers from countries such as Vietnam, Malaysia, and Thailand. Many companies are also shifting or diversifying their manufacturing operations beyond China, accelerating a trend initiated by the trade tensions between the US and China, benefiting low wage manufacturing destinations such as Vietnam and Indonesia.
- With the rise of digital technology in areas such as communications and conferences, education, financial services, medicine, logistics, lifestyle and retail, businesses providing technologies will benefit.
 - Across South East Asia, governments have committed significant funding to helping businesses complete their digital transformation. Singapore has allocated SGD 500 million (USD 364 million) to support businesses digitalize, while Malaysia has pledged around MYR 700 million (USD 166.7 million) to support digital transformation and automation in small and medium enterprises. The pandemic is forcing businesses to recognize the urgency with which they need to upgrade parts of their workflows
 - As part of a continuing study on the growth of digital consumer behavior, Bain and Facebook analyzed the buying patterns of 8,600 digital consumers in six South East Asian countries between January and June 2020. They found that the region's digital consumers expect to spend more time at home after restrictions are lifted, and they have discovered new apps that they intend to continue using. They are buying more essentials online, delaying splurge spending and are favoring value for money and trusted, established brands. In response, consumer goods companies are responding by swiftly increasing product availability and visibility online, targeting digital engagement across platforms and optimizing pricing and value perception.





Figure 6: Findings from Bain/Facebook survey of digital consumers in South East Asia, conducted between January and June 2020
 Source: Bain & Company



3.0 INDONESIA

3.1 Snapshot of the Indonesian Healthcare System

- The life sciences sector in Indonesia is dynamic, with national health expenditure almost doubling over two decades to reach 3.6% in 2018. The government has made healthcare a key priority, with public expenditure to grow by 13% from 2019 to 2020. Moreover, the measures put in place to counter the COVID-19 pandemic represent a new area of opportunity.
- Indonesia has a large under-served healthcare market, with a scarcity of public health infrastructure. This has led the government to open the healthcare sector to private investment. Private providers are establishing a growing number of hospitals, private practices, midwifery clinics, clinical laboratories and pharmacies, particularly in Tier 2 cities such as Makassar, Pekanbaru and Balikpapan. Despite this, the number of hospital beds and doctors remains low relative to the size of population.

Table 4: Number of hospitals by category, 2018

Types of hospitals in Indonesia	Number (2018)
Number of hospitals	2,813
Public	1,026
Private	1,787
Available beds per 1,000 people	1.2
Number of hospital beds	310,710
in general hospitals	281,082
in specialized clinics	29,628

Source: Ministry of Health of Indonesia

- The country faces significant challenges relating to healthcare access and territorial economic inequality. Private hospitals tend to cluster in the urban areas of Java and Sumatra, where a higher concentration of people have the ability to pay out of pocket.
- The aging population represents one of the largest challenges for the Indonesian healthcare system, as it is one of the main drivers of increasing expenditures. In 2019, Indonesia had 17.3 million people aged 65 years and above and the share of elderly population is expected to grow by more than 40% by 2025. A recent report released by the World Health Organization indicates non communicable diseases (NCD) such as strokes, ischemic heart diseases, and diabetes are the top killers of elderly Indonesians.
- Indonesia introduced a universal health insurance system called Jaminan Kesehatan Nasional (JKN). In 2019, 221 million Indonesians were covered under JKN or 83.94% of the total population. When fully implemented, it will be one of the largest programs of its kind in the world, costing USD 13-16 billion per year according to the World Bank. As the costs from the JKN cannot be met by the government's budget



on its own, private investment will be needed to help fill gaps. Key areas for public-private partnerships are hospital construction, advanced medical device supply and biotech research.

Table 5: Estimated contribution of the JKN Program in Indonesia

Sector	Output (USD billions)			Labor (thousands of people)		
	2016	2021	% change	2016	2021	% change
Government Health services	4.1	7.8	90%	864	1,348	56%
Pharmaceuticals products industry	0.71	1.35	90%	27.2	42.5	56%
Medical equipment industry	0.14	0.28	100%	17.3	27	56%
Healthcare Services and Private Social Activities	1	1.9	90%	4.7	7.4	57%
National health Insurance	0.48	0.91	89%	31	48.5	56%

Source: Deloitte

- The need of private investment is expected to increase as the COVID-19 makes it a must for Indonesia to increase its investment in its testing and treatment capacities. A significant first step was taken in April 2020, when the government announced the construction of the Galang Island COVID-19 Specialist Hospital in the Riau islands province to fight the spread of the virus. The hospital will serve as a broader research facility and infectious disease treatment center once the COVID-19 pandemic ends.
- In March 2020, Indonesia announced a COVID-19 stimulus package which includes IDR 75 trillion (USD 5 billion) for healthcare expenditure. This will be used to cover purchase of medical equipment such as test kits and ventilators; incentives for medical workers including doctors and nurses; as well as provide protective equipment for micro, small and medium enterprises that are expected to resume operations during the new normal phase.
- The outbreak has highlighted Indonesia's significant deficit in hospital beds, medical staff and intensive care facilities. In order to address such shortcomings, the government announced plans to increase the number of hospitals located in remote areas in the country from 77 in 2020 to 115 in 2024, as well as construct 300 modern health centers by 2024.
- Notwithstanding the magnitude of the COVID-19 stimulus package a number of key players in the country judge the measure as insufficient. For instance, the Indonesian Chamber of Commerce and Industry estimates that the country will need IDR 400 trillion (USD 28 billion) for healthcare expenditure. It is therefore likely that new initiatives will follow over the upcoming months.



3.2 Medical Devices and Equipment in Indonesia

OVERVIEW

- Indonesia's medical equipment segment has been growing rapidly, backed by strong domestic demand, sustained economic growth, expanding investments in infrastructure as well as international aid projects. To give a sense of the growing dynamism, in 2017 foreign investment in the industry spiked seven-fold compared to the previous year, reaching a value of USD 320 million. It is projected that these figures will further grow as the country implements measures to tackle the COVID-19 pandemic.
- Indonesia relies on imports from countries such as the US, Germany, Japan and the Netherlands for more than 95% of its medical and surgical instruments.
- Importantly, in April 2020 Indonesia announced a new temporary regulation to exempt from duties and taxes the imports of 73 types of products targeted at combating the COVID-19 outbreak. Such products include hand sanitizers, products containing disinfectants, and most personal protective equipment.
- In the same month, it was estimated that Indonesia spent USD 50 million on imported medical supplies since the beginning of the COVID-19 outbreak in the country, with 17.1 million units of imported face masks, 3.26 million testing kits, over 390,000 packs of medicine, 1.49 million units of hospital equipment, and 1.95 million units of personal protective equipment.

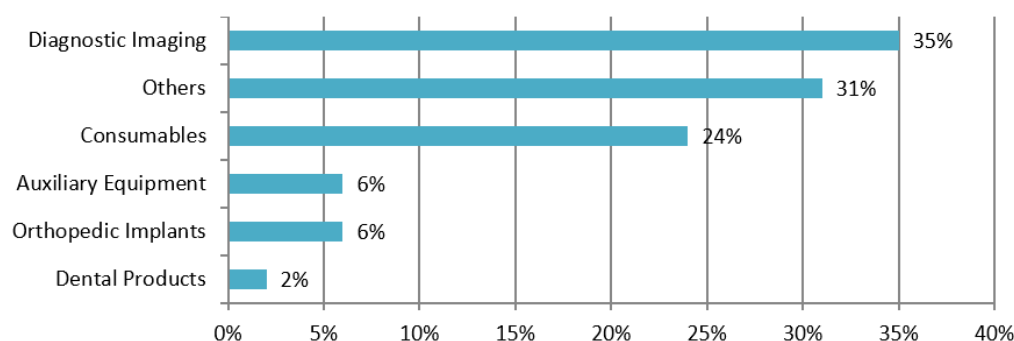


Figure 7: Estimated distribution of the medical equipment sector in Indonesia in 2018

Source: Pharma Boardroom

- Traditionally, local production is focused mainly on the manufacture of basic items like surgical gloves, bandages, orthopedic aids, and hospital furniture. However, over the last five years, a growing number of local companies have started producing more advanced medical equipment.
- Thanks to low production costs, Indonesia has also emerged as an attractive manufacturing destination for multinational companies. In an effort to counter the effects of the spread of the COVID-19, the Ministry of Health has sped up the application process for licenses to produce domestically and distribute certain medical devices and household supplies.



OPPORTUNITIES

- Indonesia is a potential manufacturing base for medical products. In order to encourage further growth of the sector, the Indonesian government has opened it up to 100% foreign ownership, and the country has emerged as an alternative low-cost production platform to China. For instance, in May 2020 it was announced that Indonesia was preparing 4,000-hectare industrial complex in Brebes, Central Java, for a yet-unnamed American pharmaceutical company relocating from China in the context of the trade war between the two countries.
- Partnering with local companies for the production of medical devices is another entry route to consider. Crucially, the Indonesian House of Representatives has urged the government to mass-produce COVID-19 equipment, instead of relying on imports. However, local players lack capabilities related to the production of advanced equipment, and are leveraging on the expertise of foreign players. For instance, Indonesia has already joined a joint production scheme for medical supplies with technically-advanced South Korea and Japan.
- COVID-19 equipment that need to be produced on a mass-scale in Indonesia include PCR test kits, RT Lamp, Turbidimetry and Colorimetric-based test kits, and non-PCR Rapid Diagnostic Test Kits (RDT), ventilators, mobile BSL-2 Laboratory, powered air-purifying respirators, and PPEs, among others.
- The government is incentivizing local production but at the same time, given the urgency of the situation, it has relaxed rules on imports. However, it is reported that Indonesia is struggling to acquire some products. For instance, the country still lacks the necessary kits to conduct PCR testing on a massive scale: as of April 2020, its stock of reagents was only enough for 35,000 test kits while Indonesia needs to conduct at least 10,000 tests a day. In June 2020, Indonesia had done about the same number of PCR tests as Pakistan, which has a smaller population than Indonesia. With around 342,000 tests performed, Indonesia's average is less than 4,000 per day.
- The government announced that it is providing full medical coverage for COVID-19 patients through the national health insurance provider, designating 132 referral hospitals across the country for treating COVID-19 patients. The government allocated a special fund for COVID-19 prevention and control.
- The private sector that is proving to be particularly dynamic in the fight against the virus, and such players should be considered among key targets. For example, Siloam International Hospitals, the country's largest healthcare group with over 24 hospitals in the country, has launched two hospitals designated for COVID-19 patients with a combined capacity of more than 630 beds. The group is among the entities authorized by the Health Ministry to perform the swab tests during the pandemic.













3.3 Healthcare IT in Indonesia

OVERVIEW

- The combination of inadequate geographical coverage and high smartphone penetration makes Indonesia a high-potential market for Healthcare IT solutions. Today, multiple telemedicine start-ups such as Halodoc and Alodokter are bringing healthcare to tens to millions of Indonesians. Crucially, healthcare IT solutions have been identified as pivotal in the fight against COVID-19.
- The digitalization of the Indonesian healthcare sector has been slow, possibly because there is currently no legislation that requires the use of digital systems, nor a national guideline for it, with hospitals free to adopt or develop their own electronic medical records. It is noteworthy that most hospitals in Indonesia are not as yet connected to their doctors and patients, most clinics have no common operating standards, and processes are still manual. Aside from interoperability, a key challenge for IT adoption in healthcare is that Indonesia has an internet penetration rate of only 53.7%, which is much lower than its counterparts in the rest of the region.
- With fewer than 4,000 hospital beds for seriously ill COVID-19 patients in an archipelago of 270 million people, the use of healthcare IT solutions is particularly adapted to the challenges faced by Indonesia. Telehealth firms have seen their usage skyrocketing during the COVID-19 pandemic. For instance, Alodokter recorded 61 million web visits and had more than 33 million active users in March 2020. The app has also been downloaded more than 5.5 million times, registering a 50% jump in traffic.

Table 6: % of users of telemedicine apps in Jakarta, pre COVID-19 figures

App	Logo	% of Users	App	Logo	% of Users
Halodoc		45.3%	flo		4.7%
Alodokter		32.3%	freeletics		3.4%
Kilkdokter		18.8%	Calm		2%
dokter.id		11.7%	Doogether		2%
DokterSehat		9.8%	MoCehat		1.5%

Source: DS Research | FITCO

- To lessen the pressure on hospitals, the government itself is directing the public to telehealth firms. Towards the end of March 2020, Indonesia's COVID-19 task force announced plans to create a "digital call center" called Sociomile adding links on its website to 20 telehealth services to direct traffic. Officials said they want patients with only mild symptoms to be treated through telehealth, with doctors referring those whose conditions worsen to hospitals.



- Indonesia's COVID-19 task force, telehealth companies and doctors have agreed to share aggregate patient data to aid efforts to slow the spread of the virus, a development which is expected to further contribute to the growth of the sector.

OPPORTUNITIES

- A key opportunity is represented by collaborations with Indonesian hospitals which are looking for solutions to limit the pressure caused by the COVID-19 outbreak. A large number of major hospital operators have partnered with local online healthcare providers such as Halodoc, Alodokter, Aido Health and Grab Health to deliver teleconsultations, as well as with tele-radiology solutions provider, in which radiological images such as X-rays, CTs and MRIs are distributed across hospital networks. Importantly, this collaborative approach between health services providers and healthcare IT players is expected to become part of the new normal in the post- COVID-19 era.
- Digitizing largely paper-based processes is a priority for speeding-up processes at Indonesian hospitals, which are struggling to cope with the inflow of patients. Medigo Indonesia is an example of a solution that helps hospitals and village clinics with outpatient management platforms to facilitate operations, including clinic line-ups, wait-times, and doctor schedules. The platform also features an appointment booking system for both staff and patients.
- There are also opportunities to collaborations with players operating outside the healthcare sector. For instance, Halodoc, which operates a mobile platform for patients to access doctors at any time of day, and pharmacy delivery across 50 cities, has partnered with Go-Jek, which operates integrated mobile ride-hailing, delivery and financial services. Together, they launched a telemedicine service called Check COVID-19, which allows Go-Jek users who feel ill to check their symptoms with over 20,000 licensed doctors in the Halodoc system.
- Robotics solutions are being explored in Indonesia too. In April 2020 it was announced that a joint team from the November 10 Institute of Technology (ITS) and Airlangga University Hospital (RSUA) launched a medical assistant robot named RAISA which can be used to minimize contact between medical personnel and COVID-19 patients while reducing the demand for protective equipment. One RAISA unit is estimated to cost USD 6,358.
- The healthcare sector is also exploring the implementation of AI solutions. For example, the Indonesian Ministry of Research and Technology has formed a consortium of local research institutions and universities to tackle the rising number of COVID-19 cases in the country. Among various initiatives, the parties will collaborate on implementing AI solutions for faster testing and for producing CT scans and X-rays.
- In June 2020, the country's president stressed that aggressive contact tracing measures using communication technology - such as mobile GPS – must be introduced quickly, as the country enters a



new phase in the fight against the virus. Some solutions are being experimented, such as the PeduliLindungi app which cross references the data stored on its users' mobile devices through Bluetooth connection enabling an anonymous exchange of information. If a user is found to have been in close proximity with confirmed suspected cases under surveillance, the app identifies them.

3.4 Biotechnology R&D in Indonesia

OVERVIEW

- In spite of being rich in bioresources, Indonesia currently lacks the expertise to realize its potential as a biotechnology hub. A shortage of qualified scientists and concerns over IP protection have traditionally been key constraints for highly innovative biotech companies to emerge, and the local pharmaceutical industry is mainly dominated by manufacturers of generic drugs with low spending on R&D. However, the situation is rapidly evolving as new measures are implemented in the context of the COVID-19 pandemic.
- Historically, Indonesia has had one of the lowest rates of drug consumption in Asia, but pharmaceutical spending per capita has been increasing rapidly in recent years. The surge of chronic illnesses and the growing spending power of the middle class is expected to generate an important demand for drugs and pharmaceutical products.
- Currently, pharmaceutical manufacturers need to import 95% of the necessary ingredients from abroad. The Health Minister said the COVID-19 outbreak has created an opportunity to boost local production of pharmaceuticals and vaccines, and in particular to decrease its reliance on China, which supplies around 60% of the pharmaceutical ingredients used in the country.
- Indonesia requires the compulsory licensing of any non-indigenous pharmaceutical products. This has had the effect of frightening away potential technology partners – which has led to a fall in FDI in biotech ventures, as foreign players are reluctant to have their IP held hostage in a joint venture.
- In February 2019, the government postponed to 2026 the Halal labelling of drugs suitable for consumption in line with Islamic law, following opposition to the measure by the International Pharmaceutical Manufacturers Group and other industry groups. Its implementation in medicinal products will be introduced only in phases, due to the lack of readiness of business players and infrastructure to ensure the production of halal products. Currently, drug products, whether Halal or non-Halal, may still be distributed in Indonesia with the stipulation that information about the materials be included until halal materials and/or halal manufacturing practices are available.
- In March 2020, the Indonesian government announced its intentions to relax standards on drug patents in order to support the country's pharmaceutical manufacturers and encourage patent-sharing.



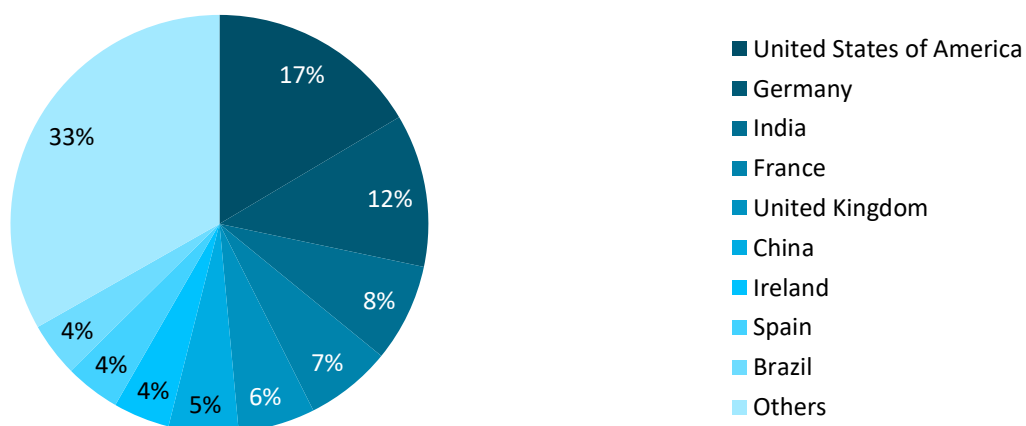


Figure 8: Exporters of pharmaceutical products to Indonesia, % over total, 2018

Source: International Trade Centre

- In order to reduce dependence on imports, the country established a pharmaceutical holding company to supply feedstock for its local pharmaceutical sector. The holding company brings together three state-owned companies, PT Bio Farma, PT Kimia Farma and PT Indofarma which have total asset valued at USD 2.2 billion.
- PT Bio Farma, a state-owned enterprise, is the only vaccine and antisera producer in Indonesia. Currently, 10 of its vaccines are WHO-prequalified. With a production capacity of 3.2 billion doses per year, 50% of the capacity is prioritized for the needs of the country's national immunization program, while the remaining capacity is exported through WHO, UNICEF, PAHO and bilateral cooperation.
- Indonesia has at least 106 laboratories that meet the standards to run PCR tests as proposed by the Health Ministry. Supplying testing kits has proven challenging but the country is developing capabilities to produce PCR kits. For example, in June 2020 it was announced that Jakarta-based East Venture had raised USD 1 million to develop prototypes of PCR test kits.

OPPORTUNITIES

- Indonesia is at the forefront of the efforts for developing a COVID-19 vaccine in the region. PT Bio Farma is the key company of the local consortium that is planning to start a pre-clinical trial for a vaccine. PT Bio Farma and the Eijkman Institute for Molecular Biology completed the first complete genome sequence of COVID-19 in May 2020. PT Bio Farma is also working on a separate cooperation with Sinovac Biotech, China's leading COVID-19 vaccine developer, to obtain the formulation, technology and active ingredients for a vaccine.



- Indonesia needs to secure a minimum of 340 million ampoules of COVID-19 vaccines, and is looking for partner countries for vaccine coproduction. A number of state-owned enterprises are already cooperating with several South Korean companies. Once clinical tests are successful, Indonesia plans to produce vaccine massively as of early 2021. Bio Farma, which exports vaccines to 147 countries, can produce up to two billion doses of vaccines every year.
- Several Indonesian research institutions and universities are part of the already mentioned research consortium led by the Indonesian Ministry of Research and Technology. Members such the Indonesian Institute of Science, the Technology Assessment and Application Agency, the Bandung Institute of Technology, the Bogor Agricultural Institute), and the University of Indonesia are key players to target as they are working on a variety of research projects ranging from creating an ozone-based safe disinfection chamber to developing a non-PCR chain reaction and non-PCR test for COVID-19 detection.
- The co-development of COVID-19 antiviral drugs is another key opportunity area. An example of a successful collaboration is between state-owned Indonesian pharmaceutical company Kimia Farma and United States-based Gilead Sciences which has its experimental antiviral drug Remdesivir in the final stages of clinical trials.
- Collaborations related to plasma treatment trials could also represent an interesting opportunity. In May 2020, it was announced that Indonesia was gearing up for a large-scale trial on convalescent plasma treatment for COVID-19 patients. The Indonesian president said that such treatment will be clinically tested on a large-scale basis in several hospitals. The Jakarta administration also plans to provide hospitals in the capital city with supplies of plasma, with the Indonesian Red Cross in charge of distribution.
- In April 2020, the Indonesian Food and Drugs Supervisory Agency announced that it would follow other foreign food and drug agencies in accelerating the drug registration process using the Emergency Use Authorization platform for any drugs with the potential to treat COVID-19. This includes the registration of any new drugs or existing drugs being repurposed for COVID-19 treatment.



4.0 MALAYSIA

4.1 Snapshot of the Malaysian Healthcare System

- Malaysia has been praised globally for its high-performing health system, attributed to its excellent infrastructure, trained workforce and quality of service delivery. However, the system is facing challenges on a number of related fronts, such as an ageing population and rising incidence of non-communicable diseases.
- Private healthcare facilities are concentrated mainly in urban areas to cater to the upper-middle income population. Even if the public sector is the largest healthcare provider, private services play an increasingly important role, particularly in specialist fields, and are experiencing growing demand due to shorter waiting times and higher-quality services.

Table 7: Number of healthcare facilities, 2018

Types of hospitals in Malaysia	Number (2018)
Public Hospitals and Special Medical Institutions	144
Hospitals	135
Special Medical Institutions	9
Available public beds per 1,000 people	1.4
Private Hospitals	210
Available private beds per 1,000 people	0.5
Available public + private beds per 1,000 people	1.9

Source: Ministry of Health of Malaysia

- Malaysia is spending more on healthcare. For instance, the 2020 budget for the sector increased by 7% compared to the previous year, a trend that is expected to be reinforced by the COVID-19 pandemic. The bulk of healthcare spending in Malaysia is used to construct new hospitals, as well as to upgrade and expand existing ones such as Tengku Ampuan Rahimah Hospital in Klang, Kampar Hospital in Perak and Labuan Hospital in Labuan. A further key strategy is the expansion of cardiology centers at existing hospitals such as in the Queen Elizabeth II Hospital in Sabah.
- The aging population in Malaysia is creating a strong demand in the market for aged care facilities, services and expertise by the general public and private sector. By 2035, Malaysia will be considered an ageing society, with 15% of its population being senior citizens, equivalent to 5.8 million people.
- Malaysia has emerged as the second most important hub for medical tourism in the region after Thailand. The country is now promoting itself as the 'Cardiology and Fertility Hub of Asia'. The state of Sabah is becoming an important hotspot for the industry and is studying the possibility of setting up a dedicated Health Tourism Council.





Figure 9: Location of the state of Sabah

Source: Wiki Commons

- As the COVID-19 pandemic hit the country, bigger private hospitals in the Klang Valley, Penang and Johor demonstrated to have considerable capacity to treat COVID-19 patients, while other healthcare facilities in rural areas struggled to replicate the performance. Malaysia's healthcare capacity was expanded in February 2020, including an 86% increment in diagnostics laboratory capacity, 89% increment in critical care bed capacity, and an 49% increase in the number of available ventilators.
- A significant part of the stimulus package that the country allocated in the context of the COVID-19 outbreak was dedicated to the purchase of medical equipment. Some USD 114 million were set to purchase medical devices such as ventilators, personal protective equipment, lab equipment, and ICU equipment. A further USD 229 million was allotted to purchasing medical equipment and expertise from private healthcare services.
- A significant development to highlight has been the surge in demand for rubber gloves coming from Europe and the US. In effect Malaysia ranks as the number one producer in the world for the product, which has been increasingly demanded in the context of the fight against COVID-19. Tellingly, the net profit of Top Glove, the world's largest manufacturer of natural rubber gloves and surgical gloves, surged 366% year-on-year to USD 81 million for the quarter ended May 31, 2020.

4.2 Medical Devices and Equipment in Malaysia

OVERVIEW

- Malaysia, which hosts around 200 medical technologies manufacturers, has established itself as a global hub for the production of medical devices. With a relatively small domestic market, manufacturers of medical devices in Malaysia activities are mainly for the export market. The country currently supplies 65% and 80% of global demand for rubber gloves and catheters, respectively. Today, it is advancing into the production of more sophisticated devices such as coronary catheters, in-vitro diagnostic devices, cardiovascular devices, and high-end diagnostic devices.
- There is a high concentration of exports in disposables, which make up around 80% of total exports in the segment. Both foreign and local players are established in the medical disposables sector – for example, in December 2019, Japanese medical device company TOP Corporation launched a new manufacturing



company Medijoy International in Tech-Valley Industrial Park in Seremban, its second manufacturing company TOP Corporation is operating in the country. The company produces glass syringes, needles, infusion sets, infusion needles, feeding sets, catheters, anesthesia needles, urine bags, and medical electronic equipment (infusion pumps, electronic thermometers), among others.

- Penang contributes about 77% of the country's total gross output for the manufacture of irradiation, electro medical and electrotherapeutic equipment, and about 22% of the total gross output for the manufacture of medical and dental instrument and supplies. Five of the world's top 25 medical devices manufacturers have operations in Penang.

Table 8: Companies in top 25 medical devices companies' global list with operations in Penang

Company	Country	Operating location in Penang
Abbott Laboratories	United States	Bayan Lepas
Cardinal Health	United States	Bayan Lepas
Boston Scientific Corporation	United States	Batu Kawan
B. Braun Melsungen	Germany	Bayan Lepas
Canon	Japan	Bayan Lepas

Source: Penang Institute

- Large multinational projects will continue to boost investment levels in the country. Interestingly, 21 projects in the medical device industry worth RM2.1 billion were approved in the first nine months of 2019, matching the level of investment for the whole of 2018.
- Some illustrative examples of how the country is moving into more advanced manufacturing is represented by the following:
 - Smith & Nephew's announcement in 2019 of its plans to build a new manufacturing facility in Penang for hip and knee implants
 - The USD 18.7 million investment announced in 2018 by Japan Lifeline to build its first factory outside Japan at the Penang Science Park to manufacture medical devices for cardiac rhythm management, electrophysiology or ablation and cardiovascular surgery for the Japanese market
 - The opening in April 2019 of the Pennsylvania-based ECRI Institute's first medical device evaluation laboratory in Selangor, the first outside the United States
- The COVID-19 pandemic has led non-medical Malaysian companies to venture into medical supplies manufacturing. For instance, SCGM Bhd, a thermoform food packaging manufacturer has expanded its portfolio by developing and mass-producing medical face shields and masks. Members of the Malaysian Plastics Manufacturers Association have been collaborating to address the shortage of personal protection equipment supplies in the country and abroad.



OPPORTUNITIES

- In the wake of the COVID-19 pandemic, Malaysian companies have been active in forming collaborations with American counterparts. Some notable examples include a joint venture formed between three Malaysian listed firms, Sanichi Technology Bhd, AT Systematization Bhd, and PNE PCB Bhd and US-based Arzon Solar LLC (ARZ) to produce medical-grade mechanical air ventilators. The three Malaysian companies are responsible for the production of the ventilators and obtaining the necessary licenses and certifications. ARZ, meanwhile, is responsible for the distribution and marketing of ventilators for both the domestic and international markets.
- The pandemic has also led local manufacturers to explore new solutions such as 3D printing, often with collaborations with American partners. This has been the case for K-One Technology Bhd, a technology solutions provider of Internet-of-Things products and healthcare devices, which is working with a US-based 3D printing technology developer and manufacturer to expanding into 3D printing for nasal swabs amid the overdrive in demand for COVID-19 screening tests.
- With contained costs and a skilled workforce, Malaysia is a compelling production base for the manufacturing of medical products. The country is playing a growing role in the global manufacturing chain for medical devices. Penang is also an established manufacturing location for medical devices.
- Private hospitals should be among key targets for direct sales in the country. An important player in this area is Avisena Group which in 2019 launched the Avisena Women's and Children's Specialist Hospital, which reported to be the biggest private hospital dedicated to women and children in Malaysia, with a total of 133 beds and 52 specialist doctors. In the same year, the group announced its plans for opening three more hospitals over the next five years, with the total capacity of 540 beds. Two of the new hospitals would be built in the Klang Valley while another in Nilai, Negeri Sembilan. Another player that Virginian companies should keep on their radar is IHH Healthcare, a private healthcare group focused on upmarket health services, representing Asia's largest private healthcare group.
- Lastly, Malaysia hospitals that are targeting the country's growing medical tourism are among the most-likely purchasers of advanced medical equipment from Virginia. The Malaysia Healthcare Travel Council has 79 partner hospitals and clinics, of which 21 and 58 are Elite and Ordinary members, respectively. Elite partners represent the most prestigious private healthcare institutions in the country and are accredited by international healthcare accreditation agencies. In 2019 Malaysia selected nine health care facilities under its medical tourism hospital program in a bid to attract more foreign patients.








4.3 Healthcare IT in Malaysia

OVERVIEW

- Thanks to its strength in both the healthcare and IT sectors, Malaysia is committed to the adoption of healthcare IT solutions. The government's eHealth strategy focuses on smart, scalable information and business management solutions within the healthcare sector. This includes investing in integration of healthcare systems, enterprise architecture for the government and healthcare service delivery, and the launch of a data warehouse. In 2017, the government launched the Malaysian Health Data Warehouse (MyHDW), a platform which aims to consolidate health-related data from public and private hospitals and clinics to share health information, including patient medical records in a secure system.
- In November 2018, the Health Minister announced that the government will implement an EMR system in 145 hospitals nationwide by 2021. According to the ministry, around 20% of hospitals in the country have such a system in place, but it is not fully operational yet.
- In 2016, Microsoft Malaysia and the Collaborative Research in Engineering, Science and Technology (CREST) created a first-of-its kind digital health hub in the country. The hub works as a network for industry, academia and government focusing on five areas: telehealth, smart access, remote patient monitoring, drug adherence and corporate wellness.
- DoctorOnCall, a digital healthcare platform by Health Digital Technologies Sdn Bhd, is Malaysia's largest digital health platform that connects patients with an extensive network of over 1,500 Specialists in private hospitals and more than 100 GP doctors throughout the country.

Table 9: Examples of digital health start-ups in Malaysia

App	Logo	Description
DoctorOnCall		Online doctor consultation platform
REMEDi		Online records with historical and current results
Naluri		B2B mental health platform for insurers and corporates
HypoBand		Alerts caregivers when the life of a diabetic patient is in danger
HealthMetrics		Personal assistant to manage employees' health benefits

Source: Orissa International



- As the country was hit by the COVID-19 outbreak, the Ministry of Health (MOH) responded by working with several online health services companies in order to lessen the volume of patients at hospitals and clinics, encourage social distancing and provide the latest health-based information. The companies the MOH worked with are QueueMed, EncoreMed, BookDoc, and DoctorOnCall.

OPPORTUNITIES

- Foreign companies are making considerable inroads in the market by partnering with local players. For example, in 2019, NewWave Health Sdn Bhd (a joint venture company between state-owned Johor Corporation's subsidiary, N2W Corporation and UK-based Smartmed Global Ltd) announced plans to spend USD 4.7 million under its digital healthcare business over the next three years to expand the reach of a healthcare mobile application known as LifeMed. LifeMed is an all-in-one digital app aims to better connect patients with medical solutions by assisting healthcare providers to monitor and engage their patients in real-time as well as for patients to manage their own health conditions.
- Telecommunications companies are also key targets for expansion in the market. A notable case of such a collaboration in the digital health space was formed in February 2020 between DoctorOnCall and Celcom, Malaysia's oldest mobile telecommunication provider. DoctorOnCall plans were embedded into Celcom digital offerings, such as Business Suite for Retail.
- Companies that have developed telehealth solutions are having success in highlighting how their products can cover population in remote areas, which suffer from unequal access to healthcare in Malaysia. An illustrative case is represented by Indian company Apollo TeleHealth Services, which in 2020 started a collaboration with TeleHealthcare Malaysia, under which it will set up 100 tele-clinics to provide remote multi-specialty care and consultation to 3 million people in Malaysia. In addition to providing healthcare services, Apollo has been providing tele-education and telementoring services as well.
- Other players have successfully entered the market by offering AI solutions. One of the most notable is UK-based Prudential, which in March 2019 introduced Pulse, an all-in-one digital app with AI-powered health information in Malaysia. The app features complementary health and wellness services from global and local providers including UK-based Babylon (symptom checker and health assessment), Tictrac (personalized wellness services), Malaysia-based DoctorOnCall (online consultations), and AIME (dengue outbreak predictor). Interestingly, AI solutions for medical application developed by International Medical University of Malaysia were in collaboration with data technology provider Fusionex.
- Moreover, Malaysia is a potential manufacturing base for healthcare IT products. An illustrative example of a company capitalizing on this opportunity is offered by Australian private medical device design and manufacturing company M3DICINE, which in 2018 made Malaysia the production base of Stethee – the world's first AI-enabled stethoscope system. The product is a combination of AI, IoT and a medical device. It was designed to work as easily as a traditional stethoscope, allowing users to listen to heart and lung sounds with sophisticated amplification and filtering technology.



4.4 Biotechnology R&D in Malaysia

OVERVIEW

- Malaysia has built a solid international reputation in the field of biotechnology R&D, and the country is particularly strong in areas such as cardiology, oncology, and infectious diseases, where most of clinical studies are concentrated.
- Most of the clinical trials conducted in Malaysia are Phase III – the testing of a drug on patients to assess its efficacy, effectiveness and safety, and typically the most expensive, time-consuming and difficult trials to design and run.
- In effect, Malaysia is highly competitive in terms of the costs of conducting clinical research at USD 350 per patient per doctor’s visit, compared to USD 1,380 in the United States.
- The top sites for clinical research are the Hospital Pulau Pinang, Sarawak General Hospital and Hospital Kuala Lumpur. The most active sponsors are Novartis, Johnson & Johnson and YSP Industries.

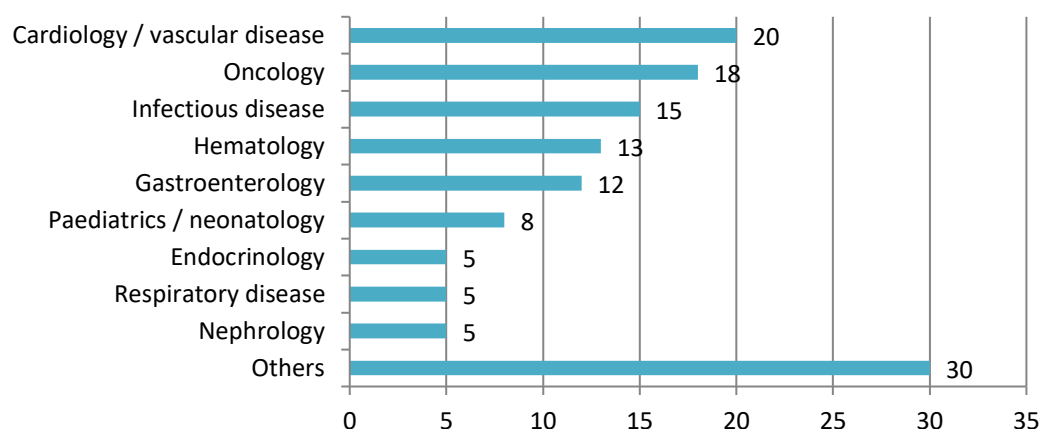


Figure 10: Clinical trials by type in Malaysia, 2018

Source: Clinical Research Malaysia

- In 2017, the country announced its plans to produce the world’s first halal vaccine. The partners involved are Pharmaniaga Berhad, Malaysia’s leading pharmaceutical manufacturer, Delhi-based MSD Wellcome Trust Hilleman Laboratories Private, and an entity under the Malaysian Ministry of Finance known as the Technology Depository Agency.
- In December 2019, a similar announcement was made, when the University of Science Malaysia, and Penang International Halal Hub signed a MoU to launch the world's first halal pharmacopeia.



OPPORTUNITIES

- A potential opportunity is to collaborate with Malaysian players for local production. An illustrative example is offered by Guardion Health Sciences, a US-based ocular health sciences company and its recently acquired subsidiary NutriGuard, which in February 2020 announced it was contracted by Malaysia's Ho Wah Genting Berhad (HWGB) to design, develop and manufacture a proprietary immune support nutraceutical formula for the latter's exclusive use. HWGB requested for the formulation to be made to meet the demands of its customers for an immune-supportive product. The formula is designed to boost type 1 interferon response to RNA viruses.
- A company to monitor is VentureTECH, an investment company established by the Government of Malaysia. In January 2020 it announced plans to expand its investments in Cell Tissue Technology Sdn Bhd. This move is primarily targeted to help boost the tissue engineering company scale up to meet the demand for tissue engineering medical products (TEMPs). Moreover, in July 2020 it was announced that the company will form a joint venture together with Duopharma Biotech Bhd and South Korea-based biotechnology firm PanGen Biotech Inc for the country's first commercial biosimilar production facility in 2024.
- In effect, human tissue processing is an emerging area of the local biotech industry, representing a potential opportunity. In January 2020, Intran Technologies announced a collaboration with Leader Biomedical, the renowned Netherlands based medical devices group, in establishing the region's first private-initiated human tissue processing facility in Malaysia. The two companies partnered with Koperasi Pusat Perubatan Universiti Malaysia Bhd (KPPUMB) as the strategic investor to plan, construct and maintain the center.
- It should also be highlighted that not only public facilities but private players in the country have also significantly expanded their testing capabilities in the wake of the COVID-19 pandemic. For example, in June 2020, B. Braun, one of the world's largest medical technology companies, announced the expansion of its portfolio of testing capabilities at its facility in Penang. The German firm has tripled the facility's testing capabilities for healthcare solutions related to intravenous access, surgical technologies, intravenous systems, central venous puncture and pain control. The site hosts the group's global Centre of Excellence for Intravenous Access with full R&D capabilities, and is B. Braun's Asia Pacific regional headquarters.
- Malaysia aims to become a COVID-19 vaccine-manufacturing county, which means it needs to develop the technology to develop human-related vaccines, a capability that the country currently does not have as it produces only animal-related vaccines. Two government-linked companies - Pharmaniaga and Duopharma Biotech Bhd - which are also pharmaceutical manufacturing facilities, have been identified as potential producers of the vaccine in the country.



5.0 PHILIPPINES

5.1 Snapshot of the Philippine Healthcare System

- From a population of 107 million in 2019, the Philippines is expected to reach a population of 150 million by 2050. Rapid population growth has added pressure to the country to increase the number of healthcare facilities and medical personnel, and to enhance the service level of existing facilities, needs that have become even more urgent as the country battles the COVID-19 pandemic.
- The private sector plays an important role making universal healthcare a reality in the Philippines, as 65% of the country's healthcare services are currently rendered by private providers.

Table 10: Number of healthcare facilities

Year	Number of Hospitals			Bed capacity per 1,000 people
	Total	Government	Private	
2011	1,819	732	1,087	1.0
2012	1,825	730	1,095	1.0
2013	1,454	542	912	0.9
2014	1,222	452	770	0.9
2015	1,195	423	772	0.9

Source: Philippine Statistic Authority

- The country's hospital system is operating at a ratio of less than one bed per 1,000 Filipinos. Large private players have laid out plans to increase this ratio. Some of the most ambitious are those of Metro Pacific Hospital Holdings Inc (MPHHI), the largest private hospital group in the Philippines with a nationwide portfolio of 14 hospitals, with a combined capacity of 3,203 beds. The goal of MPHHI is to have a portfolio of 30 hospitals and 5,000 beds by 2030. It aims to achieve these targets through the USD 700 million raised from global investment firm KKR and Singapore's sovereign wealth fund GIC in October 2019.
- The Philippine government aims to expand health coverage from 92% in 2015 to 100% enrolment by 2022. The county passed a Universal Health Care Law in 2019, which automatically enrolls all Filipino citizens in the National Health Insurance Program. For 2021, the proposed budget is USD 3.6 billion with key focus on HIV-AIDS, nutrition, and pandemic-related programs.
- Hospital beds and any expansion in infrastructure are occurring in the more economically developed island of Luzon, particularly in the National Capital Region (NCR). Out of a total of 101,688 beds, almost two thirds are in the NCR and the rest of Luzon. Only 20% of hospital beds are in Mindanao and 15% in the Visayas.



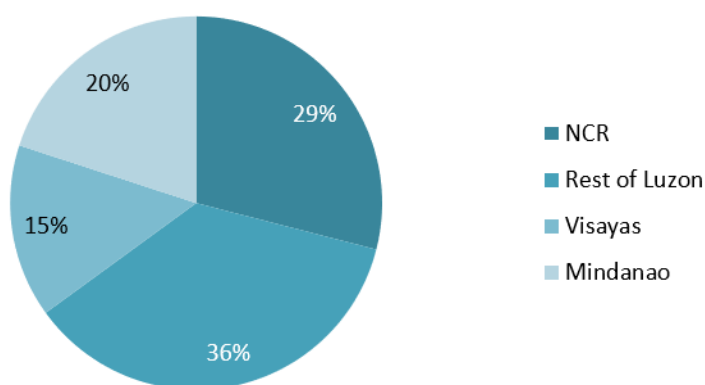


Figure 11: Hospital beds by group of island in the Philippines

Source: World Health Organization

- A further key feature to highlight is that the country is a major exporter of health workers, many of whom migrate abroad in search of better salaries. Consequently the Philippines has a shortfall of health professionals, particularly in rural and poor areas. At the moment, the country has approximately 1 physician per 1,000 Filipinos, while for nurses the ratio is of 1 to 50,000 Filipinos.
- The government has instituted measures to improve the conditions of public health facilities by partnering them with appropriate private-sector entities. These public-private partnerships (PPPs) take various forms, including technology transfer, training, funding and optimizing operational efficiencies.
- In the wake of the COVID-19 pandemic the Department of Health of the Philippines has announced plans to allocate USD 418 million for virus-response or pandemic-related programs as part of the 2021 budget. So far, most infected patients have been admitted to the Research Institute for Tropical Medicine (RITM) or in private hospitals such as The Medical City and St. Luke Medical Center facilities.
- Other players are stepping in to help the country's healthcare system weather the impact of COVID-19. For example, in April 2020, the World Bank approved a USD 100 million loan for the Philippines COVID-19 Emergency Response Project to help meet urgent healthcare needs and bolster the country's public health preparedness. The US also committed to more than USD 2.7 million to support the country.

5.2 Medical Devices and Equipment in the Philippines

OVERVIEW

- There are few local manufacturers for medical devices in the Philippines, making the nation extremely import dependent. Almost 100% of medical equipment and approximately 50% of medical disposables are imported. Local production is limited to accessories, spare parts (including customized parts), and disposables such as surgical gloves, syringes, and needles.



- The Philippine market is markedly price sensitive, which explains the growing presence of inexpensive equipment from China, South Korea and Taiwan. Hospitals with limited budgets tend to source medical equipment largely from these countries, while those with larger budgets, mostly private hospitals, focus on acquiring more sophisticated, higher-end technologies from western markets.

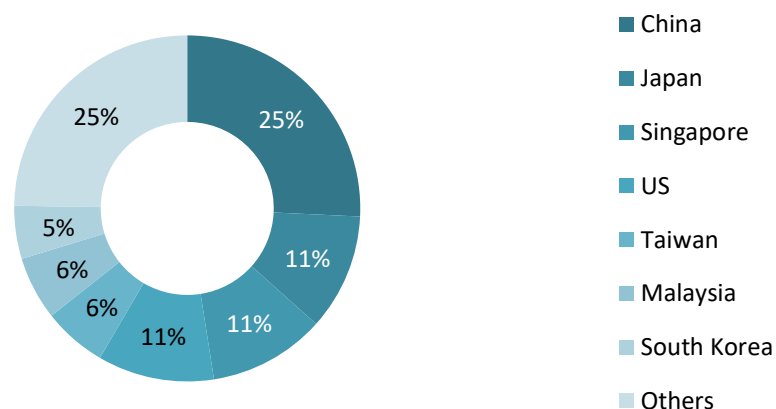


Figure 12: Philippines' imports of medical and scientific devices by supplier, 2019
Source: International Trade Centre

- The market is expected to remain dependent on imports as local production has not expanded significantly in the past several years. Consequently, while imports are forecasted to rise as the country's healthcare budget grows, exports will remain stagnant.
- Public hospitals currently tend to put greater emphasis on preventative healthcare, while private hospitals concentrate on curative services. These trends are also reflected in the purchase orders of medical equipment.
- In March 2020, the Food and Drug Administration and the Bureau of Customs sped up the entry process for importers of medical equipment that are deemed essential to treat patients with COVID-19. The government also launched a series of incentives for local manufactures of protective equipment.
- The lack of access to test kits has been a key constraint in the country's ability to counter the spread of COVID-19 cases. As of March 2020, the Philippines was reported to have only 2,000 kits, with only 1,172 tests have been conducted. However, a team of scientists from the Philippine Genome Center and the UP Manila's National Institutes of Health was able to develop a domestically-produced COVID-19 test-kit which is cheaper than foreign equivalents and can show results in a few hours.

OPPORTUNITIES

- Public-private partnerships (PPPs) could represent viable entry-opportunities, as the government is focusing on such models in order to strengthen the country's health system. A notable example of a PPP is the La Union Medical Center joint venture for access to medical equipment. Under this agreement, private investors provided a hemodialysis machine and other laboratory equipment to the center. This approach has also been adopted by the Southern Philippines Medical Center (SPMC), a tertiary referral hospital in Davao City. Lacking in funding to acquire modern medical equipment to SPMC, the hospital management implemented a PPP under which private partners publicly bid to consign medical equipment such as dialysis machines, computed and digital radiography machines and hematology, chemistry and immune-assay analyzers.
- The Philippines recently approved several bills seeking to upgrade hospital facilities to enhance the delivery of basic health services in order to implement its universal health system – this can translate into opportunities. For instance, in 2019, the country launched a USD 7 million expansion and upgrading project got two major public hospitals in the south, the Upper Valley Community Hospital and the South Cotabato Provincial Hospital.
- The Philippines recently approved a law that allows for the creation of cancer specialty hospitals and clinics by the private sector, creating opportunities for companies to supply cancer-related equipment to these players. Ayala Healthcare Holdings (AC Health) is among the first to benefit from the new ruling – in 2019, it announced a USD 38.3 million project to build the first cancer specialty hospital in the country. The fully integrated, 100-bed cancer specialty hospital will be equipped with diagnostic equipment, chemotherapy facilities, linear accelerators for advanced radiation therapy, and operating rooms for the specialist surgeons. The cancer specialty hospital will be located in Metro Manila, and is targeted to be operational by 2022.
- AC Health represents a key target, as it has a history of collaborations with foreign players. For instance, in 2019, it signed a MoU to build an integrated and advanced health technology solution in collaboration with Philips. The collaboration between the two firms includes the expansion of primary care and other specialty clinics with a total solution proposition such as provision of medical devices, clinical workflow design, software and solutions. Part of the agreement is the necessary training that Philips will provide to AC health including its cutting-edge health technology solutions such as the Lumify ultrasound solution and sleep and respiratory care solutions.
- There is a growing opportunity in the market, given the country's limited ability to manufacture sophisticated equipment. A case in point is offered by Chinese manufacturers ViraxClear, which in June 2020 received its approval certificate from the Philippines FDA for the distribution of COVID-19 Rapid Antibody Test Kits with a contract valued at up to USD 7.5 million for the distribution of up to 1 million kits in the country.








5.3 Healthcare IT in the Philippines

OVERVIEW

- Access to healthcare services remains a challenge for many Filipinos. Divided by many islands, it is difficult to provide an equitable and efficient delivery of medical treatment across the entire country. Aggravating this problem are the shortage of doctors, lack of hospital beds, and unutilized pool of nurses nationwide. Healthcare IT solutions have been identified as key pillars of a more inclusive healthcare system, a strategy that is acquiring a renewed importance in the context of the COVID-10 pandemic.
- The government is currently discussing a bill to create the country's electronic health system. Another bill has been proposed in the parliament for the creation of a Health Passport System which will hold a person's full medical records and associated information.
- Even before the COVID-19 outbreak, the Department of Health (DOH) of the Philippines was taking significant steps in the direction of a wider adoption of ICT solutions. For instance, in 2019, it rolled out a telemedicine program in the Calabarzon Region with the aim of improving health service delivery in identified geographically isolated and disadvantaged areas.

Table 11: Examples of digital health start-ups in the Philippines

App	Logo	Description
Medifi		Cloud-based app for remote doctor and patient consultation
Konsulta.MD		24/7 health hotline service platform
Stash.PH		Claims management platform
MedCheck		Clinical data analytics for non-communicable diseases
MedGrocer		Medicine purchase optimization

Source: Orissa International

- This trend accelerated as the COVID-19 pandemic hit the Philippines. In early April 2020, the DOH developed a framework for telemedicine services in a bid to decongest hospitals, minimize risks posed by unnecessary patient traffic and be able to provide access to health services during the quarantine period. Medical consultations over the phone, chat, SMS, and other audio and visual-conferencing platforms were officially considered as medical services.



- In the same month, the Philippine Medical Association joined the efforts by launching a free online consultation facility – Docph.org – aiming to help ease the huge numbers of patients flocking to hospitals and seeking assistance from healthcare system.

OPPORTUNITIES

- The DOH is a key target as it has recently embarked on numerous collaborations with private-sector players. For example, in 2020, it partnered with Telimed Management Inc. and Medgate in order to launch its round-the-clock telemedicine hotline for Metro Manila residents seeking licensed and certified doctors to provide telemedicine consultations for COVID-19 medical advice and non-COVID-19 health-related concerns.
- The Philippines suffers from a structural lack of healthcare personnel. Therefore, companies that offer solutions to tackle this problem will find a favorable market in the Philippines. An interesting example to highlight is represented by Japan's Cyberdyne, which in 2019 introduced in the Philippines the Hybrid Assistive Limb (HAL), a wearable cyborg-type robot or exoskeleton which provides support and improves the bodily functions of immobile patients with lower limb disability, thereby allowing the patient to require less assistance from nurses, which are scarce in the country.
- E-health solutions are in high demand in the Philippines. For example, in 2020, the government-owned Philippine Health Insurance Corporation (PhilHealth) announced its intention to move towards automation by integrating the agency's information system to streamline processes and prevent fraudulent transactions. According to a press release, the PhilHealth president said that the move was because the agency would be able to reduce fraudulent transactions if it had a perfectly integrated and harmonized information system.
- A recent study from cybersecurity company Kaspersky found that an estimated 76% of devices in healthcare facilities in the Philippines are infected by malicious code. Remarkably, the Philippines has the highest number of infected medical devices in South East Asia, and the second highest in the world after Venezuela. Kaspersky explained that this high percentage not necessarily due to intentional or orchestrated attacks from cybercriminal. Most of the infections found are likely the result of people using USB drives without knowing that they contained viruses capable of doing considerable damage. Given the issue, companies that specialize in e-health security would find a ready market in the country.
- AI solutions are gaining ground in the Philippines, and even more so in the wake of the COVID-19 pandemic. For instance, the DoH partnered with internet-based communication giants Senti AI and Google to centralize its COVID-19 communications nationwide, using an AI-enhanced knowledge management tool. Hospitals are showing a similar trend. An illustrative example is offered by the Baguio General Hospital which is now using scan analyzers with AI technology for COVID-19 detection. The AI analyzers built by Chinese giant Huawei take only two minutes, compared to the current screening test kits that take four to five days.



5.4 Biotechnology R&D in the Philippines

OVERVIEW

- The Biotechnology R&D field in the Philippines has huge potential as the country is starting to show widespread adoption of related technologies. The country is seeing a proliferation of stem cell treatment, genetics and genomics facilities, and increasing R&D activities. Drug discovery and development especially from natural sources has been identified as one of the priority areas under the National Unified Health Research Agenda (NUHRA). The molecular diagnostics market is also witnessing rapid growth due to high adoption of molecular diagnostics tests for infectious diseases applications.
- However, it should be noted that in total, the Philippines spends approximately 0.11% of its GDP on R&D activities. While data on the share of R&D in the healthcare sector not updated regularly, generally this number is lower when compared to regional peers. The country's neighbors, such as Thailand, Vietnam and Indonesia, typically invest close to 2% of their GDP for R&D activities.
- The increasing prevalence of infectious diseases and the upsurge in several chronic disease incidents in the country are leading to greater demand for point of care diagnostic technologies and tests, and improvements in diagnostic facilities.
- The country has a comprehensive drug discovery and development program to respond to the growing health needs of the Filipinos, and to harness the potential of Philippine biodiversity. The Tuklas Lunas R&D Program, a program under the Department of Science and Technology, aims to undertake R&D to identify potential products in the form of standardized herbal supplements, herbal drugs and drug candidates. Specific R&D priority areas for funding include:
 - Development of standardized herbal drugs
 - Management/propagation of organisms that reached at least pre-clinical development
 - Discovery of new drugs from local natural sources for development up to the pre-clinical stage
 - Development and/or validation of standard processes and protocols for various stages of drug discovery and development.
- The Institute of Human Genetics, the largest provider of genetics services in the Philippines, conducts interdisciplinary research on the genetics of monogenic and complex genetic conditions in the Filipino population. It undertakes molecular-based testing for the common genetic conditions, such as cancer, cardiovascular diseases and X-Linked Dystonia Parkinsonism as well as those genetic disorders, which are part of the new born screening program. Meanwhile, the Philippine Genome Center (PGC) conducts R&D activities on health diagnostics, therapeutics, DNA forensics and drug discovery.



- Between 2013 and 2016, the government's funding for clinical and non-clinical trials have more than doubled; however, the private sector's funding for trials is still leading the market. Foreign companies are increasingly exploiting the market gaps for advanced technologies and are introducing new technologies to bring innovative solutions to the Philippine market.
- As an example of the efforts of the government to expand public sector capabilities, in May 2020, the DOH announced that it has submitted a proposal for a creation of the Virology Science and Technology Institute of the Philippines (VIP). The institute will conduct innovative scientific research on viral agents, requiring high or maximum containment. However, the Philippines has not revealed intentions to domestically-develop a COVID-19 vaccine.

OPPORTUNITIES

- There is significant opportunity for interested companies to collaborate with the government, its research agencies, other research institutions and the private sector on R&D activities to further genomics, genetics, stem cell and other biotechnology and life sciences development in the country. Cooperation with domestic players can give Virginian companies access to resources in terms of R&D for new biotechnology applications as well as entry points for commercialization of their products in the domestic Philippine market.
- In 2019, the Department of Science and Technology (DOST) announced its intention to invest more resources in genomics R&D. According to the agency, the goal is for the Philippines to develop the ability to domestically develop more medicines. An encouraging piece of news was reported in July 2020, when the DOST announced that it had received more than 900 R&D proposals to date in 2020, up from 695 in 2019. In the same month, the DOST revealed that it had allocated USD 400,000 for a study to validate and evaluate antibody tests for COVID-19.
- The Philippines is paying more attention to developing human capital, equipment and facilities for biotechnology R&D. More investment is being directed towards the Philippine Genome Centers in Diliman, Visayas and Mindanao, and private-sector players are also joining the race, with medical equipment provider, the Philippine Medical Depot (PMD) establishing a simulation facility for medical schools in 2019. Major technologies used in the medical simulator include a virtual dissecting table and VR solutions which allow students to assess and diagnose patients, develop care plans and evaluate client progress while receiving real-time feedback. DOST has now increased the number of scholarships it offers to 10,000, from just 1,200 ten years ago.
- The recent growth in investment is also attracting a higher number of multinational companies that engage in R&D. An example is George Clinical, an Australian-headquartered clinical research organization with presence in more than 10 countries. In 2019, it expanded its Asia Pacific footprint through the opening of a new office in the Philippine capital, Manila. The company explained the decision citing the Philippines' positive performance in the clinical trial landscape, not only due to a large cohort of treatment



naive patients, but generally good treatment adherence, and a high level of English literacy. George Clinical also highlighted the country's particularly strong track record in the conduct of infectious diseases, metabolic disorders, respiratory and cardiovascular trials.

- It is interesting to note that in May 2020, the government approved Philippines' participation in at least five clinical trials for vaccines against COVID-19, with various Chinese and Taiwanese pharmaceutical groups. Trials of Japanese anti-flu drug Avigan have also begun on Philippine coronavirus patient
- In 2018, the government announced the creation of Philippine Cancer Center (PCC), under the supervision of the Philippine General Hospital, for the treatment and accommodation of patients, and conducting research with universities, hospitals and institutions for cancer prevention and cure, creating opportunities for interested companies to offer suitable technologies for such R&D undertakings.
- One of the positive effects of the COVID-19 outbreak in the Philippines is its role as stimulus for the reinforcement of testing labs' capacities. In May 2020, it was announced that AC Health will open five laboratories for COVID-19 testing following its commitment to help the government ramp up the country's testing capacity. The University of the Philippines Los Baños announced plans to convert its existing research laboratories to become a subnational testing center for COVID-19, while Chinese biotech firm BGI Group opened a new COVID-19 testing lab in Pampanga.



6.0 SINGAPORE

6.1 Snapshot of the Singapore Healthcare System

- Singapore's healthcare system has consistently been ranked as one of the most efficient and advanced in the world. Among its ASEAN peers, Singapore spends the most annually in healthcare on a per capita basis, and today new opportunities are arising as the private sector and the government formulate solutions to counter the COVID-19 pandemic.
- As of 2019, the country relied on a network of 19 acute care hospitals, 9 community hospitals, 1 psychiatric care hospital, 20 polyclinics, 77 nursing homes, 2 inpatient hospices, 2,304 general practitioner clinics, 1,097 public and private dental clinics and 256 pharmacies. As part of an increased overall healthcare capacity, six new hospitals are scheduled for completion by 2022.

Table 12: Number of hospitals by category, 2019

Types of hospitals in Singapore	Number (2019)
Number of acute hospitals	19
Public	10
Private	8
Not for profit	1
Available beds per 1,000 people	2.4
Number of community hospitals	9
Public	5
Not for profit	4

Source: Ministry of Health of Singapore

- The Joint Commission International (JCI) accredited over 20 Singaporean hospitals and healthcare facilities. Prominent international healthcare and research organizations that have established a presence in Singapore such as the American Association for Cancer Research, Duke University, the Healthcare Information and Management Systems Society, and JCI.
- Singapore's healthcare system has been undergoing a system-wide transformation to meet the challenges arising from a fast aging population, a shrinking workforce and the growing burden of chronic diseases. Today, about three in four Singaporean residents aged 65 and above are affected by diabetes, high cholesterol or hypertension. To address these issues, the country is planning to leverage new technologies and redesign its model of healthcare through digitalization.
- In line with this, a recent survey of health by health technology company Royal Philips found that Singapore scores high for technology adoption, with the highest end-use rate of electronic health records in hospitals and ambulatory care, as well as of software solutions for inventory management, computerized physician order entry and clinical decision support system solutions.



- Singapore offers universal healthcare coverage to its citizens through a mix financing system. The public sector dominates the acute care sector, delivering 80% of the services in this segment, while private providers hold the majority of the primary care market.

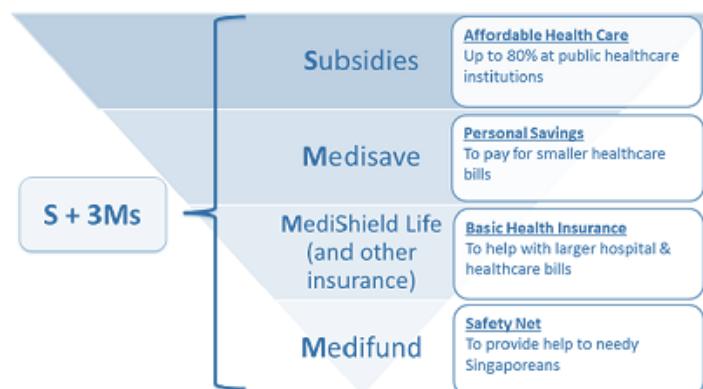


Figure 13: Singapore has a mixed financing system for healthcare

Source: Ministry of Health, Singapore

- Indeed, the city-state's excellent healthcare infrastructure has enabled it to become the life sciences manufacturing and R&D hub of South East Asia. Moreover, Singapore has a vibrant medical startup ecosystem which attracted USD 105 million across 21 deals in 2018. One of the latest local startups to make the news is Endofotonics, which in May 2020 announced an investment of USD 8.6 million for the commercialization of its startup's early gastric cancer detection system in the Asia Pacific region.
- The country is a well-established destination for medical tourism, ranking second in the global ranking of the 2020-2021 Medical Tourism Index. International patients come to the city-state to access a range of advanced medical care services at a convenient price. For instance, a knee replacement surgery costs more than double in the US at USD 35,000 compared to USD 16,000 in Singapore.
- In May 2020, Singapore more than doubled its daily testing capacity for COVID-19 to conduct over 8,000 tests per day, which it plans to scale up to 40,000 per day. It has scaled up its medical facilities by adding capacity at isolation wards and intensive care units, as well as large-scale Covid-19 temporary facilities to accommodate up to 15,000 people. Officials have unveiled a suite of additional measures including onsite medical facilities at all 43 purpose-built dormitories, medical posts that serve factory-converted dormitories housing around 65,000 workers, and 12 mobile medical teams made up of more than 50 medical personnel.
- One of the positive effects of COVID-19 has been the surge of investment directed to companies involved in the production of solutions aimed at countering its spread. For instance, backed by the spike in demand for medical supplies such as gloves and gowns, the stock price of Singapore-listed Medtecs International surged about 408% in May, UG Healthcare by 154% and Top Glove by 114%.



6.2 Medical Devices and Equipment in Singapore

OVERVIEW

- Singapore is a growing medical technology manufacturing hub for global original equipment manufacturers and specialist equipment R&D, designers and manufacturers. Currently, there are about 30 medtech devices manufacturers (mid to large) based in Singapore, with manufacturing activities geared towards global and regional exports markets.
- The country relies heavily on imports for medical equipment, as more than 80% of local demand is met by imports, estimated at approximately USD 12.8 billion in 2019. The US is the leading source, accounting for about 30% of all medical device imports into Singapore.
- Singapore is the major trading hub of the region and as a result, the majority of Singapore imports of medical devices are re-exported to other ASEAN countries and worldwide. It is estimated that around 75% of products imported into Singapore are subsequently re-exported.

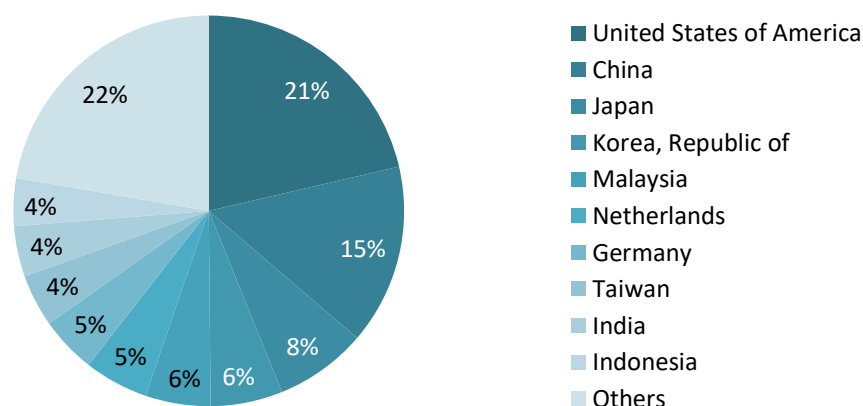


Figure 14: Singapore's exports of medical and scientific devices by market, 2019

Source: International Trade Centre

- Domestic production is focused on advanced equipment and scientific instruments. For example, 60% of the world's microarrays and one third of the world's thermal cyclers and mass spectrometers are manufactured in Singapore. Singapore also counts more than 240 healthcare start-ups in areas such as digital pathology, diagnostic imaging and cardiovascular implants.
- In the context of the COVID-19 outbreak, Singapore enacted an emergency legislation removing regulatory barriers and exempting products from regulatory approval requirements for imports. These products include: hand sanitizers, masks, thermometers, protective gears for medical professionals and respiratory devices.
- Interestingly, the pandemic has led local players to develop new solutions.



- a. In particular, it is reported that local organizations are investing in **3D printing** some of the devices whose demand has increased to the outbreak. One of these is Structo, a 3D printing startup launched by the National University of Singapore which began manufacturing 3D printed nasopharyngeal testing swabs in June 2020.
 - b. Meanwhile, home-grown medical device company Advanced MedTech, which is wholly owned by Singapore's Temasek, has received emergency approval from the Health Sciences Authority for its Alpha ventilator, which is able to provide both invasive and non-invasive oxygen.
- Some companies in Singapore are reinventing themselves as manufacturers of equipment needed to contain the COVID-19 outbreak. For instance, gaming firm Razer announced plans to set up a facility to make face masks.

OPPORTUNITIES

- A key opportunity is to leverage on Singapore's position as is South East Asia's trading hub for medical equipment. Importantly, ASEAN members signed a formal agreement that harmonized medical device regulations in the region, called the ASEAN Medical Device Directive, allowing Singaporean manufacturers and distributors to target a wider market.
- An important target is the Ministry of Health, which is the largest importer of medical equipment in the country, accounting for nearly 70% of local demand, and Parkway Hospitals Singapore, the largest private sector healthcare provider in Singapore.
- The Singaporean government plans to invest in developing advanced healthcare facilities, reinforcing the demand for medical devices and equipment. For example, the National Center for Infectious Disease recently opened a new 330-bed hospital with a high-level isolation unit for treating high-risk pathogens and bio-threat agents. On top of the six hospitals that will be ready by 2022, Singapore will build another four acute hospitals and up to 14 more polyclinics by 2030.
- Singapore offers an ideal environment for the production of advanced medical equipment through a partnership with a local player. For example, following the formation of a partnership with US-based Vyriad, Singaporean player Tessa Therapeutics announced plans to open a 90,000 sq ft commercial-scale cell therapy manufacturing facility in Singapore by end-2020, representing one of the largest commercial-scale cell therapy manufacturing facilities in Asia.
- A further option is to set up manufacturing plants, capitalizing on the expertise and world-class facilities available in Singapore. A case in point is offered by German manufacturer of bioabsorbable orthopedic metal implants, Syntellix, which in September 2019 inaugurated a production site in Singapore's Tuas Biomedical Park. The manufacturing facility hosts the first dry CNC processing of highly advanced magnesium alloys ever performed anywhere in Asia.



- It should also be highlighted that Singapore is particularly strong in the production of laboratory instruments. One of the latest American companies to capitalize on the country's strength in the area is PerkinsElmer, which in 2019 opened its largest manufacturing facility for analytical instrumentation in Singapore at JTC MedTech Hub, a dedicated facility for medical technology manufacturers and service providers.
- Finally, Singapore is an ideal center for start-up financing. A notable example is offered by One BioMed, a Singapore-based medical diagnostics company, which in 2019 raised USD 5 million from Singapore-based venture capital firm and Biopath Ventures, and US-based ARCH Venture Partners.










6.3 Healthcare IT in Singapore

OVERVIEW

- Developing a smarter healthcare sector to tackle rising costs and the challenges generated by an aging population is one of Singapore's key priorities. It is estimated that 70% of Singaporeans aged 50 and above have already engaged in the use of mobile health, thanks to a high smartphone penetration, and the share will further grow as digital health solutions have been massively developed in the context of the COVID-19 epidemic.
- Singaporean hospitals are leaders in the region for the adoption of digital solutions. Importantly, in February 2020 it was recently announced that private players will be enabled to adopt a similar version of the digital medical certificates that public institutions started to use from 2018.
- Singapore is estimated to be home to around 10% of Asia's healthtech startups, the largest number after China and India, attracting a USD 105 million in 2018.
- The government is actively supporting the development of the industry, and in 2019 it launched Singapore Health Technologies Consortium (HealthTEC) to connect academics and industry partners in areas such as health analytics and artificial intelligence.
- One of the local champions in the segment is MyDoc, which has recently been named 2020 Singapore Telehealth Company of the Year by Frost & Sullivan. Founded in 2012, MyDoc creates an integrated online-offline ecosystem for healthcare, removing inefficiencies in the current systems. Aside from Singapore, the company is present in Hong Kong, Malaysia, Sri Lanka, Vietnam, Thailand, India and the Philippines.
- A further important initiative took place in May 2020, when telecom company M1 and SGInnovate, whose mission is to foster startups in Singapore, announced a collaboration to help startups use 5G technology. Moreover, SGInnovate is promoting on its website a set of startups that are being used in the country to tackle the COVID-10 pandemic.



Table 13: Digital health start-ups promoted by SGInnovate

App	Logo	App	Logo
Clinical Decision Support		Telehealth	
Biofourmis		AskDr	
Bot MD		Doctor Anywhere	
Patient Monitoring		MyDoc	
HealthBeacon		Qritive	
Spyder ECG		Speedoc	

Source: SGInnovate

OPPORTUNITIES

- A possible entry route is represented by collaborations with the Singaporean government. An example is offered by American fitness wearables company, Fitbit, which in 2019 announced a collaboration with Singapore's Health Promotion Board to provide the country's 5.6 million people with fitness trackers in a public health initiative called Live Healthy SG. This is Fitbit's first major integration of a digital health platform and wearables into a public health program.
- Other international players have entered the market thanks to investment from SGInnovate. One of such companies is Dublin and Boston-based MedTech HealthBeacon, which developed a connected device for managing medication. The device acts as a 'smart sharps bin' where patients who self-inject medicines at home can toss instruments. The medication schedule is digitally programmed into the bin, which then sends reminders to the patient through SMS.
- Singapore is an ideal launch-pad for regional expansion. For instance, on the back of the growth in demand from the situational originated by the COVID-19 pandemic, in April 2020 Singaporean telehealth company Doctor Anywhere raised USD 27 million in a series B round to drive its international expansion plans in Malaysia and the Philippines as well as strengthening its position in Thailand and Vietnam.
- Robotics solutions are being explored in Singapore to limit reliance on PPE and to tackle the issue of a shrinking workforce. Authorities have been trialing a four-legged robot dog built by Boston Dynamics at hospitals amidst the COVID-19 outbreak in order to enforce social distancing. Alexandra Hospital has launched a robot named "BeamPro" to allow doctors to communicate with patients who are isolated, conduct visits, and deliver medications and food remotely.
- The IoT scene is also benefiting from the wave of new solutions designed to counter the COVID-19 pandemic. In effect, the outbreak highlighted the country's shortage of ventilators and the strain on healthcare professionals managing many ventilators at once, and IoT startups such as Singaporean ABM



are focusing on answering to these challenges. In particular, ABM developed BiWaze ION, the world's first IoT-enabled tele-ventilator which enables healthcare professionals to monitor and adjust ventilator settings through their online portal from any location.

- The COVID-19 outbreak also pushed non-traditional healthcare players to develop new solutions. For instance, in June 2020 OCBC Bank announced the launch of its telehealth application, which enables users (which include non-OCBC Bank customers) to consult doctors online, access digital medical certificates, invoices and laboratory results from the clinics they visited through the app.
- Finally, it should be noted that the Singaporean government has been one of the first to develop and launch a “track and trace” mobile application. TraceTogether uses Bluetooth technology to support contact tracing, by identifying the persons who come in contact with someone who has tested positive or is at high risk of carrying the virus. If the virus persists it is possible that other solutions in this area will be required.

6.4 Biotechnology R&D in Singapore

OVERVIEW

- Singapore is a global R&D hub and today the country counts more than 50 companies undertaking biomedical sciences R&D, including drug discovery, translational and clinical research, in collaboration with key research institutes in Singapore and worldwide.



Figure 15: Biomedical sciences hubs in Singapore
Source: Singapore Economic Development Board



- Much of the current life sciences and biotechnology cluster has taken shape as a result of a top-down effort to develop R&D. Three government agencies – the Biomedical Research Council of A*STAR, the Biomedical Sciences Group of the Economic Development Board (EDB), and the National Medical Research Council of the Ministry of Health – have led sector development.
- Singapore’s leading R&D capabilities have enabled the country to successfully develop COVID-19 test kits. For instance, in April 2020, Singaporean company Biolidics received approval for distribution and sale of a COVID-19 rapid test in the US. In May 2020 it was announced that researchers from the Duke-NUS Medical School invented a test kit that detects the presence of antibodies in one hour and does not require live biological materials or biosafety containment.
- In June 2020, it was announced that scientists at DSO National Laboratories Singapore's defense R&D organization, discovered five antibodies which could potentially neutralize COVID-19.
- In the same month, the government announced that it will set aside over USD 14 billion during the next five years to fund scientific research and boost support for innovation and the commercialization of technologies.

OPPORTUNITIES

- A possible area of opportunity is represented by co-developing a COVID-19 vaccine. The Duke-NUS Medical School is working with US firm Arcturus Therapeutics on a COVID-19 vaccine, and have announced human trials in August 2020. Singaporean vaccine development manufacturer Esco Aster is also working with US firm Vivaldi Biosciences on a COVID-19 vaccine which can be modified within three weeks if the virus mutates. Esco Aster reports to have capacity to produce 10 million doses and could scale up production to produce about one billion doses for the region.
- A further possible opportunity related to COVID-19 is to export antiviral drugs to Singapore. Importantly, in June 2020 the Singapore’s Health Sciences Authority awarded conditional approval for Gilead Sciences Singapore’s experimental antiviral drug Remdesivir, under the brand name Veklury, to treat adults with COVID-19 in the city-state.
- Virginian companies are also advised to consider the fast-growing genetics industry of Singapore. A notable example is the USD 1.2 billion deal signed in June 2020 between Carmine Therapeutics, the first gene therapy company in South East Asia, and Japanese R&D-focused Takeda Pharmaceutical Company for the development of treatments for rare genetic diseases. Interestingly, in 2019, Singapore built the largest Asian whole-genome sequencing databank.
- Several leading American companies have established their R&D centers in Singapore, capitalizing on the country’s capabilities. For instance, in 2019 NeoGenomics, a Florida-based clinical laboratory and pharma services company, and Pharmaceutical Product Development (PPD), a leading global contract research



organization from North Carolina, announced the opening of a NeoGenomics oncology-focused clinical trials testing lab at PPD's lab in Singapore.

- Cell therapy research is another key area for possible collaboration. In April 2019, the Singapore-MIT Alliance for Research and Technology (Smart), which is the research enterprise for the Massachusetts Institute of Technology in Singapore, launched a USD 60 million initiative called the Smart Critical Analytics for Manufacturing Personalized-Medicine (Smart Camp), with a USD 60 million fund for developing advancing cell therapy research in the city-state.
- It should also be highlighted that Singapore is at the forefront of cancer research, with world-class institutes and a dynamic private sector. For example, in June 2020, Zelluna Immunotherapy, a Norwegian company pioneering allogeneic TCR based Natural Killer cells for the treatment of cancer, announced a research collaboration agreement with Lion TCR from Singapore for the development of treatments of virally induced cancers.
- Finally, it is important to keep in mind that Singaporean public agencies have a long history of collaboration with private players. A notable example is the USD 34 million collaboration agreed in 2018 between A*STAR and pharmaceutical giants GlaxoSmithKline, MSD International and Pfizer Asia, in a research program aimed at developing new solutions for driving down drug costs for patients..



7.0 THAILAND

7.1 Snapshot of the Thai Healthcare System

- Thailand is a healthcare leader in South East Asia. Not only is it strong on the domestic side, with more than 99% of the population receiving free healthcare, but it is also a highly competitive destination for medical tourism. Heavy investment continues in the sector. Hospital groups are expanding, and the industry is set to receive even more support in the wake of the COVID-19 pandemic.
- Because of its excellent infrastructure, the country is ranked as the sixth-best in the world for healthcare by the American magazine CEOWORLD. Thailand boasts some of the region's best hospitals, such as Bumrungrad International Hospital and Phayathai Hospital, which has recently invested USD 3.1 million into its Heart Center in an effort to become the foremost cardiac treatment center in Asia. As of May 2019, Thailand has 66 hospitals and healthcare institutions certified by the Joint Commission International.
- However, there are significant regional disparities, and most healthcare providers are clustered around Bangkok (which accounts for around one-quarter of the country's physicians) and several other urban areas and tourism hotspots such as Phuket.
- Generally, the upper-middle class of the population pays for quicker services and better facilities at private hospitals. An exception to this are Thailand's highly regarded university hospitals, which serve people of all levels of society and are often better equipped with new devices and equipment than both public and private hospitals.

Table 14: Number of healthcare facilities, 2018

Types of hospitals in Thailand	Number (2019)
Number of hospitals	1,421
Public	1,074
Private	347
Number of hospital beds	157,072
Per 1,000 people	2.4
In general hospitals	122,470

Source: Ministry of Health of Thailand

- Today, one-sixth of the total Thai population, or more than 10 million people, are senior citizens. By 2030, it is estimated that one in four Thais will be more than 60 years old. Thailand is also becoming an increasingly popular retirement option for foreigners attracted by its agreeable climate, low cost of living, affordable healthcare, and strong service culture. The number of foreigners over 50 who have applied for retirement visas to stay in Thailand almost doubled to nearly 73,000 in 2017, from fewer than 40,000 in 2013.



- In effect, medical tourism is a key segment of the local market, and the country represents the third most important medical travel destination by value, capturing an estimated 28% of all medical travelers in Asia, which come to Thailand for operations ranging from cancer treatments, cardiovascular issues and surgeries, to aesthetic procedures including plastic surgeries and also dental procedures. It is estimated that foreigners contribute to 30% of private hospitals' revenues in the country.

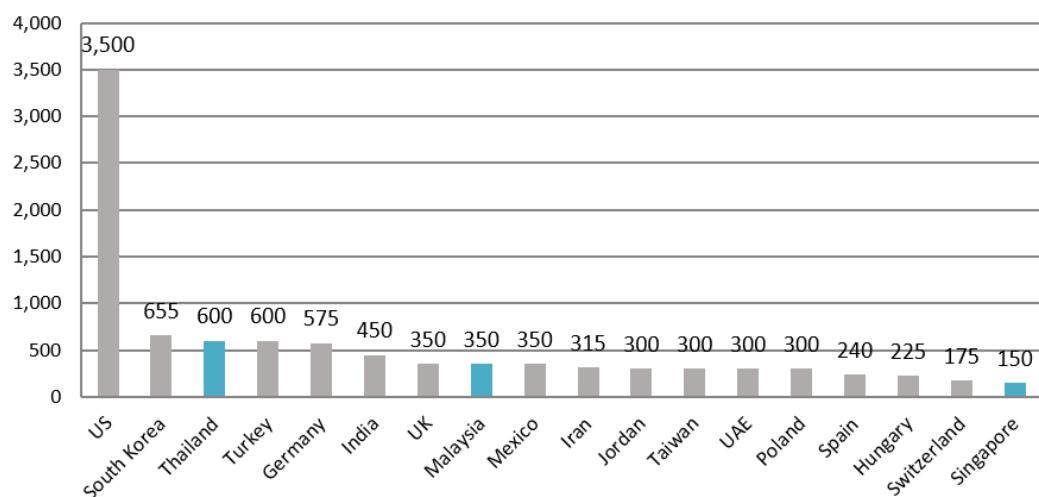


Figure 16: Top medical travel destinations by value, USD million, SEA countries in color

Source: International Medical Travel Journal, 2018

- Johns Hopkins University's 2019 Global Health Security Index ranked Thailand among the top 10 best prepared countries for confronting the COVID-19 pandemic, reflecting the country's public healthcare system's preparedness for coping with major public health emergencies. It is reported that as of July 2020, the country's hospitals are registering a surge of Chinese patients despite a substantial decrease in the number of tourist arrivals.
- The government of Thailand approved the inclusion COVID-19 related treatments into its healthcare coverage program, covering medical expenses incurred at private hospitals too.
- In an effort to better manage the COVID-19 outbreak, in late April 2020, the Thai Board of Investment (BOI) issued new incentives to encourage more investment into the healthcare sector. The latest incentives include a reduction in corporate income tax for qualified investments, measures such as the exemption of import duties for businesses that support existing production lines, and new privileges for the production of raw materials used in the manufacturing of medical products.



7.2 Medical Devices and Equipment in Thailand

OVERVIEW

- Thailand is one of the few countries in the region to possess a domestic medical manufacturing industry, which is estimated to include around 580 local manufacturers. These players supply products to the country's advanced healthcare infrastructure, but are also heavily export-oriented, with over 80% of domestic production being exported.
- The industry is fragmented between multinational companies and domestic players, which focus on the production of single-use devices such as disposable test kits and syringes, and latex products including surgical gloves. However, more Thai companies are starting to produce high-value products such as dental equipment, orthopedic appliances and artificial respirators.
- Thailand has around 2,500 medical device distributors. Many of them have operations in neighboring countries such as Laos, Cambodia and Myanmar, which are key export markets for Thailand, counting for approximately 30% of its medical device exports.
- Despite a large number of domestic manufacturers, approximately two-thirds of medical devices are imported, especially high-grade and sophisticated devices. The US is Thailand's second largest supplier after China, accounting for around 12% percent of imported devices.

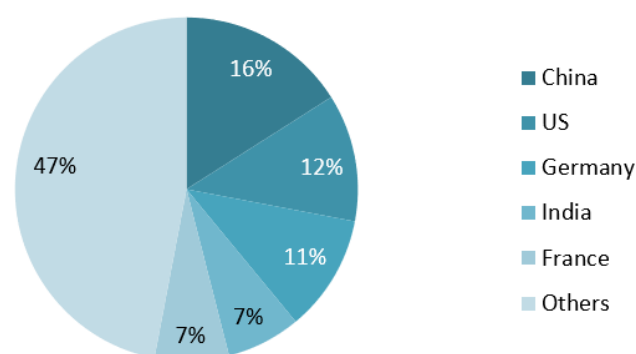


Figure 17: Thailand's imports of medical equipment by value, 2018

Source: Krungsri Research

- In the context of the COVID-19 pandemic, the government has seen the opportunity for Thailand to reinforce its role as manufacturing hub for medical equipment. In effect, the disease has created new demand for the production of consumables, a segment in which Thailand excels.
- Thailand has broadened incentives to support manufacturers of medical equipment in the country. Apart from the standard 3 to 8 year tax holiday, the government is offering a reduction of 50% of corporate income tax for 3 years to companies that produce medical devices and parts. Companies modifying their



production lines to increase the availability of medical supplies in Thailand are also eligible for the expanded incentives.

OPPORTUNITIES

- Private hospitals are expanding in the country, and purchase advanced medical equipment. Bangkok Dusit Medical Center, the largest private hospital group in Thailand, is building Bangkok Hospital Chiangrai, and has a greenfield hospital project in Jomtien, Chonburi province, targeting residents in the eastern region. The Thonburi Hospital Group will build a medical center to provide a range of medical treatments at international standards. Moreover, Vibhavadi Hospital plans to open five hospitals over the next five years, allocating more than USD 26 million to the project.
- Given Thailand's fast aging population, there is an opportunity to supply assistive equipment for the elderly. Importantly, in 2019 the country inaugurated its first city-run hospital for the elderly, the Bang Khunthian Geriatric Hospital. The hospital is located in a coastal district of the capital, and has the capacity to serve 900,000 people per year. The hospital not only offers treatments, but also serves as a rehabilitation venue and has a training center for people who want to study medicine for the elderly and become professional caretakers of old people. The Thai market is also attracting foreign healthcare service providers such as Japan's Sakurajyuji Group which has opened a clinic targeting senior patients in Bangkok.
- It is also worth highlighting that Thai hospitals are known in the region for providing world-class fertility services. Interestingly, Chinese medical tourists are among the most important buyers of such services in Thailand. In effect, countries with developed medical infrastructure such as Japan and Korea have not developed a robust fertility ecosystem because there is little local demand, whereas Thailand has been developing this area of expertise for more than 10 years, to assist medical tourists looking for fertility treatments. There is also a growing market for social freezing, which allows young women to freeze their eggs to use in fertilization procedures later in life, a process prohibited in China.
- Thai institutions and corporations have a long-standing history of partnering with foreign players for the development of new medical devices. A notable example is represented by the collaboration between the Thai Department of Industrial Promotion, and Korean company Mediana, which agreed to a technology transfer to produce automated external defibrillators (AED) for sale in the Thai market.
- A further possibility is represented by sourcing consumables produced in Thailand at competitive costs. As the demand for protective equipment rises in the US, some American manufacturers are tapping into this opportunity. A case in point is offered by Frozen Wheels, a US-based distributor of food and personal protective equipment, which has recently announced the opening of an office in Thailand for sourcing powder-free nitrile examination gloves. This step was taken in response to the challenges faced by healthcare facilities in the US to source quality gloves with FDA approvals in the middle of the COVID-19 pandemic. Frozen Wheels also announced that it is in the final stages to sign two new contracts for a total of 500 million additional gloves that will be in the US by the end of 2020.








7.3 Healthcare IT in Thailand

OVERVIEW

- Because of its digitally-savvy population, IT healthcare solutions were a key focus of the Thai medical industry long before the COVID-19 outbreak, which has helped create momentum for local champions and new entrants.
- Already in 2019 Samitivej Hospital Group, a private player in Thailand with a network of eight hospitals, launched its one-stop Virtual Hospital app, offering three key services: teleconsultations, analysis of blood samples and medicine delivery.
- Thai universities are very active in the development of innovative solutions, as the government has identified the segment as a strategic engine for growth. For instance, in January 2020, Chulalongkorn University handed over three telemedicine robots for deployment at the Bamrasnaradura Infectious Diseases Institute, Rajavithi Hospital and Central Chest Disease Institute, in order to facilitate with the assessment and treatment of infectious diseases.
- With the emergence of the COVID-19 outbreak, Thai hospitals tapped into digital solutions as a way to reduce overcrowding. For example, in May 2020 China's Huawei Technologies and the Thai Ministry of Digital Economy and Society revealed plans to provide AI solutions and 5G technology to Siriraj Public Hospital.

Table 15: Examples of digital health start-ups in Thailand

App	Logo	Description
OOca		Counselling from qualified psychologists and psychiatrists
Brain Dynamics		Computer interface technology for paralyzed patients
Chiiwii Live		Real-time phone consultations for patients in rural areas
Meticuly		Chulalongkorn University's app for 3D printed prostheses
Cerrita		Medical tourism platform that connects patients with medical providers

Source: Orissa International

- The country has also been able to develop competitive IT solutions aimed at countering the spread of the disease. An illustrative example is offered by King Chulalongkorn Memorial Hospital, which is now using



Thailand's first automated COVID-19 test system. The automated test system is 99% accurate and has received the US FDA approval. It can compute up to 1,440 samples per day, with results coming back within 3-5 hours during the initial phase.

OPPORTUNITIES

- Thai private hospitals are at the forefront of the adoption digital healthcare solutions in the region, with several of them collaborating with foreign players. For instance, in 2018 private hospital Bumrungrad Hospital acquired a 30% stake in Singapore-based medical app developer iDoctor for USD 3 million. iDoctor's Raksa app allows patients to consult experienced, certified Thai doctors from some of the best hospitals in Thailand and the US, including Boston Children's, and St Jude's. Moreover, Bumrungrad Hospital has integrated the IBM Watson supercomputer analytics into its oncology department. The IBM Watson has a processing power of 80 teraflops and is used to process patient data, medical literature and guidelines to offer personalized treatments to its cancer patients.
- Hospitals in rural areas are particularly likely to tap into healthcare IT solutions as a way to cope with their low capacity as compared to their urban counterparts. In effect, because of the shortage of medical personnel in such areas, in 2019 the government launched a telemedicine program in 32 hospitals in eight Thai provinces. The program focuses on four main illnesses: high blood pressure, diabetes, heart disease and skin disease as they account for more than 70% of hospital cases in remote provinces.
- Public institutions are also possible targets. One that deserves special attention is the Thailand Center of Excellence for Life Sciences, which in 2019 signed a MoU with American healthtech company, PhenoMx, to develop strategic initiatives for Thailand in the areas of healthcare IT. The MoU includes matchmaking between companies and research institutes in Thailand and the US in order to foster innovation and commercialization. Specific areas of focus include AI, big data, medical imaging with potential projects for ageing-cohort studies, biobanking, and national dementia screening.
- Some healthcare IT players are capitalizing on the country's reputation in medical tourism. A case in point is offered by Chinese healthcare ecosystem platform, Ping An Healthcare and Technology Company, which in December 2019 partnered with Thailand's largest private healthcare group, Bangkok Dusit Medical Services (BDMS), to launch an overseas video consultation service for Chinese patients seeking second opinions. Chinese users can purchase the service from the "Overseas Top-Tier Doctors" on Ping An's mobile application. After purchase, they can make appointments with doctors from BDMS.
- Another opportunity is represented by the launch of 5G networks in Thailand, which allows new solutions to be deployed in the country. Thai mobile operators Advanced Info Service (AIS) and True Corp have already launched 5G networks in 158 hospitals in Bangkok and other major cities around the country, with the primary purpose of aiding local medical institutes in launching telemedicine and robots that reduce the need for direct contact between medical personnel and patients.







7.4 Biotechnology R&D in Thailand

OVERVIEW

- Leveraging on their robust medical systems and high caliber of medical researchers, several Thai agencies and private players have established themselves as leaders in the field of R&D and clinical trials in the ASEAN region. Strong support from the government, coupled with a high-quality and affordable healthcare system, has attracted a large number of biotechnology companies and contract research organizations that have established operations in the country, such as Pfizer, Novartis, Roche, and Sanofi-Aventis.
- Thailand has emerged as a regional hub for clinical trials for cures in high prevalence diseases such as HIV/AIDS, hepatitis, heart disease, cancer, dengue, malaria and infectious diseases, including various strains of flu.

Table 16: Examples of Thai-made vaccines

Cocktail Vaccine (5-in-1) Developed by NSTDA with BIO-NET Asia	Dengue Vaccine, developed by NSTDA	Hemophilus influenzae type b Vaccine, developed by BIO-NET Asia	HIV Vaccine, developed by Mahidol University
			

Source: Board of Investment of Thailand

- Biopolis is a key biotech research hub. Importantly, Thailand's oil and gas giant PTT invested THB 1 billion (USD 32 million) to create the country's first cancer drug production plant in the hub. The plant's commercial operations are set to begin by 2025. Other important biomedical and pharmaceutical R&D players include the Thailand Science Park and National Center for Genetic Engineering and Biotechnology (BIOTEC) and the National Science and Technology Development Agency (NSTDA).
- The COVID-19 pandemic is acting as an engine for further developments in the industry. For instance, Siam Bioscience Co., Ltd. in collaboration with Thailand's Department of Medical Science has produced the first made-in-Thailand RT-PCR test kits for the COVID-19 virus. The test kits, which meet the World Health Organization's standard, has been distributed to medical laboratories across the country for speedy detection of the virus.
- Thailand is also accelerating its efforts to develop a COVID-19 vaccine. In June 2020, it was reported that trials on monkeys have been launched for a COVID-19 vaccine being developed in Thailand, after positive results were seen in mice. The vaccine is being developed by the National Vaccine Institute, the Department of Medical Science and Chulalongkorn University's vaccine research center.



OPPORTUNITIES

- The R&D environment in Thailand is very dynamic, with private companies playing a key role. For example, a new player that is entering the market is CP Medical Center Co. Ltd., a subsidiary of the Charoen Pokphand Group, Thailand's largest conglomerate, which is building a USD 455 million medical center equipped with an R&D center for biotechnology. The construction of the medical center is targeted for completion by 2021.
- Thai public hospitals are also open to R&D collaborations with private companies. For example, in 2019, Siriraj Hospital, the oldest and largest hospital in Thailand, signed an agreement with Thai-owned US-based Nirvamed to set up a research and innovation laboratory center at the Faculty Of Medicine in Siriraj Hospital. This was to develop and conduct research on a Rapid and Localized Heart Cooling Technology developed by Nirvamed before an actual tested prototype is available for submission for international regulatory approvals. The collaboration involves technology transfers and will help Thai companies meet international standards such as those set by the US FDA.
- A further opportunity is to take part to clinical trials in Thailand by collaborating with local players. An interesting case is offered by CytoDyn, a late-stage US based biotechnology company developing leronlimab (PRO 140), a CCR5 antagonist with the potential for multiple therapeutic indications, which in 2019 announced an agreement with Thai Red Cross AIDS Research Centre for the design and conduct of a pre-exposure prophylaxis (PrEP) clinical trial of leronlimab (PRO 140) in subjects at high risk of HIV infection.
- Thailand is on the brink of becoming the first South East Asian nation to legalize medical marijuana, hoping to become a powerhouse in a globally exploding market, which represents a new opportunity in the market. In January 2020, Rafarma Pharmaceuticals become the first American company to enter the Thailand cannabis industry, signing a joint venture agreement with local company MTP Material. MTP is a leading researcher and producer of cannabis and medical marijuana in Thailand and has an exclusive research agreement with Khon Kaen University. As part of the agreement, Rafarma gained access to Khon Kaen University's state of the art research, production and medical clinic facilities.
- Lastly, an interesting company to monitor is Siam Bioscience Group, which in March 2020 confirmed that it is developing new drugs for cancer, kidney failure, and autoimmune diseases, to be ready for commercial use by 2022. The company researches, develops and manufactures biopharmaceuticals with the aim of reducing Thailand's dependency on imported active ingredients and drugs. It has also entered into a partnership with Cuba's Center for Molecular Immunology to develop monoclonal antibodies to treat cancer and autoimmune diseases.



8.0 VIETNAM

8.1 Life Sciences in Vietnam

Snapshot of the Vietnamese Healthcare System

- Although Vietnam lags behind its regional peers in terms of quality of healthcare, a surge in foreign investment in the sector has improved the standards of its healthcare facilities. In effect, increasingly liberal government policies have triggered shifts in the entire healthcare system. Today, the Vietnamese market is considered one of the fastest growing in Asia.
- Vietnam is seeing a rise in chronic and non-communicable diseases such as diabetes, cancer, cardiovascular diseases and mental disorders. It is estimated that up to eight out of 10 deaths in Vietnam are from NCDs. Foreign players are entering the market by providing services in this area. For instance, in 2019 French pharmaceutical company Servier signed an agreement to initiate a 2-year project to improve blood pressure monitoring and diabetes control in Vietnam.
- Vietnam ranks among the 10 fastest-aging countries in the world. It is forecasted that it will take no more than two decades for Vietnam to raise the rate of people aged 65 and above to 14% from the current 7%.
- Vietnam’s healthcare system has a mixture of public and private elements. The country’s public insurance scheme provides coverage to around 90% of the population, and requires that a patient obtains lower-level hospital referral in order to get treated at higher-level hospitals. Otherwise, the patient is not entitled to a full reimbursement of the treatment expenses.

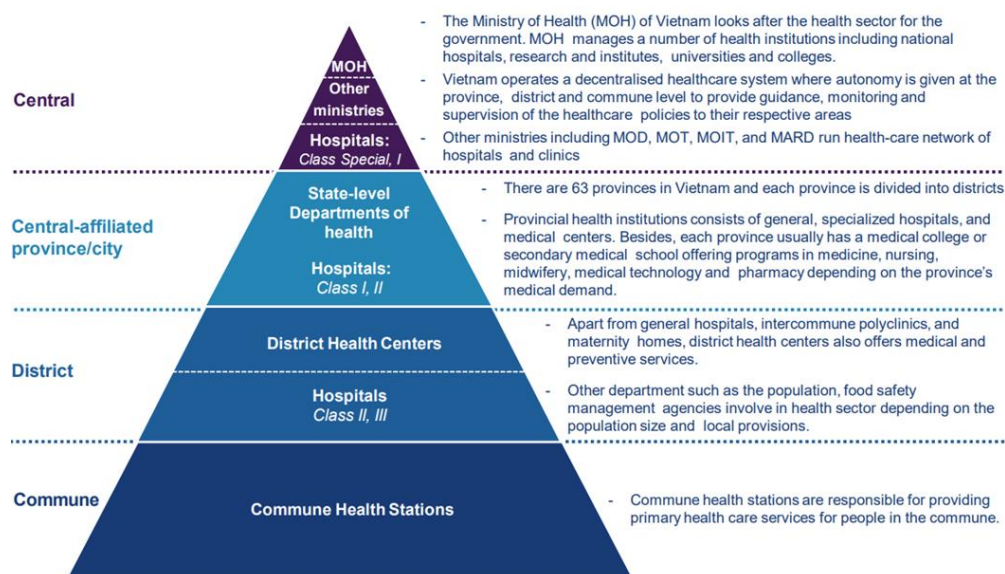


Figure 18: Organizational structure of hospital and healthcare system in Vietnam

Source: WHO, Vietnam-s Ministry of Health



- Most public healthcare services are located in Hanoi and Ho Chi Minh City, which represent around 80% of the total medical market. Urban hospitals operate at 200% or more of their full capacity during peak times because they attract patients from neighboring provinces, while rural hospitals and health establishments are generally under-utilized.

Table 17: Number of hospitals by category, 2018

Types of hospitals in Vietnam	Number (2018)
Public	1,150
Central	47
Provincial	419
District	684
Private	182
Total Public + Private	1,132
Available beds per 1,000 people	2.6

Source: World Health Organization, CIA

- Hospitals play a central role in Vietnam. The World Health Organization estimates that hospitals account for more than 50% of total healthcare visits in Vietnam, and consume more than 95% of total health insurance spending, as the majority of people visit hospitals as their first point of contact.
- Vietnam allows foreign investors to establish wholly foreign owned hospitals. There are no restrictions imposed on foreign qualified doctors to practice in the country, nor are there any restrictions on foreign backed insurers to offer healthcare plans. French and US companies are those that have invested the most into hospitals in Vietnam. The government aims to grow the number and size of private hospitals because of the public sector's limited budget and capabilities. In fact, the steady influx of investments and increasingly liberal government policies have triggered shifts in the entire healthcare system.
- An increasingly large number of wealthy Vietnamese citizens travel abroad for medical treatment. It is currently estimated that every year USD 2 billion is spent by over 40,000 Vietnamese patients travelling abroad for healthcare services, with Singapore, Thailand and Hong Kong being the most popular destinations for medical services.
- Vietnam has been highly successful in its management of the COVID-19 pandemic. The country has taken a targeted approach to testing, scaled up testing in areas with community transmission, and conducted three degrees of contact tracing for each positive case. It has also implemented mass quarantines and lockdowns, and strengthened hospital procedures to prevent infection in health care settings.



8.2 Medical Devices and Equipment in Vietnam

OVERVIEW

- The Vietnamese medical equipment market has been registering a strong growth, with the government investing heavily in healthcare infrastructure to meet an increasing demand and reduce overcrowding in central urban areas. Estimates of the market value range from just under USD 1.2 billion to approximately USD 1.4 billion in 2018. Today, Vietnam's medical equipment market, despite being relatively small in the global context, is considered one of the fastest growing in Asia. Crucially, the country is heavily reliant on international suppliers: more than 90% of medical equipment is imported.
- The Vietnamese government encourages the import of medical equipment because local production cannot meet demand. Imported equipment has therefore low import duties and no quota restrictions. Furthermore, a large share of the existing medical equipment in public hospitals needs replacement, in particular equipment for surgery and intensive care units.

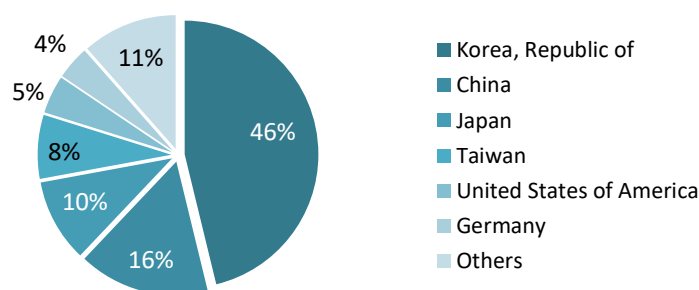


Figure 19: Vietnam's imports of medical and scientific devices by supplier, 2018

Source: International Trade Centre

- Local production is extremely limited in terms of value, but volume levels are rising. There are presently around 50 domestic firms producing approximately 600 products officially licensed by the Ministry of Health. Domestic production is focused mainly on medical beds and cabinets or other offerings such as dressings, plastic gloves and syringes.
- The largest buyers are government-funded hospitals. Foreign-owned hospitals and clinics are also large purchasers; however, these facilities usually purchase supplies from their country. Local private hospitals account for the strongest growth in demand.
- It is interesting to note that the COVID-19 outbreak as led manufacturers to expand the range of their products. For instance, Vietnamese conglomerate Vingroup, has designed two invasive ventilator models, and is self-producing or localizing up to 70% of the components including the blower, boards (PCBA controller, power), keyboard, display, battery and case. The design of these ventilators is based on a community-shared design by Massachusetts Institute of Technology, Vsmart VFS-410.



OPPORTUNITIES

- It should be highlighted that a growing number of international manufactures are setting up production facilities in Vietnam in order to reap the benefits of low labor costs and a growing domestic market. Examples of such global players include Germany's B. Braun, one of the largest medical device manufacturer in the world which has around 2,000 employees in Vietnam; Swiss company Sonova, a leading manufacturer of hearing care solutions which has set up a manufacturing hub in Vietnam; and American company Terumo BCT, a global leader in blood management, blood safety, therapeutic apheresis, cell therapy and cell collections, and which has a staff strength of about 1,600 in a state-of-the-art facility in Vietnam.
- Large hospitals in Ho Chi Minh City, Hanoi, Hue, Danang and Can Tho should be priorities for medical technology exporters. Foreign-owned hospitals and clinics are also large purchasers – a number of American hospital groups also operate in the country, and could be ideal targets. One example is American International Hospital (AIH), one of the best hospitals in Ho Chi Minh City, designed and operated to American hospital standards. With its capacity of 120 beds, AIH is equipped with modern medical facilities. Local private hospitals show the strongest growth, while research and educational institutions will also account for some of the demand.
- It should also be noted that there is strong support from the government to encourage joint-venture projects between local manufacturers and foreign companies to enable skills and technology transfer in biotechnology and medical devices. The government has stated plans to shift away from low-end consumable devices towards advanced manufacturing and in-vitro diagnostic technology.
- Interestingly, Vietnamese corporate giants like Vingroup, FPT and Mobile World are racing to open drugstores, creating new opportunities for companies offering over-the-counter medical devices. A particularly fast growing player is Pharmacity, a leading Vietnamese drugstore chain based in Ho Chi Minh City, which celebrated the opening of its 200th store in May 2019, an increase from just 100 stores in April 2018. The chain grew an average of 15 stores per year from 2011. The company announced plans to enlarge its network to more than 1,000 stores across Vietnam by 2021.
- A more niche opportunity is represented by the booming dental hygiene market. Dental clinics in Vietnam have started to adopt technologically updated dental equipment. Local dentists report that a dental implant worth USD 4,000 in the US costs only USD 1,000 in Vietnam. More and more foreigners are traveling to Vietnam to take advantage of its high quality, highly affordable dental care, with around 100,000 foreigners visiting the country each year for dental procedures. Local players are trying to capitalize on this growth. For example, the Ho Chi Minh City Odontology Hospital has plans to establish a dental tourism club, specializing in providing aesthetic dental services to tourists.
- Lastly, it should be highlighted that, as the country ages, there is a growing demand for more assistive devices for the elderly. Importantly, Vietnam has developed the 2017-25 action plan for the elderly, which



requires that all city-level and provincial-level hospitals have a gerontology faculty and even a separate specialized center for older patients.

8.3 Healthcare IT in Vietnam

OVERVIEW

- As one of the developing countries with the highest rate of ICT adoption and lowest cost of ICT use, the country has tremendous potential for digital health. The government is actively promoting digitalization to raise the quality of healthcare service providers and ease the load on central hospitals. Telemedicine is seen as an innovative solution to aid underserved communities, and its popularity is growing.
- A crucial development took place on July 2019, when Vietnam launched its electronic medical records database nationwide. 100% of public hospitals have now installed hospital information system (HIS). While some hospitals have an internal information technology team to develop HIS internally, the majority utilize solutions developed by local IT companies such as FPT (the largest private ICT company in Vietnam), Links Toan Cau, Dang Quang, and OneNet.
- Ho Chi Min City is at the forefront of the adoption of digital healthcare solutions in the country. In 2020, it launched a pilot project for a new smart health operation center, which connects, gathers and integrates data from relevant agencies, hospitals and other health facilities. It uses AI to analyze, monitor and predict the spread of diseases in the country. Cameras have been installed at 48 hospitals and connected with the center, which has also helped with sharing of information to deal with the COVID-19 outbreak.

Table 18: Examples of digital health start-ups in Vietnam

App	Logo	Description
eDoctor		Vietnamese app connecting users with medical professionals
Mosia		Peer-to-peer platform for mental health and qualified counselling
BuyMed		e-commerce platform for clinics and pharmacies
Jio Health		online pharmacy with teleconsultation and employee health check-ups
Bsgiadinh.vn		Booking app for home visits and nursing services

Source: Orissa International



- In 2019, the Ministry of Health signed an agreement with FPT Corporation to apply and develop medical information technology for the national hospital network over the 2018-2028 period. This partnership is expected to lead to the digital transformation of the entire sector. FPT's hospital management solutions have already been implemented in over 200 hospitals and medical clinics around Vietnam, including foreign-invested international hospitals.
- Vietnamese enterprises have been coming up with new technologies and apps to complement the country's e-health growth. An interesting development in the market is represented by the Microsoft Health Innovation Lab in Ho Chi Minh City. Founded by the CLAS Expara Vietnam Accelerator (CEVA) in partnership with Microsoft, the Microsoft Health Innovation Lab brings together an ecosystem of industry partners such as local and global digital health companies, biomedical multinationals, academia, as well as venture capitalists which help to connect and lead the digital transformation of hospitals and health facilities

OPPORTUNITIES

- Over the past few years, the government has recognized the need to address the existing challenges within the healthcare sector through prioritization of integration of Electronic Medical Records (EMR) and Health Information Systems (HIS); provision of remote medical service/ telemedicine; creation of medical databases; standardization and interoperability of Health Management Information Systems (HMIS); and introduction of unique patient IDs, smart patient management cards and electronic health insurance cards. Multiple plans have been laid down, while a handful of initiatives have started. It is in fact an opportune time for companies to showcase their capabilities to the Vietnamese market.
- Local companies such as telecommunication providers are partnering with foreign players specialized in digital health. An example is ViettelPay (part of Vietnam's largest mobile carrier Viettel) which in October 2019 formed a partnership with Singapore-headquartered telehealth startup, Doctor Anywhere, to bring a full suite of its online healthcare services to ViettelPay's more than six million registered users throughout Vietnam.
- Doctor Anywhere also has a collaboration with a Vietnamese insurer, which represents another potential avenue for companies targeting Vietnam. In 2019, the Singaporean start-up signed an agreement with local insurer Bao Minh Insurance to provide online healthcare services to its seven million customers in Vietnam. The agreement will deliver a suite of on- and offline healthcare services, including video consultation, medication delivery and home-based healthcare services. Users will be able to have a teleconsultation with a Vietnamese doctor on their phone and get their medication delivered to them within three hours. A similar deal was signed in 2019 between Singapore-based digital healthcare platform MyDoc and Vietnamese insurer BaoViet Group.
- Apps specifically designed to counter the COVID-19 outbreak are successful products in Vietnam. For instance, in April 2020, Vietnam launched a telemedicine application, developed by Viettel, the



Vietnamese telecom multinational, to combat the virus by providing remote medical consultations and lessening the burden on hospitals.

- Hospitals in urban areas are those mostly heavily under pressure by the inflow of patients at peak times such as those caused by the COVID-19 pandemic, and represent key targets for companies offering healthcare IT solutions. An example of a successful collaboration is represented by the one between Royal Philips and Hong Duc General Hospital in Ho Chi Minh City, which in 2019 announced a seven-year partnership covering digital solutions, among others.
- Telehealth is a growing area of opportunity. An example of a foreign player entering this segment is offered by Russia's Center of Corporate Medicine, which in 2018 entered a collaboration with Vietnam's Dr. Binh Tele Clinic for telehealth related to emergency first aid, chronic disease management, and prevention of occupational and malignant diseases. The agreement aims to provide healthcare for laborers in enterprises, especially in the field of chronic disease management and prevention of malignant and occupational diseases.
- The B2B segment represents a further market opportunity. An interesting case is offered by Beowulf Blockchain, a US-based B2B platform providing communication services via a decentralized cloud network of computing resources worldwide. In June 2020, it started a partnership with Vietnamese pharmaceutical distributor, CHAN TAN Pharma, to record drug data on Beowulf's Blockchain. This partnership will also enable CHAN TAN Pharma to provide enhanced customer service and training to pharmacies and medical offices across Vietnam via Beowulf's QUICKOM solution.

8.4 Biotechnology R&D in Vietnam

OVERVIEW

- Vietnam R&D's capabilities are low compared with those of developed western countries, but the nation is investing in this area, especially in vaccine development in the wake of the COVID-19 pandemic. It should be noted that the majority of Vietnamese pharmaceutical companies tend to produce generic drugs, and thus do not need to undertake clinical trials, hence there is greater potential in undertaking clinical trials for new drugs being introduced by foreign companies into the market. The growth in the biotechnology R&D market has positively impacted the demand for advanced laboratory and clinic equipment and information systems for research, diagnostics and treatment.
- Vietnam largely depends on imports of pharmaceuticals as most local companies lack R&D capabilities. However, there are some bright areas. For instance, Vietnam has successfully produced 12 out of 13 types of vaccines used nationwide, and today it has around 200 pharmaceutical manufacturers with WHO Good Manufacturing Practice certification.



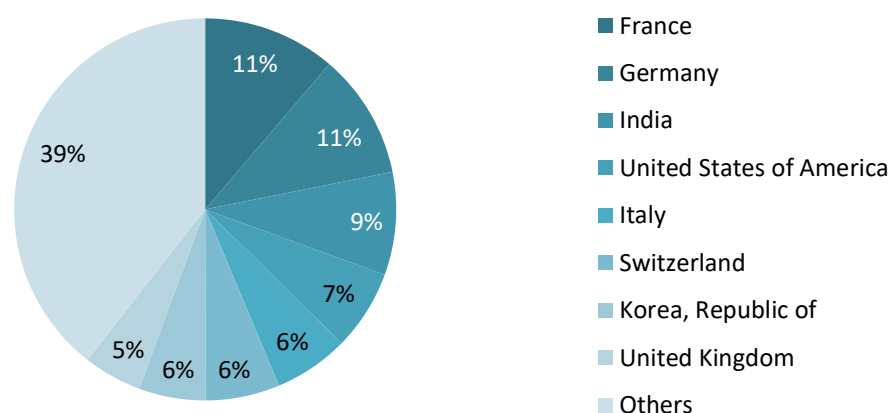


Figure 20: Vietnam's imports of pharmaceutical products by supplier, 2018

Source: International Trade Centre

- Foreign companies dominate the R&D arena, and they include Abbott (which acquired Glomed Pharmaceutical Company Inc., a leading Vietnamese drug manufacturer), Bayer HealthCare Pharmaceuticals (which has been present in Vietnam for more than 20 years), B.Braun, and Taisho Group.
- Interestingly, in 2019, the European Chamber of Commerce in Vietnam stated that the country has the potential to become a center for the research-based pharmaceutical industry including production, export and supplies of high quality healthcare services in the ASEAN region.
- Examples of local companies investing in R&D include SaVipharm, which in 2020 announced the construction of a high-tech R&D center in Ho Chi Minh City costing USD 8.7 million, and TH Group, which in 2019 revealed plans for a new hi-tech healthcare complex with an R&D center in Hanoi, which is expected to cost more than USD 1 billion.
- A notable project was launched by the Vingroup Innovation Foundation (VINIF), which announced a fund for COVID-19 research projects by the Pasteur Institute in Ho Chi Minh City, the Institute of Preventive Medicine and Public Health, and The Company for Vaccine and Biological Production No 1 (Vabiotech). The Vietnamese-German Center of Excellence in Medical Research is also working on clinical trials for a COVID-19 drug.
- Although still an emerging field in Vietnam, a search of ClinicalTrials.gov, an American database of privately and publicly funded clinical studies, uncovered over 120 clinical trials that include Vietnamese sites in some capacity. Clinical trials in Vietnam have mostly been focused around certain specific therapeutic areas. The most important therapeutic segments considered for conducting clinical trials in Vietnam are: communicable and infectious diseases; respiratory and lung disease; gastrointestinal disease; immune disorders; metabolic and liver diseases; and neurology.



OPPORTUNITIES

- The Saigon High-Tech Park in Ho Chi Minh City is attracting some of the leading players for biotechnology and R&D. They include Sanofi, which as a plant worth USD 75 million, and Nipro Pharma Corporation, Japan's biggest prescription drug contract manufacturer, which has a USD 300-million plant meant to increase the company's capacity for R&D and medical equipment production.
- The country's leading R&D players, both in the public and private sector, could be important buyers of technologies. They include the Institute of Biotechnology and the Military Medical University in Hanoi, which are intensive users of microarrays, high-resolution electron microscopes and mass spectrometers. These centers are working on proteomic and genomic research to develop treatments for diseases such as diabetes, high blood pressure and cancer. Private companies such as Vabiotech and NanoGen are working on cheap cancer treatments and vaccine development.
- Key targets also include foreign institutes such as Vietnam's two offices of the US Centers for Disease Control and Prevention (CDC), a branch of the Oxford University Clinical Research Unit, and multiple branches of the Pasteur Institute from France. In May 2020, the CDC committed to an initial USD 3.9 million for activities to support COVID-19 prevention, preparedness, and response in Vietnam. These initial resources are being used for laboratory testing, field investigations, surveillance, data analysis, and infection prevention and control.
- It is important to highlight that although the segment is overall at its early stages of development, Vietnamese players have solid skills related to R&D for tropical and infectious diseases, with well-known institutions such as the National Hospital of Tropical Diseases in Hanoi. Thanks to its capabilities, Vietnam has developed ready-to-export test kits for COVID-19, which have been approved by the UK and the WHO. Among the first nations set to receive the country's COVID-19 test kits are Iran, Finland, Malaysia and Ukraine, according to the Ho Chi Minh City Customs Office. The kits were created after research was conducted by scientists at the Vietnam Military Medical University, and are produced by the Viet A Technology Joint Stock Company.
- R&D related to non-communicable diseases represents a further area of opportunity. A very active player in this segment is AstraZeneca, which is working with the Hanoi Center for Disease Prevention and Control. Moreover, AstraZeneca is collaborating in clinical trials with partners through its network of more than 130 research sites nationwide, in which the National Cancer Hospital is one of the key partners.



APPENDIX: EXPORTS FROM VIRGINIA

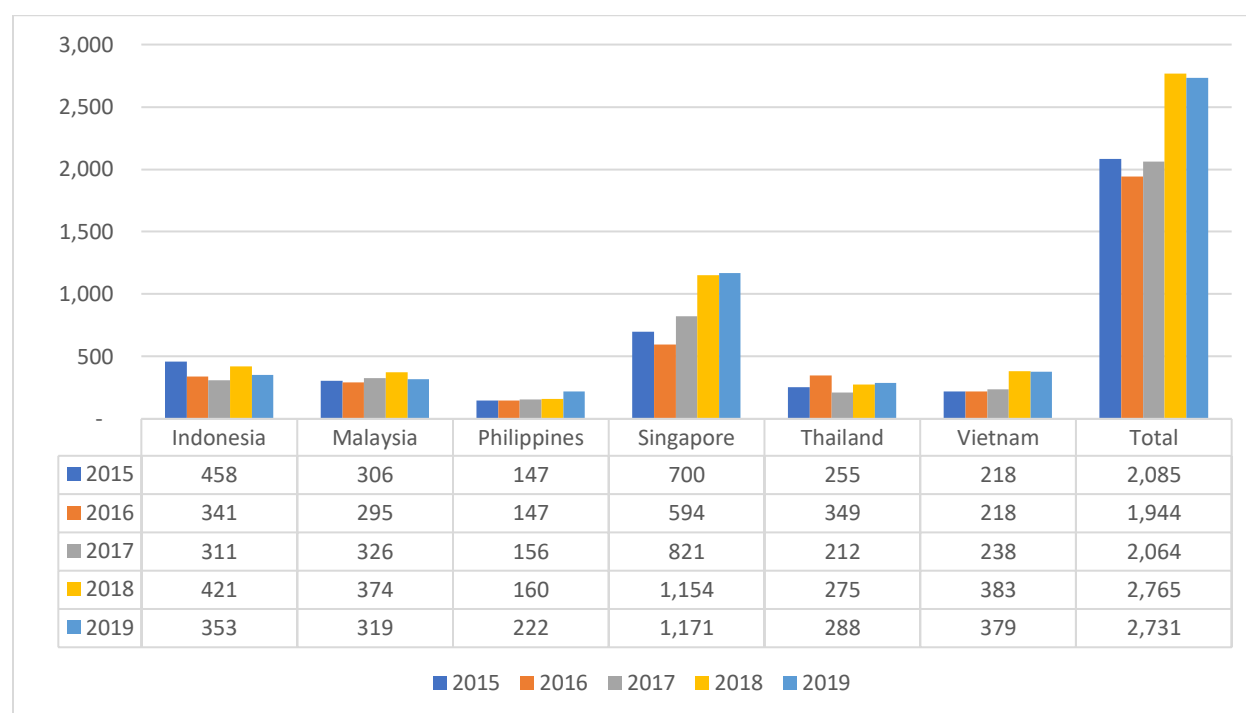


Figure 21: Exports from Virginia (USD million)

Source: United States Census Bureau

Table 19: Top 10 export items from Virginia to the six major South East Asian markets – Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam

Item (2-digit HS code and description)	Total export value from 2015 to May 2020 (USD million)
85 Electric Machinery Etc.; Sound Equip; Tv Equip; Pts	233.0
12 Oil Seeds Etc.; Misc. Grain, Seed, Fruit, Plant Etc.	80.8
55 Manmade Staple Fibers, Incl Yarns & Woven Fabrics	27.3
23 Food Industry Residues & Waste; Prep Animal Feed	15.3
39 Plastics and Articles Thereof	17.8
84 Nuclear Reactors, Boilers, Machinery Etc.; Parts	23.1
88 Aircraft, Spacecraft, And Parts Thereof	29.5
44 Wood and Articles of Wood; Wood Charcoal	25.0
48 Paper & Paperboard & Articles (inc Papr Pulp Artl)	11.2
47 Wood Pulp Etc.; Recovd (waste & Scrap) ppr & pprbd	12.3

Source: United States Census Bureau



Table 20: Top 5 export items by total export value from 2015 to May 2020

Indonesia	Malaysia
55 Manmade Staple Fibers, Incl Yarns & Woven Fabrics	85 Electric Machinery Etc.; Sound Equip; Tv Equip; Pts
23 Food Industry Residues & Waste; Prep Animal Feed	12 Oil Seeds Etc.; Misc. Grain, Seed, Fruit, Plant Etc.
47 Wood Pulp Etc.; Recovered (waste & Scrap) ppr & pprbd	84 Nuclear Reactors, Boilers, Machinery Etc.; Parts
12 Oil Seeds Etc.; Misc. Grain, Seed, Fruit, Plant Etc.	76 Aluminum and Articles Thereof
39 Plastics and Articles Thereof	39 Plastics and Articles Thereof
Philippines	Singapore
23 Food Industry Residues & Waste; Prep Animal Feed	85 Electric Machinery Etc.; Sound Equip; Tv Equip; Pts
48 Paper & Paperboard & Articles (inc Papr Pulp Artl)	88 Aircraft, Spacecraft, And Parts Thereof
84 Nuclear Reactors, Boilers, Machinery Etc.; Parts	84 Nuclear Reactors, Boilers, Machinery Etc.; Parts
85 Electric Machinery Etc.; Sound Equip; Tv Equip; Pts	39 Plastics and Articles Thereof
02 Meat and Edible Meat Offal	90 Optic, Photo Etc., Medic or Surgical Instruments Etc.
Thailand	Vietnam
12 Oil Seeds Etc.; Misc. Grain, Seed, Fruit, Plant Etc.	44 Wood and Articles of Wood; Wood Charcoal
39 Plastics and Articles Thereof	56 Wadding, Felt Etc.; Sp Yarn; Twine, Ropes Etc.
88 Aircraft, Spacecraft, And Parts Thereof	02 Meat and Edible Meat Offal
84 Nuclear Reactors, Boilers, Machinery Etc.; Parts	52 Cotton, Including Yarn and Woven Fabric Thereof
23 Food Industry Residues & Waste; Prep Animal Feed	84 Nuclear Reactors, Boilers, Machinery Etc.; Parts

Source: United States Census Bureau

