

Special theme: from Labs to Jobs: ensuring access and equity in Covid-19 vaccination

TRADE IN VACCINES AND RELATED INPUTS: A STUDY OF THE ASIA-PACIFIC REGION

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This study contains an analysis on trade and trade barriers related to vaccines and vaccine inputs in the Asia-Pacific region. The results indicate that there was significant intraregional trade in vaccine inputs during the period 2000–2020. While vaccines remained duty free or at low tariffs in many countries within this region, several non-tariff measures from the pre-COVID-19 period still continued. The secondary data research is supplemented with the findings from a survey of stakeholders concerned with vaccine production and trade in India. The following are recommendations based on the study: diversification of import sources of vaccines and vaccine inputs; lowering of tariffs; reduction in export restrictions; and the use of trade agreements to ease trade restrictions.

Keywords: Vaccines, Vaccines Inputs, Covid-19, Asia-Pacific, Tariff, Non-Tariff Measures

JEL classification: F13, I18, H51

I. INTRODUCTION

The COVID-19 pandemic took the world by surprise, resulting in huge demand and supply shocks in different sectors, especially in the health-care sector. During the pandemic, production and availability of COVID-19 vaccines became most relevant as they provided hope for containing the pandemic. While the role of vaccines in prevention and control of outbreaks of infectious diseases is well established, not all countries are capable of producing them (OECD, 2021). Limited domestic capacities combined with infrastructural and policy bottlenecks have often resulted in vaccine stockouts in many countries (WTO, 2020). In several such cases, international trade has been instrumental in overcoming these challenges (OECD, 2021). Despite immense potential for global expansion of vaccine markets and WTO (2020) reporting a five-fold increase in traditional vaccine trade since 2005, many regulatory hurdles remained, which affected their trade flows. Regulatory restrictions combined with other forms of tariff and non-tariff measures (NTMs), purportedly aimed at protecting public health, affect the availability, accessibility, and affordability of vaccines and hence the immunization rates across countries. Accordingly, the mechanism linking trade and vaccine availability remains an important aspect worth exploring (Helble and Shepherd, 2017).

In this context, this paper contributes to the literature through the analysis of trade flows, trade barriers and trade policies related to vaccines and vaccine inputs in the Asia-Pacific region. Selection of the Asia-Pacific region for this study is attributable to its rising trade share for vaccines and vaccine inputs over the past two decades, second only to the trade flows reported by Europe and Central Asia. In fact, the rise in export and import shares of vaccines and vaccine inputs have been higher in the Asia-Pacific region than the corresponding increase reported globally.¹ This paper provides a broad analysis of trade trends and patterns of vaccines and related inputs in the region while identifying the major trading countries and their key trading partners. To better understand the current and future trade related issues concerning vaccines and related inputs, this study also includes a survey of key stakeholders in India, a significant player for vaccines in the region.

The rest of the paper is structured as follows: section 2 includes a discussion on the trends and patterns of trade in vaccines and related inputs; section 3 provides an analysis of trade policies with a focus on tariff and non-tariff barriers; section 4 presents key findings from a survey of key stakeholders in India; and section 5 concludes the paper with policy recommendations.

¹ Authors' calculations from the World Integrated Trade Solution (WITS) (<https://wits.worldbank.org>).

II. TRADE TRENDS AND PATTERNS OF VACCINES AND RELATED INPUTS

In 2021, the World Trade Organization (WTO) secretariat published the Joint Indicative List (WTO 2021a) of the critical inputs for the manufacture, distribution, and administration of COVID-19 vaccines (see table 1). To study vaccine inputs trade, the analysis is based on this list, as it is the only available comprehensive list for vaccine inputs.² The list consists of 54 products under vaccine manufacturing (VM), eight under vaccine administration (VA) and four under vaccine storage and distribution (VSD), covering 66 critical inputs related to COVID-19 vaccines. The products listed under VM are further categorized into active ingredients, inactive ingredients, other ingredients, consumables, equipment and products for packaging purposes.

Table 1. Classification of critical COVID-19 vaccine inputs

Category	Subcategory	Number of products listed
Vaccine manufacturing (VM)	Active ingredients	1
	Inactive ingredients	22
	Other ingredients	8
	Consumables	12
	Equipment	8
	Packaging	3
Vaccine administration (VA)		8
Vaccine storage and distribution (VSD)		4

Source: WTO (2021a).

Note: HS2017 classification is used for categorizing the products. The classification is based on a list of 83 products, six of which have HS2017 codes missing; some products within the group of VM are repeated and one product, identified as an equipment in the VM category (Code 842230) does not have the data. Thus, trade related data are available for only 66 products. Detailed description for each product is provided in the appendix. (see table A.1)

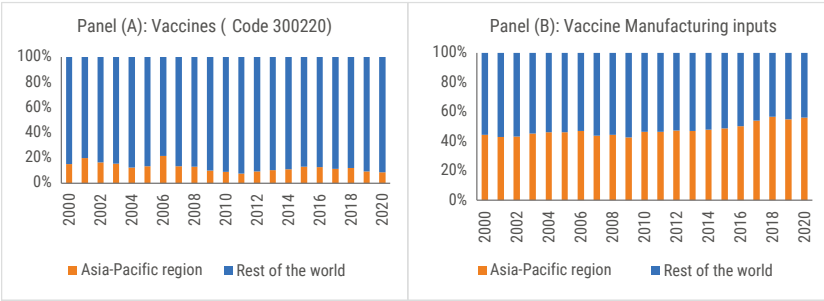
² The list was jointly produced by the Asian Development Bank (ADB), the Organisation for Economic Co-operation and Development (OECD), the World Customs Organization (WCO), some COVID-19 vaccine manufacturers, researchers Chad Bown and Chris Rogers, the Coalition for Epidemic Preparedness Innovations and DHL.

The HS17-HS96 correspondence tables are used to identify the HS96 product codes so that their trade patterns can be analysed for the years over the period 2000-2020. In the process, the active ingredient, namely HS product code 300220, is separated out from the list of VM products as it represents vaccines (for human medicines) and then the trade-related trends, patterns and policies for this product code are analysed.

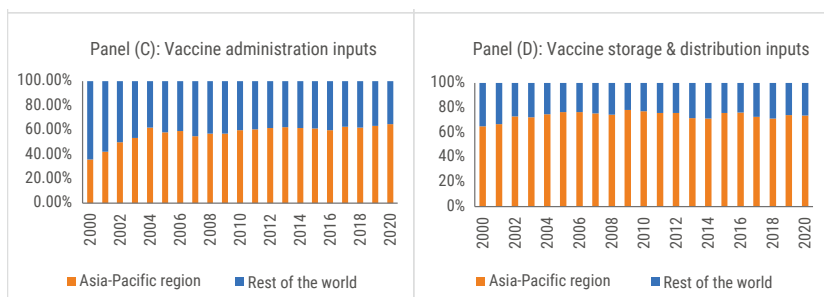
An analysis of trade data on vaccines (HS Code 300220) indicated that global exports of vaccines have steadily increased over time, though a majority of the trade shares were held by developed countries.³ The Asia-Pacific region remained a net importer of vaccines during the period 2000–2020, with rising imports over recent years. Most of the Asia-Pacific countries were also net importers of vaccine inputs, except China, Japan and Singapore, which were net exporters of VM inputs; China, Indonesia, and the Republic of Korea, were net exporters of VA inputs, and China, Malaysia and the Republic of Korea were net exporters of VSD inputs. On the other hand, major importers of VM and VA inputs have been China and Japan, and for VSD inputs, Japan and Hong Kong, China have held major shares. Thus, within the Asia-Pacific region during the period 2000–2020, few of the major trading countries for both vaccines and vaccine inputs have been China, Japan and the Republic of Korea. The major trading countries of vaccines and vaccine inputs and their trading partners are reported in the appendix (see table A.2).

It was also found that almost three fourths of the VSD input imports were intraregional (see figure 1). Contrary to the intraregional sourcing of vaccine inputs, the Asia-Pacific countries have reported very high import dependence on the rest of the world for vaccines. These findings imply the potential for greater intraregional trade ties to facilitate trade in vaccine inputs and improve the availability of input for vaccine production in the region.

Figure 1. Import dependence of vaccine input groups and vaccines of Asia-Pacific countries from within the region vis-a-vis from the rest of the world



³ Authors’ calculations from WITS.



Source: Data extracted from the World Integrated Trade Solution (WITS)

Notes: The data have been segregated based on trading partners being the world or Asia-Pacific countries; trade with the rest of the world has been computed as the difference in total import (in trade values) between the world and the Asia-Pacific countries. The import shares have been computed as a percentage of total imports from either the Asia-Pacific region or from the rest of the world, for each product category.

To infer the extent of import dependence of the individual countries within the region, the Herfindahl-Hirschman indices (HHI) are calculated for their import of vaccines (see table A.3 in the appendix) and vaccine inputs (see table A.4 in the appendix). The vaccine-related indices show that only a few countries have exhibited concentrated sourcing of imports. While import concentration was higher in 2020 compared to that in 2015 for countries, such as Brunei Darussalam, Georgia and Myanmar, many other countries in the region reported lower import concentration in 2020. Some notable examples of this were Australia, Azerbaijan, Cambodia, Fiji, Kazakhstan and Sri Lanka. Similar index calculation for vaccine inputs show that different countries exhibited different levels of diversification in their import dependence, depending on the type of vaccine inputs considered. While countries, such as Mongolia, reported concentrated import dependence, China and Turkey reported more diversified sources of imports. The HHI values in 2020 are greater than their values in 2015 for many of the selected countries, implying that the import concentration of vaccine inputs for these countries was higher in 2020 than in 2015.

III. TRADE POLICY ANALYSES FOR VACCINES AND VACCINE INPUTS IN ASIA-PACIFIC

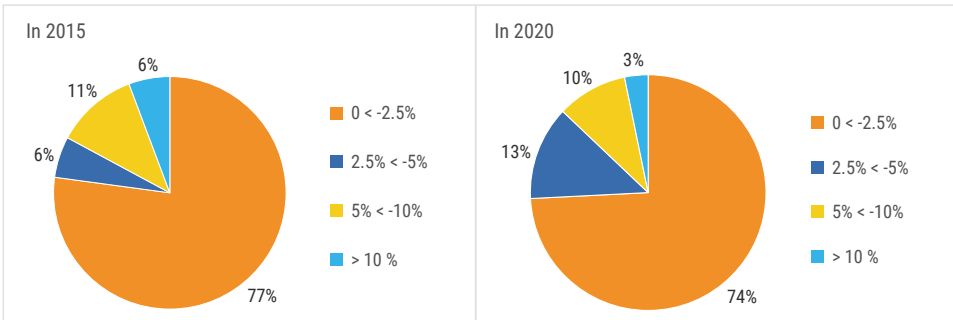
The analysis of trade policies (tariff and non-tariff barriers) and resultant bottlenecks for vaccines and vaccine inputs is important as the delay of a single input can significantly disrupt the process of vaccine production and hamper supply chains. This section contains a discussion of the trade policies pertaining to vaccines and their inputs in the region.

3.1 Analysis of tariff barriers

The highest effectively applied tariff rates⁴ imposed by any Asia-Pacific country on vaccines during the 2015–2020 period was by India at 10 per cent in 2015, which declined to approximately 8 per cent the following year. In the Asia-Pacific region, the effectively applied tariffs have remained relatively high in only a few countries or territories, such as India, Pakistan and French Polynesia. On the other hand, such countries as Australia, Singapore Viet Nam and a few others kept vaccines duty free during this period. It is worth mentioning that the tariffs imposed on vaccines have usually been much lower than those imposed on vaccine inputs.

Figure 2 shows that the majority of Asia Pacific countries imposed very low tariffs on vaccines. Compared to the conditions prevailing in 2015, fewer shares of countries reported most favoured nation (MFN) tariffs greater than 10 per cent in 2020 and a larger share of countries reported MFN tariffs between 2.5 and 5 per cent. From 2015 to 2020, MFN tariff rates were reduced in some countries, such as Pakistan (MFN tariff from 6.7 to 3.7 per cent), Kazakhstan (from 2.9 to 0 per cent) and the Russian Federation (from 2.9 to 2 per cent), whereas some countries increased their MFN tariffs on vaccines during this period, such as China (from 0 to 3 per cent), Palau (from 0 to 3 per cent), Armenia (from 0 to 2 per cent) and Kyrgyzstan (from 0.7 to 2 per cent).

Figure 2. Latest applied most favoured nation tariffs on vaccines, by duty range (% of reporting economies) in 2015 and 2020



Source: Data extracted from the WITS , corresponding to country-level MFN applied rates imposed on vaccines

⁴ WITS uses the concept of effectively applied tariff, which is defined as the lowest available tariff. If a preferential tariff exists, it is used as the effectively applied tariff. Otherwise, the MFN applied tariff is used. Thus, effectively applied tariff is equal to the MFN applied tariff unless a preferential tariff exists. (Source: http://wits.worldbank.org/data/public/WITS_User_Manual.pdf, pg. 95, pg. 127).

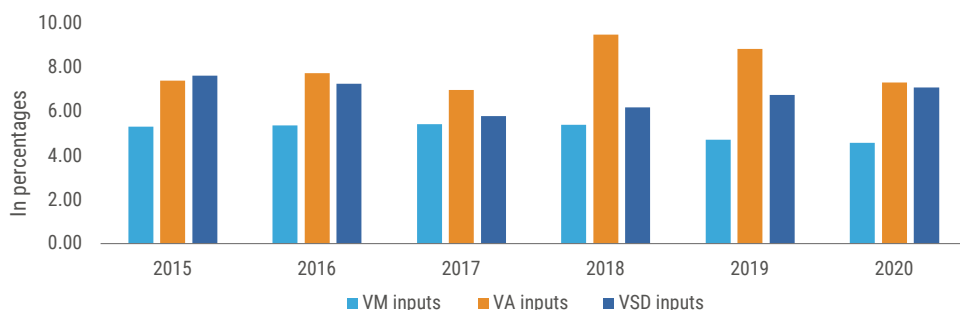
(Code 300220), during 2015 and 2020.

Note: The pie charts represent the percentage of Asia-Pacific countries reporting MFN tariffs as per the tariff bands mentioned. Two years, 2015 and 2020, corresponding to pre and post pandemic times, are selected for comparing the share of countries reporting high versus low tariffs.

A cross-country comparison of the effectively applied tariffs on vaccine imports shows that within the Asia-Pacific region, India, the Islamic Republic of Iran, Mongolia, Pakistan and French Polynesia, have been the most restrictive, while most other Asia-Pacific countries and territories, have not applied any tariffs (see table A.5 in the appendix).

To identify and analyse trade barriers arising due to tariffs on vaccine inputs, country-level data was extracted on effectively applied tariffs, considering the rest of the world as the trading partner. In addition, the researchers also extracted data on -Bound and MFN applied tariffs.⁵ Cross-country simple averages of effectively applied tariffs for each vaccine input group are presented in figure 3. As is evident, during the period 2015–2020, VM inputs have reported the lowest range of applied tariffs, with slight reductions since 2018. VA or VSD vaccine inputs reported relatively higher rates of applied tariffs during this period. While the average applied tariff on VA inputs has slightly declined since 2018, the applied rates on VSD inputs have increased, especially since 2017.

Figure 3. Comparison of effectively applied tariff rates across vaccine input groups (in percentage)



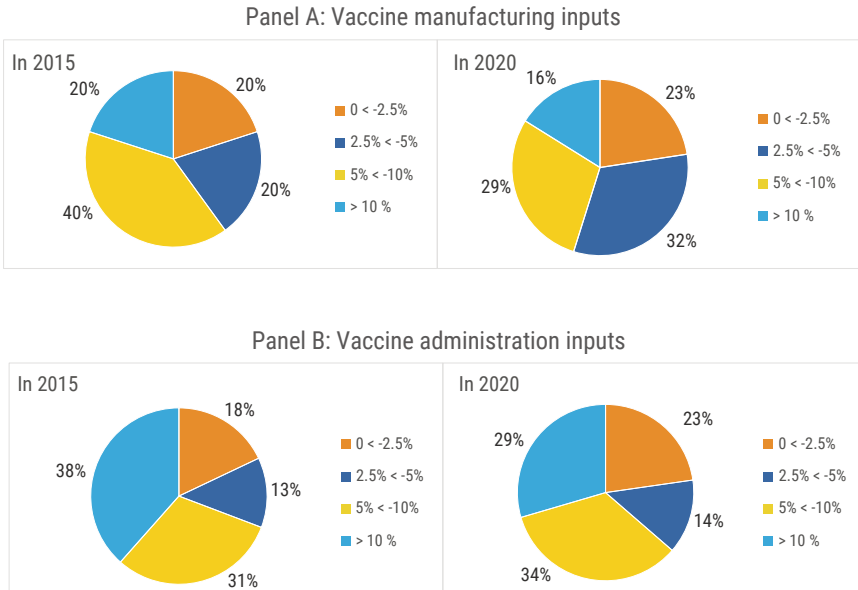
Source: Data extracted from the WITS corresponding to the effectively applied rates imposed by the Asia-Pacific countries on the three vaccine input groups, during the period 2015–2020. The tariff rates reported here are computed as the average of the tariff rates reported by all countries in the region as of a particular year.

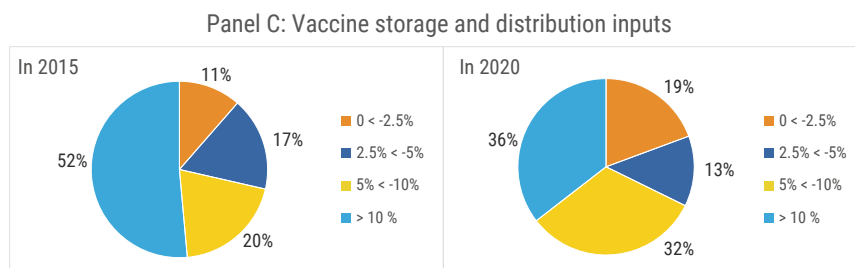
⁵ The analysis is based on countries reporting a minimum number of observations on tariff data.

Among the Asia-Pacific countries, Indonesia imposed the highest simple average of the effectively applied tariffs imposed on VM inputs in 2017. During this period, the average effectively applied tariffs had been high in Maldives, Afghanistan, and India, whereas Brunei Darussalam, Georgia and New Zealand maintained relatively low levels of effectively applied tariffs. Singapore, Hong Kong, China; and Macao, China have remained duty free for VM inputs during this period.

Figure 4 shows the share of countries reporting high versus low tariffs, as of 2015 and 2020. Panel (A) shows that a fewer proportion of countries reported MFN tariffs greater than 10 per cent in 2020 and a larger number of countries reported MFN tariff rates between 2.5 and 5 per cent in 2020. Panel (B) shows that fewer countries reported MFN tariffs greater than 10 per cent in 2020, while more countries reported lower MFN tariff rates compared to those in 2015 for VA inputs. The change in the share of countries reporting low tariffs signifies a reduction in trade restrictiveness across the region. Panel (C) shows that far fewer countries reported MFN tariffs greater than 10 per cent in 2020, while a larger share of countries reported MFN tariffs less than 2.5 per cent or between 5 and 10 per cent compared to those reporting in 2015.

Figure 4. Applied most favoured nation tariffs on vaccine inputs, by duty range (percentage of reporting economies) in 2015 and 2020





Source: Data extracted from the WITS, corresponding to country-level MFN applied rates imposed on vaccine inputs, during the period 2015–2020.

Note: The pie-charts represent the percentage of Asia-Pacific countries reporting MFN tariffs as per the tariff bands mentioned. Two years, 2015 and 2020, corresponding to pre and post pandemic times, are selected for comparing the share of countries reporting tariffs as per different tariff bands.

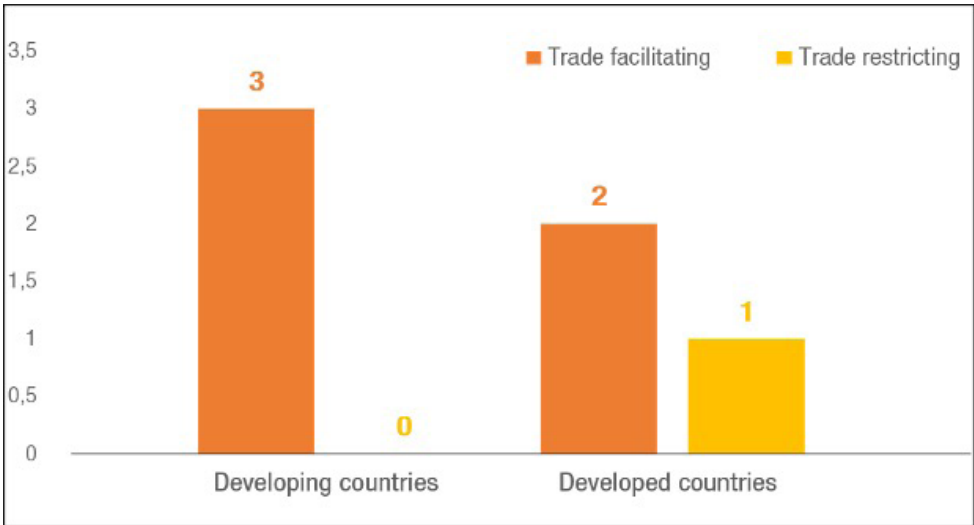
Across the sample of Asia-Pacific countries covering the 2015–2020 period, it was found that the highest effectively applied tariffs have been imposed on inactive ingredients, ethanol, chemically pure sucrose or consumables, such as liquid storage bags of polymers of ethylene and plastics while the lowest tariffs were imposed on equipment, such as chromatography systems or ingredients, such as potassium chloride in bulk, neomycin and cholesterol. Australia, the Lao People's Democratic Republic and Turkey have maintained low average rates of effectively applied tariffs. Brunei Darussalam, Georgia Malaysia; New Zealand, Singapore, Hong Kong, China and Macao, China remained duty free for VA inputs during this period.

3.2 Analysis of non-tariff measures

Non-tariff measures play an important role in global trade of medical goods, including vaccines. These have been frequently used by many countries during the COVID-19 pandemic to meet different trade and non-trade objectives. For instance, NTMs, such as export restrictions, have been used to prevent shortages of supplies of medical products in exporting countries as a reaction to increased domestic demand, whereas other NTMs have been adapted to facilitate imports of important goods (UNCTAD, 2021). Accordingly, it is relevant to analyse the prevalence of NTMs on vaccine and vaccine inputs trade. For this purpose, for this study, the NTMs nomenclature is based on the United Nations Conference of Trade and Development (UNCTAD revised classification of NTMs is used (UNCTAD 2019), which includes, for example, sanitary and phytosanitary (SPS) and technical barriers to trade (TBT), import licensing, prohibitions, quantity-control measures, price-control measures and export-related measures.

As per the UNCTAD data on NTMs, frequently used trade restricting NTMs across the globe during the COVID-19 pandemic include export prohibitions; license or permit requirements to export; and import prohibitions for SPS reasons. On the other hand, frequently used trade facilitating NTMs are tax and duty exemptions; reductions; other fiscal incentives; relaxation of regulations concerning terms of payment for imports; and relaxation of licensing requirements. As far as NTMs for COVID-19 vaccines and vaccine inputs trade are concerned, not much information is available. This may be due to non-reporting of such NTMs by the imposing countries. UNCTAD provides very broad information on such NTMs based on the income group classification of developing and developed countries. This is shown in figure 5.

Figure 5. Non-trade measures on COVID-19 vaccines



Source: Reproduced from UNCTAD (n.d.).

A search of non-trade measure-related information was also conducted from the UNCTAD NTM database, the WITS TRAINS database, the WTO database and the ITC Market Access Map. Limited information is available pertaining to NTMs on COVID-19 vaccines in the context of Asia-Pacific countries; it is presented in table 2.

Table 2. Non-trade measures on COVID-19 vaccines in the Asia-Pacific region

Enacting Country	Measure description	Measure type	Affected Products	Effect On Trade
China	Announcement by the Ministry of Commerce, the Ministry of Industry and Information Technology, the National Health Commission and the National Medical Products Administration on publication of the List of COVID-19 vaccines for exportation. In order to ensure the smooth exportation of COVID-19 vaccines and support international cooperation on fighting the epidemic, the COVID-19 vaccines approved or conditionally approved by the National Medical Products Administration "NMPA" are hereby included in the "List of COVID-19 Vaccines for Exportation (developed and manufactured by Chinese enterprises). The list will be dynamically adjusted in due course according to NMPA marketing authorizations	Export authorization of vaccines	COVID-19 vaccines	Facilitating
Fiji	Temporary elimination of VAT on imports of certain products, such as vaccines and pharmaceutical products (HS chapter 30); medical equipment (HS chapter 90); scanners and cameras used in medical examinations; hand sanitizers and antibacterial hand wash; gloves, masks; disposable hair nets; disinfectant wipes; tissue papers; face shields (medical use); medical goggles and spectacles; protective garments of rubberized materials; long-sleeved medical gowns; ethanol for companies involved in hand sanitizer production; disinfectants/sterilization products; hospital beds; hydrogen peroxide; paper bed-sheets; thermometers; air purifiers; and boots (specifically used in the medical environment), due to the COVID-19 pandemic	Tax and duty exemptions, reductions, other fiscal incentives reducing burden of taxes otherwise due	COVID-19 vaccines	Facilitating
Indonesia	Exemption from import tariffs and VAT on COVID-19 vaccines	Tax and duty exemptions, reductions, other fiscal incentives reducing burden of taxes otherwise due	COVID-19 vaccines	Facilitating

Table 2. (continued)

Enacting Country	Measure description	Measure type	Affected Products	Effect On Trade
Philippines	Tax-free and duty-free importation of COVID-19 vaccines	Tax and duty exemptions, reductions, other fiscal incentives reducing burden of taxes otherwise due	COVID-19 vaccines	Facilitating

Source: UNCTAD (n.d.) and WTO (2021b).

Based on the analysis of the available information on NTMs, two interesting findings should be highlighted. First, some countries have imposed trade facilitating NTMs on vaccines after the COVID-19 pandemic. However, many of the trade restrictive NTMs that were imposed prior to COVID-19 still exist. Second, these trade restrictive NTMs are not vaccine-specific, but rather are imposed by such countries across many pharma products. For instance, Brunei Darussalam imposed import licensing requirements under its Poison Act in 2001 on various products, which also included some of the vaccines' codes at the HS 8 digit level. Similarly in Pakistan, the Control of Narcotic Substances Act XXV of 1997 states that no one shall import, export, transport or transship any narcotic drug. The HS codes included in the list of this Act also include vaccine HS code 300220.

Many countries have resorted to export restrictions on vaccines, particularly after a surge in Delta-variant COVID-19 cases. For instance, India introduced restrictions on vaccine exports to fulfil its domestic demand and vaccinate its own population after a significant rise in COVID-19 cases in April 2021. It resumed exports of vaccines in November 2021. According to WTO (2021c), at least 13 WTO members maintained measures that may affect the export of certain inputs included in the Joint Indicative List of Critical COVID-19 Vaccine Inputs, and some active ingredients that are classified in the HS together with the final vaccines under the subheading, 300220. Export restrictions continue to impede access to vaccine inputs and thus create uncertainty in vaccine supply chains. Exports by vaccine manufacturers to foreign "fill and finish" sites also face export restrictions, both for sites owned by the manufacturer and the contract development and manufacturing organizations with which vaccine originators may have partnered.

IV. SURVEY FINDINGS

To gain insights on trade-related issues concerning vaccines and related inputs, a survey of relevant stakeholders was conducted in India. Being a significant player for vaccines in the Asia-Pacific region, India can provide substantial insights and takeaways for other trading countries. In this context, online personal interviews of ten key stakeholders were conducted from December 2021 to February 2022 to better understand how regulatory frameworks, tariff and non-tariff barriers, constraints to production, scaling up, and vaccine nationalism can affect vaccine availability and its distribution, thereby providing lessons for future pandemics. The stakeholders contacted included representatives from pharma companies, subject experts, think tanks and academicians. The main findings from the primary survey can be categorized into four broad pillars.⁶

A. Regulatory framework for vaccine production and trade related barriers

Vaccines are public goods but the global supply and trade in vaccines are subject to license-based regulatory frameworks. Trade is considered instrumental in facilitating access to and supply of goods. The same should hold true for vaccines or related inputs. However, as the pricing and purchase arrangements for vaccines have been dominated by high-income countries and selected pharma companies, smooth trade flows of vaccines were affected, especially for COVID-19 vaccines.

While tariffs are not considered critical for COVID-19 vaccines, NTMs have played a crucial role. Most of these NTMs are imposed by exporting countries and not importing countries. The most significant issue in the case of NTMs is the sharing of trade secrets and the control of technology. Licensing agreements can be obtained only for fill and finish, but not for vaccine manufacturing. There exists contract manufacturing licensing, which implies that the contracted company is producing only for the contracting company and other countries cannot use it. For example, Biological E got a contract to manufacture J&J COVID-19 vaccine in India, but this vaccine cannot be used in India.

Harmonization of regulatory approval requirements has broadly been acceptable, but the level at which this should happen has remained an important issue for consideration. Global manufacturers do not support harmonization at a lower threshold, but if harmonization is aimed at higher levels, the compliance requirements for manufacturers from developing countries will increase.

⁶ It may be noted that the findings in this section represent the views of the respondents and not of the authors.

The experience of India regarding Covaxin regulatory approval from WHO bring out issues related to appropriate rigorous documentation and data-sharing. This may hold true for vaccine manufacturers of the global South if they lack proper documentation for regulatory approvals. It affects the global benchmarking of their vaccines through WHO approval, in the absence of which they may not be able to supply it to other countries.

B. Vaccine production and scaling up

Though India had a delayed start, it rapidly improved its vaccine roll-out programme. Government policies concerning, for example, boosters and vaccine roll-outs have been playing an important role in the roll out of the vaccines. Vaccine manufacturing is a package that needs to be delivered to the targeted countries. Bulk manufacturing formulations can be transported to other countries provided the target country has a fill and finish facility and the capacity to do so. However, half of the global South does not have the required capacity. In such a situation, the option for enhancing supply in non-vaccine producing countries is to transport ready-to-inject vaccines. Even post-production processes of vaccine distribution and administration is time consuming and requires pre-planning. This was probably a reason for the delayed roll-out of vaccines in early 2020, leading to the widespread emergence of the Delta variant.

Inactivated virus vaccine platforms are relatively easier to handle. Large amounts of vaccines can be produced through such technologies. For example, Covaxin is produced using this technique. However, there are barriers associated with this method such as the safety risks and the containment technologies required at a large scale. Many countries do not have such large containment technologies.

Global tendering of vaccines has not been a successful model of operation. The process of tendering vaccines may work differently for COVID-19 versus traditional vaccines. COVID-19 vaccines require rapidity, stringent storage requirements, robust supply chains and high demand. Additionally, it is likely to be difficult to get suppliers through tendering in the middle of any pandemic. Bilateral agreements are likely to be more effective than global tendering for supplying vaccines and vaccine inputs across the countries.

C. Vaccine nationalism

Vaccine nationalism has been evident during the COVID-19 pandemic. It is visible from a comparison of the number of doses supplied through the Covax initiative and bilateral agreements, such as Vaccine Maitri, vis-a-vis the number of vaccines administered in the global North. Vaccine nationalism in India was evident, but short-lived. It was solely due to the sudden emergence of the Delta wave in April 2021.

D. Lessons for future pandemics

Trade openness can be instrumental in the production of vaccines as a country alone cannot produce vaccines against all kinds of pathogens. Elimination of export and import barriers are important for vaccine trade, distribution and administration. Input availability is a crucial determinant of vaccine availability. In some cases, these inputs are produced under trade secrets. In such cases, compulsory licensing can be issued.

A key takeaway from the pandemic is the need for higher investments in research and development (R&D) and technology development related to vaccine production in the Asia-Pacific region as well as globally. Another significant learning from the production and trade in COVID-19 vaccines is the associated regulatory approval process. The usually long periods needed for approval were reduced into a one-year time window, implying that some of the commonly held assumptions of regulatory approval for already approved vaccines may have to be revisited.

V. CONCLUDING THOUGHTS AND POLICY RECOMMENDATIONS

Most of the Asia-Pacific countries are import dependent on vaccines and vaccine inputs. As the supply chains of all products can be adversely affected during a pandemic, as was evident during the COVID-19 pandemic, increased import concentration of countries may result in higher risks for the availability of vaccines or related inputs. Accordingly, countries need to diversify their sources of imports for vaccines and vaccine inputs.

The tariff analysis shows prevalence of high tariffs in some of the Asia-Pacific economies. Only a few of these economies had reduced or eliminated tariffs on vaccines during the COVID-19 pandemic. Economies need to bring down tariffs to decrease the cost of imports of vaccines and vaccine inputs. The analysis of NTMs shows a continuation of many of the NTMs that were imposed on vaccines prior to the COVID-19 pandemic. Most of these NTMs were not specific to vaccines, but were imposed on vaccines together with other medical products. These legacy NTMs have the potential to delay the sourcing of vaccines and vaccine inputs from other countries. Therefore, these NTMs need to be identified by respective countries and eliminated if not of any particular significance.

There is a lack of transparency with respect to the administration of NTMs for vaccines and vaccine inputs trade and changes in these NTMs with the onslaught of the COVID-19 pandemic. Export restrictions have significantly hampered the availability of COVID-19 vaccines in many countries. However, only a few selected countries had notified such NTMs and changes thereof to WTO. It might be helpful if countries

notify the applicable NTMs on vaccines and related inputs so that the manufacturers and exporters and importers of vaccines remain aware of them beforehand, as it would assist them in planning their inventories and minimizing any delay owing to the administration of such NTMs.

China and India, being the two major global producers of vaccines in the Asia-Pacific region, can play a significant role in enhancing intraregional trade in vaccines within the region. However, such potential may not be fully realized due to regulatory requirements from either the exporting country or the importing country or both sides. Regulatory coherence is required to enhance intraregional trade within the region. Free trade agreements between or among Asia-Pacific countries may be used to ease import and export restrictions on vaccines and vaccine inputs. Such agreements need to have specific provisions for enhancing vaccine trade among the contracting parties.

Intraregional trade in the Asia-Pacific region could also be increased by creating a regional hub for vaccines in the region. This requires regional cooperation for vaccines trade, which could be facilitated through the Economic and Social Commission for Asia and the Pacific. The institution can work towards using the strength and capabilities of producers of vaccines and related inputs in the region for creating such a regional hub for vaccines. The sharing of knowledge and harmonization of intraregional trade through this regional hub would help to enhance the distribution and administration of vaccines across countries in this region in normal times as well as during future pandemics.

Successful vaccine campaigns require not only adequate supply of vaccines, but also logistic, storage and distribution capacities. Accordingly, apart from ensuring adequate supply of vaccines through trade, equal emphasis should also be given to developing transportation and storage capabilities. While domestic demand is a key determinant of putting trade restrictions, the leading producers of vaccines should strive for the equitable distribution and availability of vaccines across countries as no one is safe until everyone is safe from contagious diseases, such as the COVID-19.

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APPENDIX

Countries and territories selected for this study:

Afghanistan; American Samoa; Armenia; Australia; Azerbaijan; Bangladesh; Bhutan; Brunei Darussalam; Cambodia; China; Cook Islands; Fiji; French Polynesia; Georgia; Guam; Hong Kong, China; India; Indonesia; Iran (Islamic Republic of); Japan; Kazakhstan; Kiribati; Kyrgyzstan; Lao People's Democratic Republic; Macao, China; Malaysia; Maldives; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Nepal; New Caledonia; New Zealand; Niue; Northern Mariana Islands; Pakistan; Palau; Papua New Guinea; Philippines; Republic of Korea; Russian Federation; Samoa; Singapore; Solomon Islands; Sri Lanka; Taiwan Province of China; Tajikistan; Thailand; Timor-Leste; Tonga; Turkey; Turkmenistan; Tuvalu; Uzbekistan; Vanuatu; Viet Nam

Note: Data for some of the countries for some years are missing. For the analysis, the maximum number of observations available are used.

Table A.1. Product codes and descriptions for vaccine input groups

HS96 product codes	HS17 product codes	Product description
170199	170199	Inactive ingredients
220710	220710	Inactive ingredients
220720	220720	Vaccine administration
220890	220890	Vaccine administration
250100	250100	Inactive ingredients
280610	280610	Inactive ingredients
281121	281121	Vaccine storage and distribution
281511	281511	Inactive ingredients
281512	281512	Inactive ingredients
282731	282731	Inactive ingredients
283330	283330	Other ingredients
283522	283522	Inactive ingredients
283524	283524	Other ingredients
285210	293490	Other ingredients
285390	284800	Inactive ingredients
290544	290544	Other ingredients

Table A.1. (continued)

HS96 product codes	HS17 product codes	Product description
290613	290613	Inactive ingredients
291211	291211	Other ingredients
291521	291521	Inactive ingredients
291529	291529	Inactive ingredients
291814	291814	Inactive ingredients
291815	291815	Inactive ingredients
292219	292219	Inactive ingredients
292249	292249	Inactive ingredients
292250	292250	Inactive ingredients
292320	292320	Inactive ingredients
293329	293329	Inactive ingredients
294190	294190	Other ingredients
300220	300220	Active ingredients
300510	300510	Vaccine administration
310420	310420	Inactive ingredients
340213	340213	Inactive ingredients
350300	350300	Other ingredients
350510	350510	Inactive ingredients
350790	350790	Other ingredients
382200	382200	Consumables
391740	391740	Consumables
392310	392310	Vaccine storage and distribution
392321	392321	Consumables
392329	392329	Consumables
392330	392330	Consumables
392690	392690	Consumables
401511	401511	Vaccine administration
401519	401519	Vaccine administration
401699	401699	Packaging
482110	482110	Consumables
482190	482190	Consumables
701090	701092	Packaging
701710	701710	Consumables

Table A.1. (continued)

HS96 product codes	HS17 product codes	Product description
701720	701720	Consumables
701790	701790	Consumables
830990	830990	Packaging
841830	841830	Vaccine storage and distribution
841840	841840	Vaccine storage and distribution
841920	841920	Equipment
841989	841989	Equipment
842129	842129	Consumables
842230	842230	Equipment
847982	847982	Equipment
847989	847989	Equipment
854370	854389	Vaccine administration
901831	901831	Vaccine administration
901832	901832	Vaccine administration
902720	902720	Vaccine manufacturing
902790	902790	Equipment
903289	903289	Equipment

Source: Identifying the critical input product codes from the WTO (2021a) and mapping it to identify the HS96 product codes from the correspondence tables (<https://unstats.un.org/unsd/trade/classifications/correspondence-tables.asp>). Accessed on 7 November 2021

Table A.2. Vaccine trading partners of leading exporter and importer Asia-Pacific countries of vaccine trade

	Vaccines		Vaccine inputs	
	Major destination	Major source	Major destination	Major source
China	India	United States	United States	Japan
	United Arab Emirates	France	Hong Kong, China	Germany
	Thailand	Ireland	Japan	United States
	Brazil	Belgium	India	Republic of Korea
	Egypt.	Italy	Republic of Korea	Singapore

Table A.2. (continued)

	Vaccines		Vaccine inputs	
	Major destination	Major source	Major destination	Major source
India	Nigeria	Indonesia	United States	China
	Brazil	Belgium	United Arab Emirates	United States
	Bangladesh	France	United Kingdom	Germany
	Philippines	United States	China	Japan
	Pakistan	China	Germany	Canada
Indonesia	Japan	Belgium	Japan	China
	United States	India	United States	Canada
	Singapore	France	Singapore	Japan
	China	United States	China	Thailand
	Afghanistan	China	Australia	Singapore
Japan	Republic of Korea	United States	China	China
	United States	France	United States	United States
	Thailand	Belgium	Republic of Korea	Germany
	Mexico	Ireland	Germany	Thailand
	India	Germany	Thailand	Republic of Korea
Republic of Korea	Pakistan	United States	China	Japan
	Bangladesh	Italy	United States	United States
	Brazil	Belgium	Japan	China
	Ethiopia (excludes Eritrea)	France	Vietnam	Germany
	Viet Nam	Germany	Hong Kong, China	Netherlands

Source: Author's calculations based on data from the WITS (n.d.).

Note: The leading exporter and importer countries or territories were identified on the basis of highest trade values of vaccine trade as reported by the countries. The major trading partners of these countries or territories were identified from the descending order of percentage of import or export shares of vaccine trade for each country or territory and only five such partners have been reported.

Table A.3. Herfindahl-Hirschman Index (HHI) of import dependence of Asia-Pacific countries and territories for vaccines (HS Code 300220)

Herfindahl-Hirschman Index of import dependence	2015	2020
Armenia	0.282	0.264
Azerbaijan	0.367	0.294
Bangladesh	0.321	N/A
Brunei Darussalam	0.301	0.816
Cambodia	0.239	0.189
China	0.642	0.294
Fiji	0.477	0.269
French Polynesia	0.259	0.308
Georgia	0.273	0.434
Hong Kong, China	0.219	0.312
India	0.239	0.224
Indonesia	0.159	0.169
Iran, Islamic Republic of	0.309	N/A
Japan	0.293	0.272
Kazakhstan	0.411	0.279
Kiribati	N/A	0.989
Republic of Korea	0.354	0.274
Kyrgyzstan	0.324	0.276
Lao People's Democratic Republic	0.266	N/A
Macao, China	0.995	0.275
Malaysia	0.232	0.295
Maldives	0.274	N/A
Mongolia	0.167	0.244
Myanmar	0.162	0.225
Nepal	0.644	N/A
New Caledonia	0.328	N/A
New Zealand	0.233	0.276
Pakistan	0.153	0.210
Philippines	0.200	0.232
Russian Federation	0.220	0.252
Samoa	0.476	N/A

Table A.3. (continued)

Herfindahl-Hirschman Index of import dependence	2015	2020
Singapore	0.245	0.259
Solomon Islands	0.542	N/A
Sri Lanka	0.409	0.274
Tajikistan	N/A	0.275
Thailand	0.141	0.150
Turkey	0.266	0.181
Uzbekistan	N/A	0.221
Viet Nam	0.264	0.263

Source: Authors' construction using trade values (USD) from WITS (n.d.).

Note: An increase in the index values is reported by some countries or territories, such as Brunei Darussalam; Hong Kong, China; Malaysia; New Zealand; Philippines; and Singapore,. "N/A" stands for data not available.

Table A.4. Herfindahl-Hirschman Indices for import dependence of Asia-Pacific countries or territories for vaccine input groups

Herfindahl-Hirschman Index of import dependence	VM		VSD		VA	
	2015	2020	2015	2020	2015	2020
Afghanistan	0.406	N/A	N/A	N/A	0.483	0.261
Armenia	0.092	0.169	0.124	0.248	0.162	0.214
Azerbaijan	0.089	0.112	0.524	0.313	0.172	N/A
Bangladesh	0.111	N/A	0.253	N/A	0.091	0.638
Cambodia	0.174	0.261	0.232	0.287	0.102	0.099
China	0.095	0.124	0.213	0.176	0.205	0.188
Fiji	0.145	0.191	0.215	0.377	0.110	0.139
Georgia	0.094	0.087	0.564	0.475	0.142	0.167
India	0.104	0.115	0.287	0.427	0.262	0.440
Indonesia	0.082	0.106	0.231	0.349	0.244	N/A
Iran, Islamic Republic of	0.148	N/A	0.455	N/A	0.153	0.321
Kazakhstan	0.126	0.166	0.358	0.442	0.329	0.202
Kiribati	0.183	0.124	0.292	0.281	0.401	0.318
Kyrgyzstan	0.148	0.189	0.208	0.281	0.272	N/A
Lao People's Democratic Republic	0.485	N/A	0.772	N/A	0.088	0.110

Table A.4. (continued)

Herfindahl-Hirschman Index of import dependence	VM		VSD		VA	
	2015	2020	2015	2020	2015	2020
Malaysia	0.092	0.118	0.266	0.364	0.099	N/A
Maldives	0.095	N/A	0.122	N/A	0.165	0.151
Mongolia	0.268	0.177	0.809	0.608	0.243	0.496
Myanmar	0.295	0.245	0.288	0.427	0.293	N/A
Nepal	0.583	N/A	0.477	N/A	0.340	0.399
Pakistan	0.200	0.210	0.247	0.181	0.387	0.244
Philippines	0.080	0.106	0.533	0.322	0.129	0.236
Russian Federation	0.075	0.081	0.207	0.228	0.568	N/A
Samoa	0.235	N/A	0.315	N/A	0.390	N/A
Solomon Islands	0.138	N/A	0.265	0.143	0.250	0.332
Sri Lanka	0.119	0.221	0.244	N/A	N/A	0.484
Tajikistan	N/A	0.241	N/A	0.293	0.225	0.159
Thailand	0.135	0.146	0.270	0.204	0.124	0.142
Turkey	0.076	0.075	0.158	0.241	N/A	0.400
Uzbekistan	N/A	0.143	N/A	0.144	0.124	0.199
Viet Nam	0.148	0.196	0.286	0.377	0.483	0.261

Source: Authors' construction using trade values (USD) from the WITS (n.d.).

Note: "N/A" stands for data not available. A majority of the countries reported higher concentrated import dependencies in 2020 than in 2015. Kiribati is the only country or territory exhibiting lesser import concentrations in 2020 than in 2015, for all the vaccine input groups.

Table A.5. Cross-country comparison of effectively applied tariffs on vaccine inputs

Country	Effectively applied Tariffs on VM inputs	Effectively applied Tariffs on VA inputs	Effectively applied Tariffs on VSD inputs
Iran, Islamic Republic of	12.177	23.425	33.750
Pakistan	11.643	32.391	15.661
Maldives	20.317	13.316	17.005
India	12.331	29.590	7.787
Bangladesh	9.490	14.534	20.900
Indonesia	7.558	27.970	7.360

Table A.5. (continued)

Country	Effectively applied Tariffs on VM inputs	Effectively applied Tariffs on VA inputs	Effectively applied Tariffs on VSD inputs
Nepal	9.733	9.744	16.533
Bhutan	7.458	11.106	15.418
Fiji	9.506	6.214	17.343
Sri Lanka	4.055	14.000	14.036
Samoa	7.947	11.440	8.000
Thailand	4.271	9.631	12.363
Viet Nam	5.130	11.522	9.191
Cambodia	7.177	7.391	10.276
Malaysia	4.646	0.000	19.584
China	6.130	9.012	9.055
French Polynesia	6.825	7.511	8.794
Solomon Islands	7.484	7.321	8.140
Afghanistan	13.06	2.50	5.28
Uzbekistan	3.267	6.145	11.338
Tonga	8.063	6.667	5.250
Russian Federation	4.110	8.422	7.323
Azerbaijan	5.000	3.757	9.513
Mongolia	4.916	7.342	4.941
Republic of Korea	9.045	4.549	3.100
Kyrgyzstan	3.045	7.488	5.548
Kazakhstan	3.503	5.106	6.368
Armenia	3.126	4.741	7.047
Taiwan Province of China	3.827	6.625	3.071
Philippines	3.065	3.529	5.277
Myanmar	2.265	4.688	3.731
Palau	2.821	2.600	3.000
Turkey	4.368	2.496	1.125
Lao People's Democratic Republic	2.709	1.851	2.572
Japan	1.748	4.485	0.752
Australia	1.732	2.083	2.326
New Zealand	0.955	0.000	2.246

Table A.5. *(continued)*

Country	Effectively applied Tariffs on VM inputs	Effectively applied Tariffs on VA inputs	Effectively applied Tariffs on VSD inputs
Georgia	0.794	0.000	1.239
Brunei	0.086	0.000	0.244
Hong Kong, China	0.000	0.000	0.000
Macao, China	0.000	0.000	0.000
Singapore	0.000	0.000	0.000

Source: Compiled from the WITS (n.d.). Simple average of the tariffs for each country-vaccine input combination was computed for the period 2000-2020.