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Comparative Advantage and Competitiveness of COVID-19-Related Medical Products Exporters

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Abstract

The coronavirus disease (COVID-19) pandemic generated an upsurge in demand for medical products. Trade policy changes, including export restrictions and import reforms, have led to a shortage of medical products. The World Health Organization has recommended countries to encourage local production and identify various import sources for medical products to ensure sustainable healthcare capacity to combat the COVID-19 pandemic and any similar events in the future. This study aims to examine the comparative advantages and competitiveness in producing medical products among top exporters. The contribution of this study is the ability to identify various import sources specific to developing countries. From the exporter's perspective, this study allows countries to recognize their existing competitive strengths in the medical products trade, allowing them to strategize and compete in the international markets of medical products. Using Balassa's revealed comparative advantage index, this study analyzes 25 primary medical product exporters, identifying several countries with a comparative advantage in producing medical products. Medicines are primarily dominated by high-income countries, including Switzerland and Germany, whereas middle-income countries, such as China and Malaysia, are more specialized in medical supplies, medical equipment, and personal protective products. This finding provides a basis for policy formulation that can facilitate the process of building a sustainable healthcare capacity.

Keywords: competitiveness, comparative advantage, COVID-19, medical trade, medical devices
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1. INTRODUCTION

In the era of globalization, infectious diseases spread easily. Economic activities establish opportunities for cross-border interaction between humans, animals, and ecosystems, accelerating the potential for spreading infectious diseases and acting as a driving force behind pandemics. A pandemic is defined as the large-scale outbreak of an infectious disease over a wide reach of geographical regions, severely affecting morbidity and mortality (Madhav et al.,

2017). The most recent pandemic declared by the World Health Organization (WHO) is the coronavirus disease (COVID-19) (WHO, 2020). The first outbreak was identified in the city of Wuhan, China, in December 2019. This disease infected at least 143.4 million people with 3.05 million deaths (WHO, 2021) and spread across more than 188 countries in less than a year. This rapid and large-scale outbreak generated a surge in demand for medical products, particularly those related to prevention, testing, and treatment (WTO, 2020), resulting in shortages of such products in many countries. Ahmed et al. (2020) confirmed that the limited supply of essential goods has contributed to consumers' impulsive buying behavior.

To protect domestic needs, many countries have adopted preventive measures, such as export restrictions, tariff increments, and other non-tariff barriers. Evenett et al. (2020) reveal that countries adopted heterogeneous trade policies and measures in response to COVID-19. The World Trade Organization (WTO) received 355 members' notifications related to COVID-19 from February 2020 to April 2021 (WTO, 2021). Some countries banned or limited the export of medical products, such as face masks and personal protective products, to support domestic needs. Contradicting traditional trade policy, governments are now restricting exports and reforming imports. Although export restrictions and bans are prohibited by most multilateral trading systems, some exceptions allow for temporary measures to prevent or relieve critical shortages. These measures may inadvertently impact the cross-country flow of medical products and cause an unprecedented disruption in global trade. As a result, countries with a high reliance on imported medical products may suffer from medical product shortages, making it difficult for these countries to contain the spread of the virus. Such supply shocks will also trigger increases in the price of medical products. This circumstance raises concerns regarding national preparedness in mitigating the pandemic.

The COVID-19 pandemic is not the final health emergency that the world will experience. Countries will continue to face disease outbreaks in the future (WHO, 2020); therefore, they must build sustainable healthcare capacity to manage COVID-19 outbreaks and any similar events. This includes ensuring an appropriate amount of investment is allocated to procure medical products. Countries that invested in healthcare facilities in the wake of previous healthcare emergencies have been successful in preventing and mitigating disease outbreaks, including the current COVID-19 pandemic. The WHO has introduced the Strategic Preparedness and Response Plan, which describes the need for sustainable capacities for long-term preparedness and actions that member states can take. The suggested actions include the implementation of a supply chain control and management system for medical and other essential supplies and the encouragement of local capacity building and sourcing of high-quality products to strengthen expedient access to supplies (WHO, 2020).

This scenario sparks a question regarding which countries are competitive in exporting medical products. This study aims to analyze the comparative advantage of producing medical products. The findings provide insights into the export competitiveness of medical devices, which will be beneficial for countries in at least two ways. First, it helps to identify the potential medical products to focus future investment on. Second, it helps countries diversify external medical supply sources in case of emergencies or shocks. This information could facilitate countries' formulation of development strategies to build a sustainable healthcare capacity in response to

the COVID-19 pandemic and to prepare for similar events in the future. The sample countries used for this study include the 25 primary medical product exporters, including Germany, the United States of America (USA), Switzerland, Belgium, Ireland, China, the Netherlands, France, Italy, the United Kingdom (UK), Japan, India, Singapore, Spain, Austria, Sweden, Canada, Denmark, South Korea, Poland, Malaysia, Hungary, Hong Kong, the Czech Republic, and Israel. These countries contributed about 93% of the world's total exports in 2019. The timespan for this study is from 2014 to 2020.

Medical products vary greatly; however, this study focuses only on medical products relevant to COVID-19 prevention and medical treatment in general. The WTO has identified and classified these products into four categories: medicines, medical supplies, medical equipment and technology, and personal protective products (PPP). PPP includes products used by healthcare workers to minimize exposure to specific hazards (Table 3, Appendix).

In total, the export of medical products increased from USD 508 billion in 2014 to USD 932 billion in 2018 (United Nations, 2020). According to the WTO (2020), this amount reached USD 995 billion in 2019, accounting for about 6% of the exports of the total products. Throughout the years, medicines remained the largest category of exported medical products. The top ten exporters of medical products in 2019 were Germany, the USA, Switzerland, Netherlands, Belgium, Ireland, China, France, Italy, and the UK. Most of the top medical product exporters are high-income countries, except for China. These countries contributed approximately 74% of the global medical exports in 2019 (WTO, 2020).

The remainder of this study is organized into four sections. Section 2 presents a brief survey of the literature on medical trade; Section 3 describes the methodology and empirical strategy used in this study; Section 4 presents the results and discussions; and the final section, Section 5, concludes and proposes the policy implications of the study.

2. LITERATURE REVIEW

The trade impact of the COVID-19 pandemic has captured the attention of numerous scholars. Using monthly trade data, Hayakawa & Mukunoki (2021) demonstrate that the COVID-19 pandemic has negatively affected international trade flow for both exporting and importing countries, particularly during the early phase of the pandemic. Uncertainty led to a rise in impulsive buying behavior (Ahmed et al., 2020) due to society's concerns regarding the pandemic, causing countries to establish various policy measures (Evenett et al., 2020) to protect the needs of people.

Mikic et al. (2020) show that policy responses related to the "Great Lockdown" led to immediate short-term disruptions in the supply and trade of critical healthcare and medical products. Export restrictions imposed by medical product producer countries distorted the flow of medical products to other countries, resulting in global shortages. Baldwin & Evenett (2020) and Ahmed et al. (2020) demonstrate that medical product shortages originated from the upsurge in demand rather than the collapse of the domestic market. Restricting exports and imports generates a surplus in producing countries, and the only incentives that can be offered to producers are high floor prices, which do not benefit society. Additionally, Stellinger et al. (2020) emphasize that it

is dangerous for countries to radically reduce dependencies on imports. Countries have diverse skill intensities; therefore, they must specialize and trade accordingly.

In response to the COVID-19 pandemic, several studies highlighted the pattern of trade in medical products. Hallak (2020) shows that the European Union (EU) was the net exporter of all four groups of medical products. Most of the EU trade surplus includes pharmaceutical products or medicines. Meanwhile, the EU's weaker domain was PPP. Gopalakrishnan et al. (2020) demonstrated that developed countries monopolize the production of high-tech medical equipment, whereas developing countries, such as China, conquer the PPP market. Medical supply exports among Commonwealth countries are dominated by developed countries, whereas developing countries remain the major importers. This indicates a highly concentrated production and trade of COVID-19 medical products. This pattern of concentration is also shown to occur in vaccine production, wherein vaccine manufacturers are located in a limited number of producer nations (Evenett et al., 2021), delaying countries' immunization strategies and recovery processes.

The theory of comparative advantage suggests that countries should specialize and produce the goods that it is capable of producing at the lowest opportunity costs (Ricardo, 1817) for the world to realize gains from trade. Hecksher-Ohlin further explained the basis for comparative advantage. Based on the theory, countries should specialize in producing goods in which they have a relatively abundant factor. Accordingly, it is expected that developed countries should specialize in capital-intensive export goods, whereas developing countries should specialize in labor-intensive export goods. Grossman (1989) predicts that countries with abundant skilled labor and scarce natural resources will specialize in industrial innovation and high-technology (high-tech) products. Medicines and medical equipment usually require intensive technology (Kuriyama, 2020). Therefore, some medical products are considered high-tech products, whereas others are low-tech products. For example, hormones, antibiotics, and vaccines are considered high-tech products (European Commission, 2006). In contrast, low-tech medical products include soap, gloves, and disinfectants (Stellinger et al., 2020). Following this, the EU's strongest and weakest domains are described.

Contradicting to the theory, the Economist Intelligence Unit (2020) reports that China, a developing country, dominates the global supply of antibiotics, vitamins, and anticoagulants (heparin). Furthermore, despite being the largest producer of some healthcare products, the USA has depended on imports to meet local demand during the COVID-19 pandemic. This scenario implies that the concept of comparative advantage is dynamic rather than static. Developing countries may develop a comparative advantage in high-tech products as a result of the potential for productivity growth (Redding, 1999) and technical change (Dudley & Moenius, 2007). This is also demonstrated in the Indian pharmaceutical industry. India is a developing country currently showing potential in the high-tech industry. After becoming a signatory member of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement (Kiran & Mishra, 2011), the Indian pharmaceutical industry increased research and development (R&D) activities (Tyagi et al., 2014; Goldar, 2013) and established stronger intellectual property rights (Kiran & Mishra, 2011; Chadha, 2009; Pradhan, 2007). India is now the largest global supplier of generic medications (IBEF, 2020), and the Indian response to the COVID-19 pandemic adds additional pressure for developing countries that rely on generic medications.

The pattern of the medical products trade in Malaysia fits the theory of factor endowment. According to the Malaysian Rubber Export Promotion Council (MREPC, 2019), Malaysia produces more than 50% of the global medical gloves export. The data indicate that Malaysia's main exports of medical supplies are rubber-based products. Malaysia is one of the primary global exporters of rubber; hence, the export of byproducts aligns with the nation's resource endowment. Additionally, Malaysia also has the potential to venture into the production of halal medical products. Products such as surgical sutures, in vitro equipment, and endotracheal tubes have attracted importers from India, Pakistan, Egypt, Oman, Saudi Arabia, Iran, China, the United Arab Emirates, Germany, and Turkey (Zarmani et al., 2014).

Patterns of specialization are mixed in the PPP industry. The main PPP exporters are developed and developing countries, including China, the USA, and the EU (Bown, 2020). The intra-industry trade among these countries is high. For example, the USA is heavily dependent on imports of PPP while simultaneously being a major exporter of PPP, which is true of China. When these countries adopted export restrictions, the limited amount of exports circulated mainly among them, and developing countries were left behind, with limited access to essential PPP to combat the pandemic. During the pandemic, China reorganized its manufacturers of nonmedical devices, such as automobile manufacturers, to pursue PPP production to address supply bottlenecks (Park et al., 2020). Although China responded with additional supplies, new concerns emerged over issues of product quality and appropriate regulatory levels. In addition to overall shortages, global PPP markets are in chaos, with reports of piracy, defective products, hoarding, and price gouging. This indicates that specific skills are required to produce some medical products, calling for specialization and trade rather than curbing exports. Export restrictions hamper the trade of medical products (Gopalakrishnan et al., 2020; Hoekman et al., 2020), particularly in the period of crisis. Countries are advised to diversify their sources to secure access to medical equipment in crises (Fuchs et al., 2020).

We argue that nations should specialize and trade rather than restrict exports in response to pandemics. This implies a need to identify the strengths of the domestic production capacity and diversify the sources of imports. This will help countries build sustainable healthcare capacities and strengthen preparedness to combat the COVID-19 pandemic and similar events in the future. This study seeks to analyze the comparative advantages and patterns of specialization in medical products among the main exporters. We hypothesize that developed countries will dominate high-tech intensive medical products markets, whereas developing countries will dominate low-tech intensive medical products markets. The classification of developed and developing countries is based on income per capita, following the World Bank grouping. Developed countries refer to high-income countries with a GDP per capita higher than USD 12,535. In contrast, developing countries refer to low- and middle-income countries with a GDP per capita of less than USD 12,535.

3. RESEARCH OBJECTIVE, METHODOLOGY AND DATA

The objective of this study is to analyze the comparative advantage of producing medical products. The most common measure of comparative advantage is the revealed comparative

advantage index (RCA) introduced by Balassa (1965). This measure is widely applied in the literature, e.g., in Fertö & Hubbard (2003), Seyoum (2007), Amin & Hamid (2009), Abbas & Waheed (2017), and Saki et al. (2019). The RCA is defined as follows:

$$RCA_{ij} = \frac{X_{ij}/X_{ik}}{X_{wj}/X_{wk}} \quad (1)$$

where X refers to the value of exports, the subscript i denotes the country under study, and j denotes the exported products. In this study, j refers to a group of medical products. The subscript k denotes all traded products, except j and w, representing all other countries excluding i. The RCA index ranges from zero to infinity. If the RCA index is smaller than 1, country i has no comparative advantage in product j. An RCA index greater than 1 indicates that country i has a comparative advantage in product j.

The research described in this paper addresses the following research questions:

1. Which country has comparative advantages in producing COVID-19-related medical products?
2. What are other import sources for COVID-19-related medical products?

For this study, the sample countries include the 25 primary global exporters of medical products. The sampled countries' list is presented in Table 2 (Appendix). The export data from 2014 to 2020 are obtained from the United Nations Commodity Trade Statistics Database (COMTRADE). Comparative advantage is a dynamic rather than a static concept. The comparative advantage may change over time; thus, the competitiveness among the exporters of medical trade-related products can also be measured. We contend that it is appropriate to focus on recent years' data to analyze the trend of comparative advantage in the medical products trade. Medical products are defined based on the HS2017 code in Table 3 (Appendix). The 92 products are then grouped into 4 categories of medicines, medical supplies, medical equipment and technology, and PPP, following the classifications made by the WTO, described in Section 2.

4. RESULTS AND DISCUSSION

The results of the RCA index for medical products among primary exporters are presented in Table 1. The analysis and discussion of the comparative advantage will be segmented following the four groups of medical products.

4.1 Medicines

Switzerland has the strongest comparative advantage in the production and export of medicines. From 2014 to 2020, the average RCA index was 8.17, the highest RCA index among all other exporters of medicines. One of the contributing factors is innovation in the pharmaceutical industry. Achilladelis & Antonakis (2001) showed that 80% of the innovations in the pharmaceutical industry are contributed by the USA, Switzerland, Germany, the UK, and France. Switzerland's RCA in medicines demonstrates a decreasing trend from 2014 to 2019; however, it increased significantly in 2020, the year of the COVID-19 pandemic. The pandemic generated a demand for medicines calling for countries with the capacity and capabilities to produce them,

such as Switzerland, to increase production. According to the Global Competitiveness Report (WEF, 2019), by leveraging its superior innovation ecosystem, Switzerland remains among the most competitive countries in the world. This has led to highly innovative and competitive industries, with pharmaceuticals as one of the country's substantial export strengths.

Apart from Switzerland, India also shows a strong and increasing comparative advantage in medicines. The average RCA from 2014 to 2020 is 3.46. Similar to the case of Switzerland, India strengthened its comparative advantage in medicine to achieve a 5.04 index point in 2020, the year of the pandemic. India is the only developing country that demonstrates a comparative advantage in medicines. Other developed countries have superior innovation ecosystems; however, the Indian pharmaceuticals industry presents competitive behavior akin to the global giants. The strength of India's pharmaceutical industry is in its reverse engineering skills, which helped India to become a global leader in generic drug production (Mahajan, 2018). The pharmaceutical industry in India expanded tremendously since 1995 when as a signatory member of WTO, India adopted the TRIPS Agreement (Kiran & Mishra, 2011). The expansion of the Indian pharmaceuticals industry has been accompanied by an increase in R&D intensity among the pharmaceutical firms (Tyagi et al., 2014; Goldar, 2013), as well as the strengthening of intellectual property rights (Kiran & Mishra, 2011; Chadha, 2009; Pradhan, 2007). Given India's comparative advantage in medicines, it appears to be a potential competing import source for other countries; however, India also introduced export restrictions to secure domestic consumption due to COVID-19. This may disrupt the supply chain, particularly in countries with demand for inexpensive and generic drugs.

In addition to Switzerland and India, several other countries that demonstrate a comparative advantage in producing medicines include Ireland, Belgium, Italy, the UK, Israel, France, Sweden, Spain, Canada, and Germany.

4.2 Medical Supplies

For medical supplies, Tab.1 (in the appendix) reveals several countries with a comparative advantage, including Austria, China, Denmark, France, Hungary, Ireland, Malaysia, the Netherlands, South Korea, Singapore, Spain, Sweden, and the USA, with an average RCA greater than 1. Among these countries, Malaysia appears to have a stronger comparative advantage pattern, with the highest average RCA of 5.12 from 2014 to 2020. Its comparative advantage increased tremendously to 12.86 in 2020. The RCA index for Malaysia also indicates that Malaysia moved from a comparative disadvantage to a comparative advantage in medical supplies from 2014 to 2016. According to the COMTRADE database, Malaysia's main exports of medical supplies in 2019 were rubber-based products, such as gloves (HS-401519 and HS-401511), as well as medical and surgical instruments and appliances, such as catheters (HS-901839). Malaysia is the primary global supplier of medical gloves and supplies, meeting more than 50% of global demand (MREPC, 2019). One of the contributing factors is Malaysia's vast rubber resource endowment. As a developing country, Malaysia's export competitiveness is rooted in low-technology medical products, such as medical supplies, compared with developed countries, such as Switzerland, which shows export competitiveness in the production of medicines. Unlike the case of medicines in India, Malaysia's medical supply export trend conforms to the Ricardian theory of comparative advantage.

The second potential producer of medical supplies is Denmark. The average RCA of Denmark ranked the second-highest at 3.04; however, the trend of specialization has decreased over the six years examined. Other countries that demonstrate a comparative advantage in medical supplies are the USA, Singapore, China, the Netherlands, Hungary, Ireland, Austria, Sweden, South Korea, Spain, and France.

4.3 Medical Equipment

According to the average RCA index, 10 countries exhibit a comparative advantage in medical equipment, including Japan, South Korea, Malaysia, the USA, Hong Kong, Israel, Singapore, the Netherlands, China, and Germany. On average, Japan has the strongest comparative advantage, with an average RCA of 6.28; however, the RCA index has decreased over the past six years. After Japan, South Korea also has a high rate of specialization, with an average RCA of 3.81. Similar to Japan, comparative advantage in medical equipment is decreasing. Malaysia ranked third in terms of comparative advantage in medical equipment, with an average RCA over the past seven years of 3.02, and a decreasing pattern from 2014 to 2018, which increased again in 2019. From the trade data, Malaysia's main exports of medical equipment are medical, surgical, and dental instruments and appliances; n.e.c. in heading no. 9018 (HS-901890), with an export value of USD 677 million in 2020.

Israel and Singapore also present an increasing pattern of comparative advantage over the years. Israel demonstrated an increase in RCA from 1.63 in 2014 to 5.73 in 2020. Singapore also exhibits the same pattern, with an RCA index of 1.11 in 2014, which increased to 3.09 in 2020. Other countries that exhibit a comparative advantage in medical equipment are the USA, Hong Kong, the Netherlands, Singapore, and China.

4.4 Personal Protective Products

On average, China has the strongest pattern of comparative advantage in PPP production, with an average RCA over the past seven years of 12.72. This number is far above the nation's other medical products and other countries' RCA. China's RCA in PPP decreased from 2014 to 2018; however, it increased to 10.26 in 2019 and 12.92 in 2020, indicating that China is highly specialized in producing PPP. This finding follows Bown's (2020) analysis indicating that 60% of the world's PPP exports are from China. Its comparative advantage in PPP was strengthened in 2020, with an RCA of 12.92. China is the first country where the pandemic began. When other countries were at the peak of struggling to manage the outbreak, including taking drastic actions in response to exogenous economic shock (Kuckertz et al., 2020), China was slowly recovering and beginning production to fulfill global PPP demand. Given its strength in PPP, China was able to maintain its position as the main source of PPP during the pandemic. This may increase other countries' import reliance on China, particularly during such crises; therefore, it is essential to identify and diversify other import sources for PPP to avoid supply chain disruptions during the pandemic.

Apart from China, Hong Kong also has a comparative advantage in producing PPP, with an average RCA of 5.25. Malaysia is ranked third in terms of comparative advantage in PPP production, with an average RCA of 4.83. However, a decreasing trend is recorded. Malaysia

was relatively more specialized in PPP in 2014 (RCA = 9.27) than in 2020 (RCA = 0.67). Another potential producer of PPP is Czechia, with an average RCA of 4.15. In addition to these four countries, Poland, South Korea, Japan, Hungary, Austria, Canada, and the USA have a comparative advantage in PPP production.

5. CONCLUSION

The COVID-19 pandemic has been a game-changer for international trade policy. Before the pandemic, countries encouraged exports and restricted imports; however, the pandemic led to the execution of export restrictions and import reforms in many countries, particularly for essential goods like medical products. These policies were undertaken to address shortages due to the upsurge in demand. Countries' decisions to support domestic needs are well understood; however, this prioritization resulted in international supply disruptions. The world, as a whole, suffers from shortages in medical products that are essential to combating the spread of the virus. Export limitations lead to an increase in the price of medical products due to supply shortages. Thus, exports only circulated among the countries that could afford these medical supplies, leaving the developing countries behind. Subsequently, there is a need to assess the local production capabilities and identify new import sources for medical products. This will facilitate countries' development of sustainable health capacity and enhance preparedness to combat the COVID-19 pandemic or similar events in the future.

This study aims to evaluate the comparative advantage and competitiveness of countries in producing medical products. The finding indicates that Switzerland, India, Ireland, Belgium, Italy, the UK, Israel, France, Sweden, Spain, Canada, and Germany have a comparative advantage in producing medicines. Regarding medical supplies, Austria, China, Denmark, France, Hungary, Ireland, Malaysia, the Netherlands, South Korea, Singapore, Spain, Sweden, and the USA have a comparative advantage. Japan, South Korea, Malaysia, the USA, Hong Kong, Israel, Singapore, the Netherlands, China, and Germany show specialization in producing medical equipment. Finally, China, Hong Kong, Malaysia, the Czech Republic, Poland, South Korea, Japan, Hungary, Austria, Canada, and the USA have a comparative advantage in PPP production. These findings indicate that middle-income countries, such as China and Malaysia, are more specialized and have increased competitiveness in medical supplies, medical equipment, and PPP rather than in medicines. This is because medicine production requires high-tech medical products. Specializing in producing medicines must be accompanied by considerable investment and R&D activities; hence, the results demonstrate that countries with a comparative advantage in producing medicines are high-income countries, except for India.

To ensure an adequate world supply of medical products, countries with high competitiveness in medical products should consider prioritizing the encouragement of increased local production. An appropriate amount of investment, including R&D activities and human capital development, should be allocated to the development of such industries. Regarding the medical products for which countries have comparative disadvantages, alternative import sources should be identified to ensure the smooth supply of essential medical products in the future.

The findings of this study have some limitations. Despite being widely used, the RCA index

introduced by Balassa (1965) is asymmetrical and not comparable with both sides of unity. Future research could consider alternative measures to evaluate the comparative advantage of medical products exporters. Additionally, disaggregating the medical products in a more detailed category could provide a richer analysis of the specific products in the four groups for which each country has a comparative advantage.

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Appendix

Tab. 1 - Revealed Comparative Advantage (RCA) Index for medical products, 2014–2020. Source: own research

#	Country	Income group	Medical products	RCA							
				2014	2015	2016	2017	2018	2019	2020	2014-2020
1.	Germany	High-income	Medicines	1.06	1.04	1.04	1.10	1.21	0.91	1.22	1.08
			Medical Supplies	0.49	0.49	0.51	0.79	0.73	0.86	0.87	0.68
			Medical Equipment	1.22	1.29	1.27	1.19	1.10	1.23	1.27	1.22
			PPP	0.99	1.00	1.00	0.90	0.87	1.19	0.63	0.94
2.	USA	High-income	Medicines	0.45	0.48	0.44	0.35	0.35	0.32	0.44	0.40
			Medical Supplies	2.34	2.28	2.67	2.11	2.19	2.25	2.12	2.28
			Medical Equipment	3.66	3.25	3.36	2.64	2.50	2.49	2.53	2.92
			PPP	1.32	1.29	1.34	0.92	0.90	1.15	0.65	1.08
3.	Switzerland	High-income	Medicines	9.19	9.88	10.75	6.37	6.51	6.16	8.32	8.17
			Medical Supplies	0.10	0.09	0.08	0.25	0.24	0.24	0.22	0.18
			Medical Equipment	0.09	0.08	0.13	0.34	0.33	0.31	0.32	0.23
			PPP	0.14	0.13	0.11	0.11	0.11	0.12	0.07	0.11
4.	Belgium	High-income	Medicines	4.02	3.75	3.58	1.76	2.08	2.17	3.62	3.00
			Medical Supplies	0.56	0.56	0.55	0.88	0.78	0.65	0.46	0.63
			Medical Equipment	0.13	0.15	0.16	0.64	0.49	0.47	0.42	0.35
			PPP	0.27	0.29	0.31	0.46	0.48	0.55	0.28	0.38
5.	Ireland	High-income	Medicines	5.09	4.92	3.77	1.53	2.06	1.73	3.17	3.18
			Medical Supplies	1.37	1.52	2.12	1.50	1.18	1.29	0.86	1.40
			Medical Equipment	0.10	0.10	0.11	0.42	0.32	0.34	0.31	0.24
			PPP	0.06	0.04	0.05	0.32	0.28	0.33	0.16	0.18
6.	China	Middle-income	Medicines	0.04	0.05	0.05	0.08	0.09	0.07	0.05	0.06
			Medical Supplies	1.69	1.65	1.52	1.51	1.50	1.45	1.06	1.48
			Medical Equipment	1.78	1.75	1.74	1.43	1.41	1.49	0.93	1.50
			PPP	18.15	17.27	16.20	7.18	7.04	10.26	12.92	12.72
7.	Netherlands	High-income	Medicines	1.03	0.92	0.90	0.79	0.60	0.55	0.73	0.79
			Medical Supplies	1.40	1.56	1.40	1.42	1.63	1.66	1.69	1.54
			Medical Equipment	1.71	1.77	1.80	1.37	1.75	1.78	1.71	1.70
			PPP	0.66	0.75	0.81	0.70	0.74	0.87	0.52	0.72
8.	France	High-income	Medicines	1.70	1.59	1.70	1.52	1.46	1.34	1.78	1.58
			Medical Supplies	1.58	1.55	1.17	0.73	0.80	0.77	0.76	1.05
			Medical Equipment	0.21	0.22	0.25	0.60	0.58	0.60	0.60	0.44
			PPP	0.57	0.62	0.63	0.92	0.95	1.17	0.65	0.79
9.	Italy	High-income	Medicines	1.67	1.40	1.40	2.17	2.12	2.21	2.82	1.97

9.	Italy	High-income	Medical Supplies	0.29	0.36	0.34	0.33	0.33	0.33	0.37	0.33
			Medical Equipment	0.32	0.41	0.42	0.49	0.48	0.41	0.43	0.42
			PPP	0.82	0.96	0.96	1.01	1.06	1.13	0.62	0.94
			Medicines	1.77	2.21	2.05	1.90	1.67	1.28	1.40	1.75
10.	United Kingdom	High-income	Medical Supplies	1.01	0.82	0.97	0.73	0.77	0.87	1.01	0.88
			Medical Equipment	0.48	0.40	0.41	0.58	0.65	0.78	0.86	0.60
			PPP	0.55	0.45	0.47	0.57	0.67	0.88	0.56	0.59
			Medicines	0.14	0.18	0.21	0.20	0.23	0.23	0.36	0.22
11.	Japan	High-income	Medical Supplies	1.15	1.18	1.12	0.82	0.81	0.85	0.76	0.96
			Medical Equipment	11.77	10.67	9.12	3.36	3.12	2.98	2.96	6.28
			PPP	2.23	1.95	1.89	3.00	2.90	3.44	1.87	2.47
			Medicines	2.81	2.95	2.86	3.49	3.62	3.47	5.04	3.46
12.	India	Middle-income	Medical Supplies	0.42	0.35	0.29	0.29	0.29	0.28	0.28	0.31
			Medical Equipment	0.30	0.24	0.20	0.26	0.30	0.31	0.29	0.27
			PPP	0.41	0.42	0.47	0.65	0.55	0.62	0.29	0.49
			Medicines	0.84	0.97	0.88	1.92	0.54	0.42	0.58	0.88
13.	Singapore	High-income	Medical Supplies	3.29	2.44	2.10	0.33	1.22	1.40	1.25	1.72
			Medical Equipment	1.11	1.35	1.57	0.52	2.67	2.96	3.09	1.90
			PPP	0.73	0.61	0.74	1.16	0.70	0.85	0.48	0.75
			Medicines	1.61	1.72	1.70	1.18	1.24	1.30	1.65	1.49
14.	Spain	High-income	Medical Supplies	1.03	0.82	0.76	1.46	1.33	1.18	1.13	1.10
			Medical Equipment	0.18	0.18	0.20	0.31	0.32	0.28	0.28	0.25
			PPP	0.73	0.71	0.73	0.91	0.95	1.09	0.66	0.83
15.	Austria	High-income	Medicines	0.86	0.81	0.90	0.85	0.84	0.84	1.11	0.89
			Medical Supplies	0.79	0.81	0.81	1.80	1.89	1.78	1.72	1.37
			Medical Equipment	1.09	1.25	1.08	0.46	0.44	0.42	0.39	0.73
			PPP	1.24	1.29	1.17	1.09	1.07	1.22	0.71	1.11
16.	Sweden	High-income	Medicines	1.60	1.61	1.55	1.47	1.51	1.53	2.00	1.61
			Medical Supplies	1.15	1.36	1.34	1.01	1.06	1.01	0.90	1.12
			Medical Equipment	0.40	0.36	0.41	0.55	0.49	0.41	0.50	0.44
			PPP	0.64	0.59	0.61	0.70	0.67	0.77	0.44	0.63
17.	Canada	High-income	Medicines	1.01	1.17	1.24	0.96	1.16	1.06	1.20	1.11
			Medical Supplies	0.82	0.62	0.51	0.89	0.85	0.88	0.84	0.77
			Medical Equipment	0.89	0.80	0.78	0.81	0.65	0.66	0.83	0.78
			PPP	1.06	0.97	0.93	1.45	1.26	1.50	0.98	1.16
18.	Denmark	High-income	Medicines	0.70	0.60	0.61	0.78	0.87	0.87	0.86	0.75
			Medical Supplies	3.31	4.38	4.27	2.52	2.20	2.05	2.54	3.04
			Medical Equipment	1.10	1.15	1.03	0.38	0.37	0.36	0.40	0.69
			PPP	0.99	0.99	1.00	0.76	0.80	0.94	0.59	0.87

19.	South Korea	High-income	Medicines	0.16	0.16	0.14	0.31	0.34	0.34	0.58	0.29
			Medical Supplies	1.26	1.51	1.59	0.87	0.89	0.81	1.45	1.20
			Medical Equipment	6.65	6.11	5.98	2.36	2.15	2.16	1.24	3.81
			PPP	3.19	3.32	3.67	2.67	2.63	3.23	1.37	2.87
20.	Poland	High-income	Medicines	0.43	0.40	0.35	0.70	0.48	0.42	0.48	0.46
			Medical Supplies	0.56	0.83	0.93	0.72	0.74	0.85	0.93	0.79
			Medical Equipment	0.16	0.24	0.32	0.70	0.80	0.89	0.84	0.57
			PPP	3.47	3.59	4.01	2.79	3.95	4.57	2.98	3.62
21.	Malaysia	Middle-income	Medicines	0.06	0.05	0.05	0.02	0.02	0.02	0.02	0.03
			Medical Supplies	0.08	0.07	0.07	8.00	7.87	6.88	12.86	5.12
			Medical Equipment	5.02	5.56	4.83	1.36	1.47	1.79	1.12	3.02
			PPP	9.27	9.65	9.71	1.34	1.35	1.85	0.67	4.83
22.	Hungary	High-income	Medicines	0.75	0.77	0.68	1.30	1.33	1.07	1.46	1.05
			Medical Supplies	1.72	2.00	2.60	0.83	0.90	1.01	0.93	1.43
			Medical Equipment	0.18	0.18	0.21	0.32	0.29	0.32	0.34	0.26
			PPP	1.59	1.46	1.49	1.45	1.36	1.79	1.00	1.45
23.	Hong Kong	High-income	Medicines	0.14	0.15	0.14	0.21	0.19	0.16	0.13	0.16
			Medical Supplies	0.14	0.15	0.16	0.61	0.58	0.63	1.06	0.48
			Medical Equipment	2.95	2.93	3.19	2.37	2.74	2.90	2.91	2.85
			PPP	6.82	6.50	6.37	4.40	4.28	5.28	3.13	5.25
24.	Czechia	High-income	Medicines	0.33	0.32	0.33	0.46	0.46	0.41	0.53	0.41
			Medical Supplies	0.83	0.72	0.69	0.82	0.80	0.76	0.71	0.76
			Medical Equipment	0.19	0.19	0.21	0.80	0.87	0.89	0.95	0.59
			PPP	4.42	4.55	4.49	3.85	3.80	5.00	2.92	4.15
25.	Israel	High-income	Medicines	1.90	2.11	2.30	2.08	1.49	0.63	0.39	1.56
			Medical Supplies	0.04	0.04	0.12	0.22	0.27	0.41	0.58	0.24
			Medical Equipment	1.63	1.35	1.15	1.41	1.88	3.56	5.73	2.39
			PPP	0.38	0.38	0.37	0.36	0.45	0.84	0.76	0.51

Tab. 2 – List of sample countries. Source: own research

Country	Medical product exports (USD billion) in 2019	Share of world's medical product exports (%)	Country	Medical product exports (USD billion) in 2019	Share of world's medical product exports (%)
Germany	138.47	14.52	Austria	14.67	1.54
USA	116.57	12.22	Sweden	13.70	1.44
Switzerland	89.91	9.43	Canada	13.34	1.40
Belgium	65.80	6.90	Denmark	10.54	1.11

Ireland	65.40	6.86	South Korea	9.84	1.03
China	51.56	5.41	Poland	9.29	0.97
The Netherlands	50.32	5.28	Malaysia	9.26	0.97
France	49.97	5.24	Hungary	7.86	0.82
Italy	42.87	4.50	Hong Kong	7.02	0.74
United Kingdom	38.24	4.01	Czech Republic	6.69	0.70
Japan	22.60	2.37	Israel	5.63	0.59
India	19.16	2.01			
Singapore	18.29	1.92	TOTAL	893.46	93.70
Spain	16.49	1.73	WORLD	953.58	100.00

Tab. 3 – List of medical products relevant to the COVID-19 pandemic. Source: WTO (2020)

Group	HS 2017	Short product description
Medicines (Pharmaceuticals)	300213	Immunological products, unmixed, … not for retail sale
	300214	Immunological products, mixed, … not for retail sale
	300215	Immunological products, … for retail sale
	300219	Immunological products, n.e.s.
	300220	Vaccines for human medicine
	300310	Medicaments containing penicillins, … not for retail sale
	300320	Medicaments containing antibiotics, … not for retail sale
	300331	Medicaments containing insulin, … not for retail sale
	300339	Medicaments containing hormones … not for retail sale
	300341	Medicaments containing ephedrine … not for retail sale
	300342	Medicaments containing pseudoephedrine "INN" or its salts, … not for retail sale
	300343	Medicaments containing norephedrine or its salts, … not for retail sale
	300349	Medicaments containing alkaloids or derivatives thereof … not for retail sale
	300360	Medicaments containing any of the following antimalarial active principles: … not put up for retail sale
	300390	Medicaments consisting of two or more constituents mixed for therapeutic or prophylactic uses, not for retail sale
	300410	Medicaments containing penicillins or derivatives thereof … for retail sale
	300420	Medicaments containing antibiotics, … for retail sale
	300431	Medicaments containing insulin but not antibiotics, … for retail sale
	300432	Medicaments containing corticosteroid hormones, … for retail sale
	300439	Medicaments containing hormones or steroids, … for retail sale
	300441	Medicaments containing ephedrine or its salts, … for retail sale
	300442	Medicaments containing pseudoephedrine "INN" or its salts, … for retail sale
	300443	Medicaments containing norephedrine or its salts, … for retail sale

Medicines (Pharmaceuticals)	300449	Medicaments containing alkaloids or derivatives thereof… for retail sale
	300450	Medicaments containing provitamins, vitamins,… for retail sale
	300460	Medicaments containing any of the following antimalarial active principles … for retail sale
	300490	Medicaments consisting of mixed or unmixed products … for retail sale
Medical Supplies	220710	Undenatured ethyl alcohol, of the actual alcoholic strength of ≥80%
	284700	Hydrogen peroxide, whether or not solidified with urea
	300120	Extracts of glands or other organs or of their secretions, for organotherapeutic uses
	300190	Dried glands and other organs for organotherapeutic uses; heparin and its salts, …
	300212	Antisera and other blood fractions
	300290	Human blood; animal blood …; toxins, cultures of micro-organisms and similar products
	300510	Adhesive dressings and other articles … put up for retail sale for medical, surgical, dental, or veterinary purposes
	300590	Wadding, gauze, bandages, and the like put up for retail sale for medical, surgical, dental, or veterinary purposes
	300610	Sterile surgical catgut, similar sterile suture materials,…
	300620	Reagents for determining blood groups or blood factors
	300630	Opacifying preparations for x-ray examinations; diagnostic reagents for administration to patients
	300650	First-aid boxes and kits
	300670	Gel preparations designed to be used in human or veterinary medicine …
	340212	Cationic organic surface-active agents
	340213	Nonionic organic surface-active agents
	350400	Peptones and their derivatives; other protein substances and their derivatives, n.e.s.; …
	350790	Enzymes and prepared enzymes, n.e.s.
	370110	Photographic plates and film in the flat, sensitized, unexposed, for X-ray
	370210	Photographic film in rolls, unexposed, for X-ray
	380894	Disinfectants, put up in forms or packings, for retail sale
	382100	Prepared culture media for the development or maintenance of micro-organisms
	382200	Diagnostic or laboratory reagents on a backing prepared diagnostic or laboratory reagents and certified reference materials
	392620	Articles of apparel and clothing accessories produced by the stitching or sticking together of plastic sheeting
Medical Supplies	401490	Hygienic or pharmaceutical articles
	401511	Surgical gloves of vulcanized rubber
	401519	Gloves, mittens, and mitts of vulcanized rubber
	701710	Laboratory, hygienic, or pharmaceutical glassware, of fused quartz or other fused silica
	701720	Laboratory, hygienic, or pharmaceutical glassware having a linear coefficient of expansion $\leq 5 \times 10^{-6}$ per kelvin within a temperature range of 0°C–300°C
	701790	Laboratory, hygienic, or pharmaceutical glassware n.e.s
	901831	Syringes, with or without needles, used in medical, surgical, dental, or veterinary sciences

Medical Supplies	901832	Tubular metal needles and needles for sutures, used in medical, surgical, dental, or veterinary sciences
	901839	Needles, catheters, cannulas, and the like, used in medical, surgical, dental, or veterinary sciences
Medical Equipment	841920	Medical, surgical, or laboratory sterilizers
	901050	Apparatus and equipment ….; negatoscopes
	901110	Stereoscopic optical microscopes
	901180	Optical microscopes
	901811	Electrocardiographs
	901812	Ultrasonic scanning apparatus
	901813	Magnetic resonance imaging apparatus
	901814	Scintigraphic apparatus
	901819	Other electrodiagnostic apparatus
	901820	Ultraviolet or infrared ray apparatus used in medical, surgical, dental, or veterinary sciences
	901890	Instruments and appliances used in medical, surgical, or veterinary sciences, n.e.s.
	901920	Ozone therapy, oxygen therapy, aerosol therapy, artificial respiration, or other therapeutic respiration apparatus
	902150	Pacemakers for stimulating heart muscles
	902212	Computer tomography apparatus
	902214	Apparatus based on the use of X-rays for medical, surgical, or veterinary uses
	902219	Apparatus based on the use of X-rays
	902221	Apparatus based on the use of alpha, beta, or gamma radiations, for medical, surgical, dental, or veterinary uses
	902229	Apparatus based on the use of alpha, beta, or gamma radiations, n.e.s
	902230	X-ray tubes
	902290	X-ray generators, high tension generators, control panels and desks, screens, …
	902511	Thermometers, liquid-filled, for direct reading, not combined with other instruments
	902519	Thermometers and pyrometers, not combined with other instruments
	902780	Instruments and apparatus for physical or chemical analysis, or measuring or checking viscosity, …
	903020	Oscilloscopes and oscillographs
	940290	Operating tables, examination tables, and other medical, dental, surgical, or veterinary furniture
Personal Protective Products	340111	Hand soap
	340130	Hand soap
	340220	Other cleaning products
	382499	Hand sanitizer
	392690	Face masks
	630790	Face masks
	900490	Protective spectacles and visors
	902000	Face masks