ARTICLES

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Global dynamics, impasses of SUS and HEIC as a way out of the crisis

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Abstract

This paper examines the context of production and innovation in health in Brazil and its response capacity to COVID-19 pandemic and discusses the possibility of connecting the assurance of universal access to health with a more equitable development pattern. It analyzes critical aspects of the geopolitics of innovation in health; how those dynamics interfere in the national sovereignty in health, as well as the main knowledge to be retained. Finally, we propose alternatives to avoid repeating the preventable difficulties that resulted from the pandemic. These alternatives arise from a shift in the perspective of public policy design and the incorporation of paradigms of the 4th technological revolution in public health, seeking to establish a structural connection between innovation and universal access in the context of the Unified Health System.

Keywords: Covid-19. Health Economic-Industrial Complex (HEIC). Unified Health System (SUS). Economic Development. 4th Technological Revolution.

Introduction

The new coronavirus has spread worldwide causing different reactions among the affected countries. Despite an effort by the World Health Organization (WHO) to coordinate initiatives multilaterally, responses to the pandemic occurred mainly according to competitive dynamics with less co-operation than what is necessary for systemic action. From the perspective of the Health Economic-Industrial Complex (HEIC), the response to crises such as that resulting from the pandemic must consider efforts of permanent rather than momentary and fragmented articulation. Such an articulation allows to configure structures capable of adapting and reconfiguring themselves to meet specific circumstances and emergencies. Since the response itself has a systemic character, it needs cohesion among the parts if it is not to compromise the capacities of the whole.

In the Brazilian case, this cohesion is managed constitutionally, with the guarantee of integral, universal, and equitable access to health, with the implementation of the largest universal health system in the world in terms of population (Brasil, 1996). The Unified Health System (SUS), however, faces contradictions and difficulties. Historically underfunded, SUS was created in a period of implementation of access and subsequent deepening of external vulnerabilities, followed by a budgetary stagnation amid growing demands to maintain the constitutional commitment to offering integral, universal, and free health in the Brazilian territory.

The scale of SUS is sufficient to precipitate tensions that permeate many subtopics in society, having an immediate impact on health, of course, but also on the economy, industry, technology, as well as international relations. The commitment to universal access generates a demand proportional to the challenge of ensuring promotion, prevention, and health care on a national scale, which exceeds the installed productive and technological capacity. In a country of continental dimensions, without the development of a productive and technological base focused on the needs of SUS, the progressive expansion of the universality of the system was accompanied by an increase in imports and the formation of growing trade deficits.

This is not only a trade deficit, but a synthesis of the external dependence of the Brazilian health and thus constitutes a vulnerability of access to health in the country. According to Gadelha and Temporão (2018), precisely in a period of expansion of the SUS and increase in access, structural blockade to development was presented as a vulnerability in health. The precariousness of the national productive structure in health, which reflects the development pattern historically adopted in Brazil, creates obstacles to the autonomy of the provision of health care for citizens. This reality, however, is not a spontaneous configuration in the country. On the contrary, it is a consequence of a specific international dynamic that condemns the countries excluded from a restricted set of generation and retention of knowledge to be dependent. The Covid-19 pandemic crisis intensifies these contradictions. The consequences of the Covid-19 pandemic are mainly translated by the characteristics of the dynamics of production and innovation in health that could be deduced or perceived before the pandemic, and which have now been opened up and put in the light of the public debate. In the Brazilian case, critical issues for the sustainability of SUS, which were already being discussed in specific academic, institutional, and political forums, were brought to the center of the national discussion on health assurance, sovereignty, and development. These issues will be investigated in the following.

Global Conditions of The HEIC and the Geopolitics of Innovation and Health Production

The international production and innovation system in the health area is concentrated and segmented. Few countries produce innovation and knowledge. The recent phenomenon of globalization itself helped in this international division of labor and became noticeable for a marked acceleration in the frequency and intensity of interactions among the countries worldwide, which involved the financial sector, communications, and transport, as well as the asymmetric organization of global value chains. There has been no process of overcoming the real international asymmetries

that historically distinguish the so-called developed countries from the others. What is valid is the traditional structuralist perception of the conformation of a clear center-periphery relationship within the global system, notably with regard to currency, knowledge, technologies and power relations, manifested in defense and also in critical strategic areas such as health.

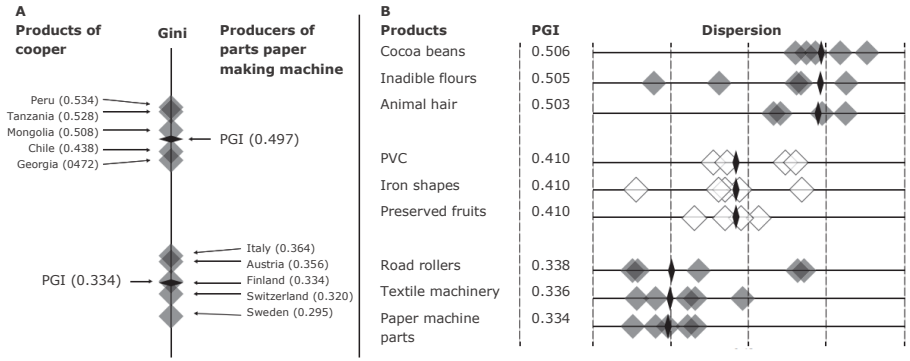
This is because the situation of global asymmetry, which structurally excludes countries, regions, and populations from access to health, is also a reflection of an international division of labor in which some countries become mere consumers of technology, while others define the current technological standard, which leads them to hold a geopolitical domain that focuses on public policies, including health (Gadelha *et al*., 2018).

According to Celso Furtado, "the countries that started on the right path had a diversified economy, while others focused on the production of raw materials, showing very little technical progress" (Brasil, 2003). The analysis of the international division of labor provides factors to help understand why some countries lag behind, while others can advance. There is a very close relationship between the productive structure, the lowest levels of inequality and the potential for promoting well-being.

Figure 1 was created based on the context of the analysis of Economic Complexity, a methodology developed at Harvard about ten years ago by associating productive sophistication and development (Hidalgo; Hausmann, 2009), and more recently disseminated in Brazil (Gala, 2017). This approach recovers the classical teachings of the structuralist school, although with some important gaps in terms of the recognition of the theoretical matrix of the ECLAC school, which has always explored the link between productive structure, model of society, and the need for State intervention to overcome the delay in a non-deterministic way.

It is possible to perceive the relationship between the complexity of the productive structures and the inequality captured by the Gini coefficient:

Figure 1 - Association between productive structure and the Gini index (2008)



Source: Hartmann *et al*., (2017).

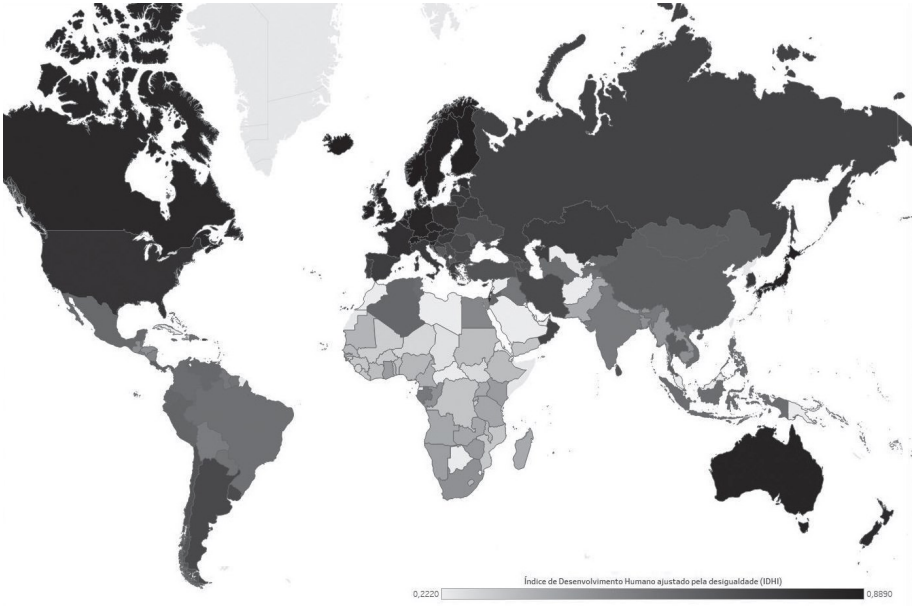
Notes: a) The product Gini index (PGI) is a weighted average of the Gini coefficients of the countries that export a product. The Gini coefficients of five copper exporters are grouped on the top of the graph. At the bottom, we show the Gini coefficients of exporters of papermaking machine parts. b) The three upper, three middle and three lower products are distributed by PGI values. The PGI value is indicated with a black diamond. The Gini values of the five countries that contribute most to each of these PGIs are measured with diamonds. All values are measured using data from 1995-2008.

It is reasonable to assume that the productive structure of a country is complex when the economy is diversified and when unique and original products are produced. Internationally, this experience of convergence has proven to be quite concentrated within a small group of leading countries and the incorporation of a few countries in the "developed" group, always with strategic and decisive geopolitical factors (for instance, Japan, South Korea, and China, more recently). In a way, inequality and polarization manifested themselves more explicitly in the conformation (or reaffirmation) of an essentially asymmetrical and unequal global order.

The following maps were prepared with the same perspective to show how there is a relevant degree of correspondence between the production of patents and the indications of human development and equity. Therefore, it

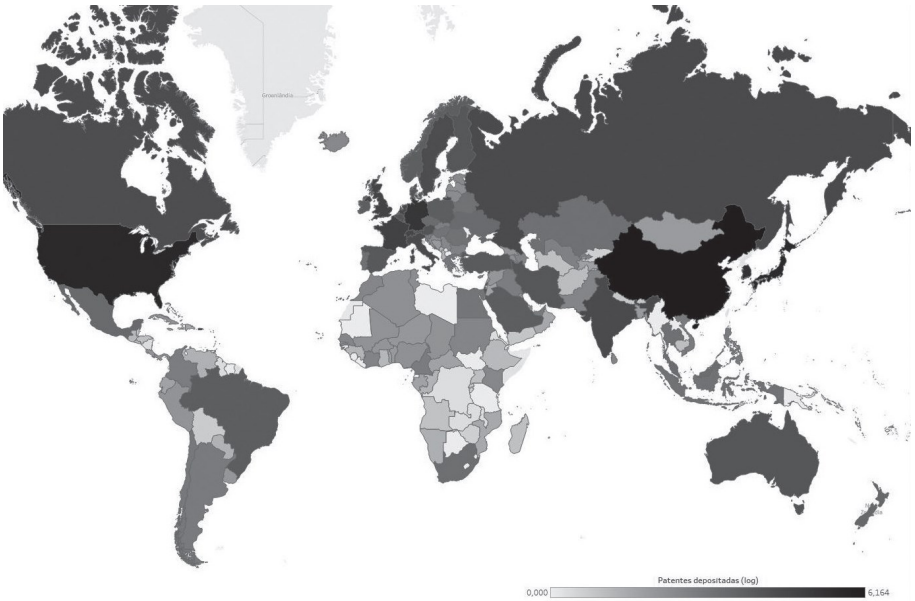
is possible to see the reproduction of asymmetries in multiple dimensions, which reflects a complex and interdependent social and geopolitical process between the institutional and political factors that lead to singular paths of development.

Figure 2 - Inequality-adjusted Human Development Index (HDI)



Source: Prepared by the authors based on data from the *United Nations Human Development Report* (2020).

Figure 3 - Patents filed (logarithmic scale)



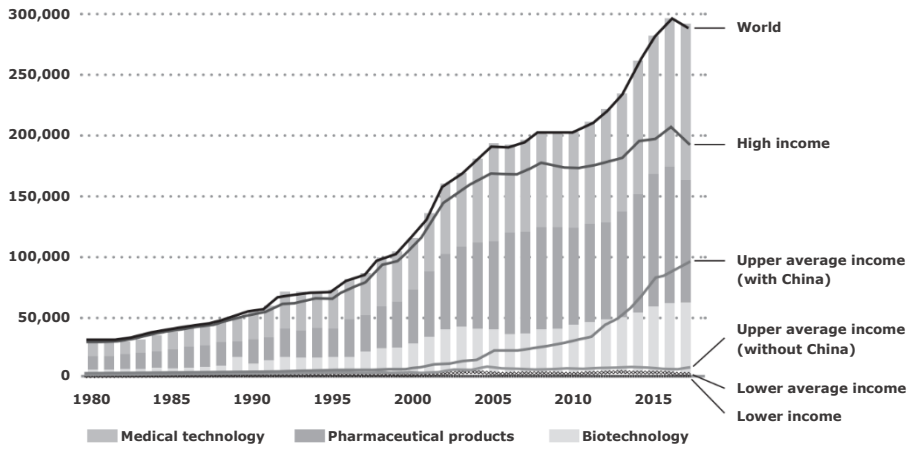
Source: Produced by the authors based on WIPO data (Dutra; Lanvin; Wunsch-Vincent, 2019).

With the exception of China, which stands out in the number of patents, there is a similar prevalence of darker areas in both maps. Such asymmetries of the global development pattern are expressed in several areas and have great importance in science, technology, and innovation (ST&I) activities. Only one hundred companies, for example, concentrate 60% of research and development (R&D) spending, 2/3 of which is spent in only three industries, namely, the computer, pharmaceutical and automotive industries (Belluzzo; Galípolo, 2017).

In turn, currently, only 15 global companies hold 60% of patents in biotechnology for the treatment of cancer and other chronic diseases. Patent indicators reflect the technological productive profile of the future. If patents are currently held by a small number of companies, it means more concentration and more asymmetry from a productive and technological point

of view to face future challenges in other pandemics, health problems, access to cancer treatment, mobility technologies, environmental sustainability, etc. Data on patent in the health area show this trend of higher concentration, as can be seen in Figure 4. The fact that only ten countries account for 88% of health patents evidences the increasing trend of asymmetries within the HEIC and an even greater fragility for the future.

Figure 4 - PCT (Patent Cooperation Treaty) files per technology, 2000-2018



Source: Dutra; Lanvin; Vincent, 2019.

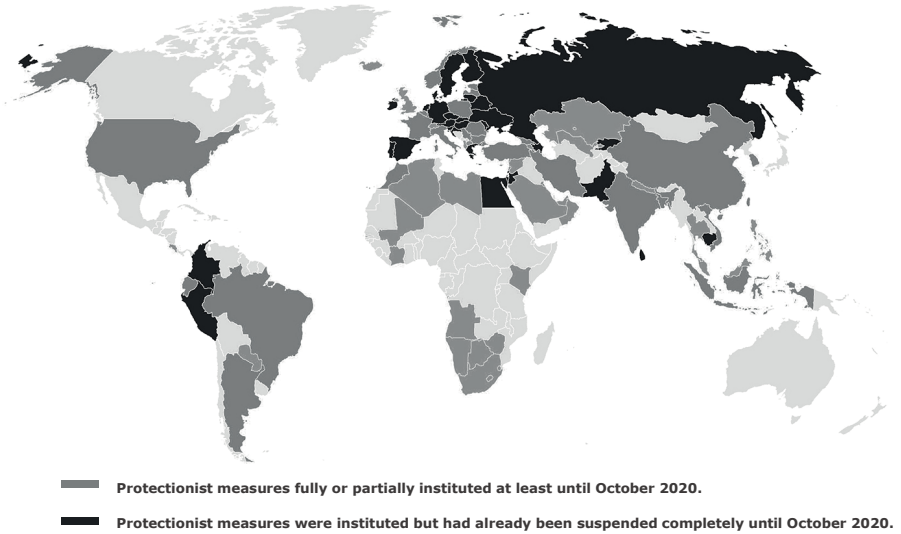
The asymmetries related to intellectual property are high in a pattern that is reinforced and accelerated. In this context, there are the technologies of the Fourth Technological and Industrial Revolution, the Health 4.0 – alluding to the ongoing technological transformation –, in particular, which is a point of convergence of this process. Artificial intelligence, big data, nanotechnology, biotechnology, genome editing, and additive manufacturing are strategic technologies that find in health the most promising applications of insertion in society. In this sense, the "natural" technological paths of the Fourth Industrial Revolution can amplify global asymmetries in the HEIC,

unless incisive and long-term public policies are adopted to promote a productive and CT&I basis to meet social needs and enable less vulnerable health systems.[1]

The pandemic crisis of Covid-19 tends to exacerbate the structural imbalance of access and development of technologies. This occurs because the great argument for promoting global value chains and deepening the international division of labor would be the efficiency and capacity that countries have to quickly adapt production in cases of changes in demand. However, in an environment of great uncertainty and weakening of the collective dimensions at the international and local levels, most countries – especially the most developed ones because of their importance in health trade – promoted exactly the opposite of simplistic or biased visions of globalization. Widespread restrictions were imposed on exports of essential products to combat Covid-19, which exposed and increased the social and economic vulnerability of populations and less developed countries in the context of international relations, as shown in Figure 5.

1 The technological path is not deterministic, but emerges from the interactions between the social, political and economic scenario. Democratization and equity in health research in the context of the Fourth Industrial Revolution depend on the existence of research, industrial production, and high-density knowledge services in the least developed countries.

Figure 5 - Barriers to the export of pharmaceuticals and medical devices/health supplies during the pandemic



Source: *Global Trade Alert* (2020).

Note: In total, 92 jurisdictions, 89 countries and three trade blocs (European Union, Southern African Customs Union and Eurasian Economic Union) restricted exports of health supplies and pharmaceuticals during some period in 2020.

At the end of March, 2020, there were a total of 54 barriers to the export of medical goods as a direct consequence of the sudden increase in demand as a consequence of cases of Sars-CoV-2. In October, 90 countries had already set up 215 barriers to the export of medical goods (*Global Trade Alert*, 2020).

The perspective of HEIC recognizes these global asymmetries regarding the creation of knowledge and innovation and the national productive structure as fundamental factors to understand the current international pattern and the growing monopolization of health production and innovation, by questioning the structure of the liberal aspect of globalization. A

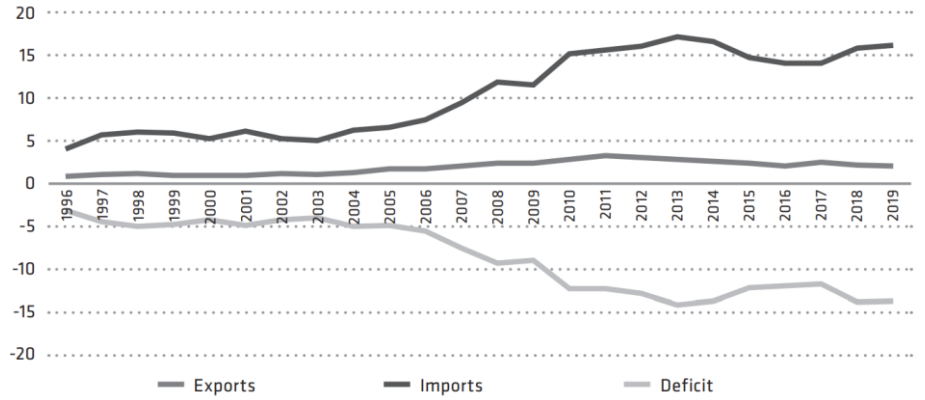
sustainable development agenda with an inclusive and more homogeneous pattern requires considering these complex geopolitical dimensions and how they affect the innovation and development of each country, requiring effective and not just verbal actions to implement, in fact, the meritorious objective of the 2030 agenda of not leaving any one behind. This objective can only be achieved in critical social areas such as health by reducing the global monopoly and with a greater variety of actors, countries, companies, and places where the process of knowledge generation and production and innovation takes place in the context of the Fourth Technological Revolution.

The impasses of SUS in the pandemic

Despite being historically underfunded, SUS comes from an important period of expansion and diversification of access. Together with the advancement of primary care, increasingly expensive and specific new technologies are entering its supply list. Added to this is the history of denationalization and deindustrialization experienced by the country, which made the supply of products that would guarantee the constitutional commitment to offer comprehensive, universal, and free health in the Brazilian territory vulnerable.

As the productive and technological base of Brazil has not evolved to meet the needs of universal access, the progressive expansion of the universality of the Unified Health System was accompanied by the penetration of imports, which led to increasing trade deficits, as can be seen in Figure 6.

Figure 6 - Trade Health Balance (1996-2019) – Billion



Source: Prepared by the authors based on the methodology developed by the Coordination of Prospecting Actions of the Presidency/Health Innovation Group CP-GIS/Fiocruz, based on data from the Comex Stat/MDIC (2020).

The high and constant deficit, together with the underfunding of SUS, jeopardizes the integrity of the health service, as it places it at the mercy of unstable and volatile macroeconomic variables. This is a delicate situation because the healthcare area, with its deficit close to US$15 billion/year, is the industry that accounts for the largest participation in the high-tech trade deficit in the country (Brasil, 2020).

Actions were taken to mitigate this process, perhaps explaining the stability of the "curve of dependence and vulnerability in health" even with a high level. However, the reversal of this level can only be achieved by a comprehensive and lasting industrial policy action articulated with the productive sector, since the expansion of public access to health technologies puts pressure on the demand for products of this strategic sector in the country. One way out of this situation of social vulnerability is the use of SUS' purchasing power, one of the largest in the world, for a more qualified acquisition of products and technologies, and may also involve regulatory activities that stimulate local production and innovation. The centrality in large volume negotiations on the one hand and the ability to promote

articulated and systemic development on the other, are important conditions to be developed. However, despite recent successes, SUS has been having difficulties with the use of this tool, since it requires legal certainty, institutional stability and long-term vision.

The Covid-19 pandemic enters this context and intensifies these contradictions, as it finds an environment in which the system of articulation and development of these tools was being dismantled. The Executive Group of the Health Industrial Complex (Gecis) was the most comprehensive and articulated industrial policy initiative in Brazil. It brought together 14 ministries, the National Bank for Economic and Social Development (BNDES), regulatory agencies and other bodies in the coordination of the interaction of public and private spheres (Brasil, 2008). For the first time in history, a ministry of the social area coordinated an industrial policy. It brought together instances of public policy, recognizing that health is an area of high sensitivity, vulnerability, and opportunity for the productive and technological development of the country. It was a group within several ministries aimed at production and technological development in health in liaison with the private sector. However, this procedure was dismissed in December 2017. In early 2018, the Ministry of Health's Department of Industrial Complex and Innovation in Health itself was demoted to coordination.

The Covid-19 crisis required both public agencies and private companies to act together with governments to supply the enormous demand for personal protective equipment (PPEs), tests, and medical devices, such as ventilators. It was not possible to gather the producers, demonstrate multi-year commitments and raise the issue of responsibility in relation to SUS and public demand, as European and Asian countries and the United States did. The initiative to bring together the main HEIC actors in a forum of government and civil society favored an environment of predictability and representation, and it was possible to test some cohesion between the parties with the reduction of information asymmetries and the convergence of public and private strategies around agreed commitments.

The crisis scenario evidenced the difficulty of sectoral articulations, in the absence of channels of this nature. Without this ability to articulate, attempts were made to centralize the acquisition of products and some bets of rapid

industrial conversion for some ventilator companies. Some clothing and related-product companies tried to produce masks, caps, and aprons.

Due to external restrictions, difficulties in our acquisition process, and other political and institutional factors, the success necessary to centralize the purchase of masks, tests, ventilators, and other products for the pandemic crisis was not achieved. States and municipalities were responsible for purchasing in the foreign market, and many of them were victims of opportunistic behaviors. Prices of essential goods showed high variation, and the national acquisition system proved to be relatively inflexible to meet the external acquisition models in the context of Covid-19. The effect of this condition and this growth in demand was the significant increase in the prices of these purchased goods when it was possible to buy them.

In the case of ventilators, which appeared as a prominent example of health vulnerability, the increase in dependence was already evident before the pandemic, as in this century the number of imports of ventilators tripled to a level of US$52 million. In addition to these data, there are other characteristics of the current context, as can be seen in Table 1:

Table 1 - Domestic production of ventilators

Company	Ventilators Transport/ Month	Ventilator Bedside ICU/ Month	Total/ Year
Intermed (USA)	-	100	1200
Leistung	-	50	600
Magnamed	130	50	2160
KTK	50	30	960
TOTAL	**180**	**230**	**4920**

- 1999: US$9.72 million in imports
- 2019: US$52.22 million in imports
  Amounts in US$ million, updated by the CPI/USA
  Source: Authors' survey, 2020

- Marked Technological vulnerability of SUS
- Asymmetrical economic and political power
- Since the beginning of the pandemic, more than 90 countries have established export barriers, including developed countries

Source: Data collected by the Ministry of Health in April 2020.

Note: By looking at the website of the Brazilian National Health Surveillance Agency (Anvisa), sixty records of mechanical ventilators were found. Seven are from national manufacturers, and effectively only four produce and only three have national capital: 1) KTK Indústria, Importação, Exportação LTDA.; 2) Leistung Equipamentos LTDA.; 3) Magnamed Tecnologia Médica AS; 4) Intermed Equipamento Médico Hospitalar LTDA. The latter was purchased by Vyaire, formerly Carefusion, from the United States, in 2012 (Vieira, 2012).

The capacity of response influenced by the limitation of the national production caused by technological and productive gap showed that, while the demand for health expanded, the productive and technological base did not evolve at the same pace. Currently, only four companies produce ventilators in Brazil, but most of its parts are imported from critical technological components. As early as 2019, 60% of local production depended on imports, and, looking at it more carefully, it is possible to identify that, in the more sophisticated items such as software and sensors, 80% of the demand depended on imports.

The consequence of this traditionally dependent and fragile market from the point of view of the global value chain was the enormous difficulty in acquiring equipment. In addition, after choosing to purchase in the domestic market, there was a pronounced delay in manufacture because some critical technological components are not produced in Brazil. The same behavior translates into the difficulty in formulating a systemic response to the crisis, as evidenced by the lack of pharmaceuticals necessary for patients on mechanical ventilation (there was even a shortage of anesthetics for intubation of patients). In addition, it also reveals the need to understand the interdependence between the HEIC subsystems in order to avoid a perspective imprisoned by a single topic.

Purchasing power, however, can be used in a more structured way and connected with the process of technological development. Multiple public policies, which should advance with institutional learning, were rooted in the HEIC concept and adopted in the last decade, demonstrating that Brazil has the institutional, scientific, and productive capacity to aim for a less vulnerable position in relation to guaranteeing access to health.

The most consistent example, among the mechanisms formulated in this framework, are those of Product Development Partnerships (PDP). It is a collaboration between public institutions that produce strategic health products and CT&I and private companies aimed at meeting the specific demands of SUS and giving the Brazilian State sufficient bargaining strength to mitigate national technological dependence.

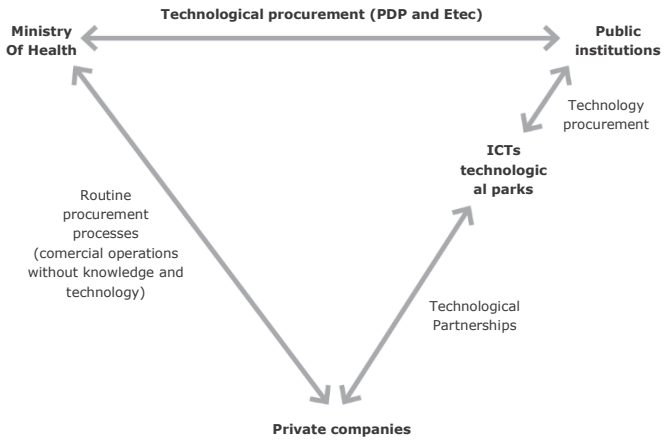
In summary, the Ministry of Health (MS) guarantees PDP partners a portion of the public market, which can vary from 25% to 100%, of a given

medication for a certain period. On the other hand, the technology of this medication must be fully transferred to the public institution. The intention is to convert the immense demand of SUS into an incentive for technological cooperation that would hardly occur spontaneously. There is no direct investment of the Ministry of Health in public institutions (these can be obtained by other complementary programs) or in the private entity. The economic and health advantage will occur by ensuring price and quantity stability in the supply of strategic products for SUS and, above all, by internalizing technological platforms in Brazil that, for example, allow the country to have the capacity to produce vaccines for Covid-19 with high responsiveness, in the face of global dispute. For this process, it is critical to consider the transfer of technology, local training, reduction of dependence, and sovereignty for the national health policy. The advantage for PDP participants is to have a market horizon to enable what is strictly an innovation for the country context (following the international definition and the Country Innovation Law).

For this to be possible, the Ministry of Health has to play the role as coordinator of SUS, centralizing the acquisitions of the input in question, or establishing a PDP with products with already central purchases. This issue is relevant since, thanks to the decentralized nature of SUS, acquisitions tend to occur in a diluted way, which makes it difficult to use the potential of the state's purchase power.

It should be noted that, strictly, PDP is a technological procurement for products with high technological content and with risk in the absorption and internal development process, focusing on reducing the huge technological gap in relation to global production. This format of productive and technological articulation guided by social needs can be seen in Figure 7:

Figure 7 - The PDD and Etec Model as a basis for overcoming vulnerability



Source: Prepared by the authors, 2021.

This same figure shows the recent institutional progress in formalizing the technological procurement instrument that differs from PDP, as it is aimed at global innovations of technologies that are not yet available in the world market (Brasil, 2018). The bet of Brazil, Fiocruz, and particularly Butantan, relied on these two instruments. Fiocruz's technological capacity in biopharmaceuticals and Butantan's capacity in viral vaccines, based on complex technologies obtained by the PDP instrument or analogs (the process of technology transfer in vaccines was not usually called PDP, but strictly followed the logic of this instrument), have paved the way for the agreements and led Brazil to an unprecedented position in the global market for the production of a new vaccine globally, together with innovative institutions, companies, and countries.

Today, Brazil is prepared to produce vaccines for Covid-19 because Fiocruz and Butantan have accumulated historical capacity to conceive a project in partnership with the private sector for technological appropriation, development and large-scale production, by simultaneously including the

State, the business sector and the CT&I institutions around a clear national and global challenge. Undoubtedly, this is the most important contemporary example that confirms the HEIC's conceptual hypothesis that the development process is, at the same time, an articulated economic and social process. The productive and technological base faces the greatest challenge of SUS nowadays.

Lessons from the crisis and the HEIC

The main perceptions from the pandemic context are related to the binomial between limited production and internal technological capacity and the challenge of meeting social needs, which requires instruments of national articulation. The reduced national production does not only have to do with the fact that the country, with its internal production, was not able to respond to the demand created by the pandemic. Even the main producing countries faced difficulty in meeting the needs of their respective health systems, but the capacity of responding to those needs proved to be absolutely dependent on the existence of universal health and production-based systems with prior innovation, especially in the industrial sector and in the most qualified services.

The consequences of the narrow production base, which is traditionally dependent on the external sector, have shown the difficulty of purchasing essential products. The difficulties encountered in the policy of industrial conversion have revealed the importance of having a production base with accumulated previous capacities to ensure the sensitivity and agility necessary for a policy of conversion of production. There have been several errors in public procurement processes, and, for all intents and purposes, the projected demand has not been met.

Therefore, the country is not only dependent on products but mainly on knowledge, a dependence arising from the "lack of know-how". The Covid-19 context therefore reinforces the need for coordinated action by the State in the role of guiding the products and technologies that are critical for the country. This gap contributes to the difficulty of articulation with private

industrial sectors in a zero-sum dynamics. It became evident that it was necessary to adopt a perspective to profit from the robustness of the internal market, enabling a long-term strategy in which the social rights and demands of SUS should be conceived as viable alternatives to resume development.

There is a concrete global process of blocking local production and technological development initiatives, and this should not be treated ideologically. This process is widely known. Global oligopoly practices often follow this road map when countries seeking for national development attempt to respond. The steps are usually as follows: 1) a national production project is approved to reduce the vulnerability of the health system; 2) the leading competitors of the international oligopoly initiate an attack and practice predatory prices to disrupt and delegitimize the initiatives; 3) national production is judicialized or questioned by control bodies and state leaders when they have a short-term perspective; 4) these events disturb the predictability of public and private institutions that have bet on the development of this national productive sector; 5) production is paralyzed and the conditions of the oligopoly domain of the market are restored; 6) the health system remains vulnerable and dependent.

The vicious circle of underdevelopment shown in another article in this magazine is also seen in the health area, not only due to a technical issue but above all because of a global competitive struggle in which the interests that maintain the monopolistic images in health become hegemonic, including in the field of ideology and vision that permeates the state apparatus itself and public policies.

The policy guided to innovation is judicialized and criminalized and it is common to face accusations of overbilling. There are also much more subtle mechanisms, including those within public policy bodies, in which the short-term perspective of allocative efficiency overlaps with the long-term perspective of efficiency for development. In the end, the local production initiative is aborted, and the companies that are global leaders and could be attracted to produce in Brazil, as in the case of vaccines and other products supported by PDPs, dominate the local market again, only to sell products and not to generate wealth and reduce the vulnerability of SUS. And, in this process, the price returns to the old highest or most speculative levels, as

seen in the case of respirators, PPE and HEIC products in general.[2]

In fact, the fragility of the productive technological sector in the face of the pandemic expresses the more general conditions and weaknesses of the country's development pattern. Since 1980, the Brazilian economy has been characterized by a long process of deindustrialization associated with the regressive specialization of the productive structure and "reprimarization" of the export agenda towards commodities and intensive manufacturing in natural resources.

It is important to distinguish the specialization in natural resources from the diversification of the productive structure, since it is the lower presence of technology-intensive sectors, and not the export specialization, that distinguishes Latin American economies.[3] Thus, the regressive specialization of the Brazilian economy, accentuated in the last five years, should be understood in a broader framework of reproduction of a productive base unable to maintain itself and be ahead of dynamic sectors, which is expressed, simultaneously, in the flagrant insufficiency of qualified formal jobs and the vulnerability of social policy.

The pandemic just made everyone realize earlier that the strategy of recent years is regressive from a social and economic perspective. The search for increased competitiveness based on the emphasis on low value-added activities and segments with low social impact, to the detriment of industrial policies and investments in science and technology (S&T) linked to national challenges, has hindered the national response capacity.

The competitiveness, degree and modality of insertion in global production chains depend notably on the quality of infrastructure and industrial policies

2 Another example of barriers to innovation if there had been a national production initiative for a new generation of mechanical ventilators two years before. They would probably be more expensive than their international counterparts, as well as this cost difference would probably be enough to define the purchase of imported devices. During the pandemic, however, buying ventilators, no matter how expensive the prices were, was simply not possible.

3 The export of natural resources exceeds 40% of the total in high-income countries such as Australia, Canada, Denmark, Finland, Ireland, Norway, and New Zealand. The diversification of the productive structure was mainly due to the increase in per capita income and domestic demand. Exports were essential to avoid the external restriction on growth, but it was the expansion of domestic markets that led to the modernization of the productive structure and then to the diversification of the export agenda. This strategy was quite different from that verified in Asian countries, where the increase in per capita income and the modernization of the productive structure resulted from manufacturing exports (Medeiros, 2015).

that, along with the purchase of technology and investments in ST&I, generate technologies and investments in critical national production chains, allowing the country to move through the production chain and advance in the production of innovation and in the appropriation of the results of the technological progress (Coutinho, 1994; Medeiros, 2015).

This appropriation occurs not only due to the compensatory distribution of resources, but above all due to a productive capacity that generates employment, better wages, inclusion, opportunities for innovative enterprises and that reduces the vulnerability of universal welfare policies.

Health as a structuring way out of the crisis and entry into the Fourth Technological Revolution

In view of the context of the Fourth Technological Revolution and the specific characteristics of the Brazilian economy, it is possible to consider health as an economic, productive, and technological system, with high dynamism and high social impact. Health represents 9% of the gross domestic product (GDP); 9% of formal jobs; 1/3 of the country's research effort, and is one of the areas of greatest innovation, being key to Brazil's entry into the Fourth Technological Revolution, focused on welfare, quality of life, and environmental sustainability.

The construction of a welfare state in Brazil can leverage national development and the industry, in particular, and the social demand must be incorporated by industrial and innovation policies. One has to face the challenge of overcoming the "short-term" logic (without dynamism and deeply identified with financial interests), to, from a systemic perspective, strategically build policies that relate the structural issues of economic growth with the confrontation of the enormous inequalities and deficiencies of the country.

That is, social rights not only "fit into GDP", but, by converting them into major national challenges, are structural sources of demand for the productive sector and a pole of technological modernization in the country. They can and should be seen as part of the solution to the current crisis,

generating income, employment, investments, innovation, and taxes, allowing a progressive adjustment but not a civilization regression. The pattern of detached development of social areas leads to the dichotomy between welfare and development, a false dilemma that needs to be overcome so that social demands can be understood as a valuable opportunity to adopt a model of society that is supportive, inclusive, dynamic, and sustainable, resulting in a structured insertion in the Fourth Technological Revolution.

Final Considerations

The Sars-CoV-2 pandemic is a global tragedy. There is no positive outlook in this regard. But, undoubtedly, public policymakers should learn as much as possible from this reality. Therefore, attention should be given to the data revealed by the pandemic: we live in a context of emergence of a new industrial pattern; global dispute is deeply asymmetric; sectors of great technological complexity require large investments and access to knowledge and technology that are concentrated in central countries. When it was more important, the multilateral approach was completely overshadowed by unilateral actions. Health is a strategic sector, and that is why global value chains tend to disarticulate in times of pandemic crisis, since the natural reaction of each country is still the resolution of internal issues, especially in the context of a crisis in post-war global governance.

In addition, Brazil has a large population, whose access to health is guaranteed by the Constitution. There is even sufficient normative and political maturity to identify the simultaneous emergence of these factors as important opportunities for our society. Thus, SUS can establish itself as a powerful hub for technological modernization in the country, with a high impact on welfare. The guarantee of universal access to health together with competence in the HEIC and CT&I, as verified in the potential of the vaccine for Covid-19, allows us to give concrete answers to the population.

Therefore, it is necessary to strengthen HEIC, since there is no single response to systemic crises, and it is essential to have environments for the

coordination of national efforts, especially in strategic areas, so that the learning process occurs to deal with and overcome crisis situations and so that we can face the challenges of the present and the future in building a dynamic economy and a structurally fairer society.

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