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The Health Economic-Industrial Complex 4.0: for an integrated vision of economic, social, and environmental development

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Abstract


COVID-19 pandemic is one of the most important phenomena of recent history. The current national and global context has dramatically revealed the correctness of the central hypothesis of HEIC research program, which indicates the endogenous, analytical and political interdependence between social and economic dimensions of development. In the light of the challenges presented by the current technological, economic, and social transformations intensified with the pandemic, this paper points to the need of political-theoretical boldness to overcome false and linear dichotomies and rethink development strategies. Finally, it suggests a new agenda for the HEIC research program, incorporating the challenges raised by the contemporary transformations and pointing out ways so that health and well-being are thought as possibilities to overcome the historical impasse of development, in a systemic and structural approach committed to economic dynamism, social needs, and nature.

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

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Underdevelopment, like the god Janus, looks both forward and backward and it has no definite orientation. It is a historical impasse that spontaneously can only lead to some form of social catastrophe. Only a political project supported by consistent knowledge about social reality can break its perverse logic.

Celso Furtado, 1992.

1. Introduction

The Covid-19 pandemic is one of the most important phenomena in recent Brazilian and global history. Millions of cases and deaths caused by the new coronavirus have impacted several material and immaterial spheres of life organization, in addition to making structural trends evident in a world whose economic and social relations are increasingly marked by connectivity and social interdependence. Faced with a crisis of such magnitude, the challenge of thinking about theoretical perspectives that are not limited to dealing with circumstantial and unforeseen elements, but also with the structural dimensions related to the global and national development pattern, arises. This article aims to discuss the concept and research program of the Health Economic-Industrial Complex (HEIC) and argues that, from this perspective, it is possible to propose analyses and concrete answers to the social, political, technological, economic, and environmental challenges that the world has been facing in recent decades and which have been amplified by the pandemic.

The theoretical hypothesis, with political developments of the research program that guides the conception of HEIC, is that an equitable society committed to social rights and life is only viable with productive, technological and innovation grounds in health that supports it, with an endogenous relationship between the social and economic dimension of development. The new coronavirus pandemic has tragically confirmed this hypothesis and, at the same time, the lack of schools of thought that perceive the economic world as an isolated system of society and politics.

As in any complex system, the confrontation of the health emergency simultaneously led to the convergence of several activities, involving the capacity to treat and analyze epidemiological data the production and availability of Personal Protective Equipment (PPE) for health professionals, a wide supply of masks, gloves and hygiene and cleaning materials in the context of an extremely vulnerable population and without basic water and sewage resources, large-scale industrial production capacity of molecular diagnostic tests and examination processing in diagnostic centers, a network of services that involves primary care and Intensive Care Unit (ICU), technological and industrial capacity for the scale production of fans, medicines, and vaccines (Gadelha, 2020).

In fact, the confrontation of the pandemic mobilizes a productive, technological, and innovation economic system of high complexity, which involves several industries and services and the organization of health systems as interdependent dimensions. The current national and global context revealed the correctness of the central hypothesis of the research program that has been developed at Oswaldo Cruz Foundation (Fiocruz) for about two decades, indicating the analytical and political interdependence between the economic and social dimensions of development. In this research program, health is now seen as a clear and prominent space of reproduction of capitalist dynamics in its tense articulation with life, politics, and society, overcoming the fragmented and sectorized views that sometimes treat health as an externality (or as mere human capital) or as a specific and insulated field of social policies. The pandemic emphasized the importance of treating health as a space for both economic and social development to overcome the false and linear dichotomies between these spheres and help to rethink national and global development strategies that integrate and guide the expansion of economic activity to meet social needs and environmental sustainability.

In the second section, the article shows the set of challenges posed by the technological, economic, and social transformations that have been occurring since before the pandemic. The third section shows that any effective response to these challenges necessarily involves the adoption of a theoretical perspective that starts from the articulation between the economic and social

dimensions of development. In the fourth section, the concept of HEIC is presented from both descriptive and analytical perspectives. The fifth section discusses a new agenda for the HEIC research program in the context of the Fourth Technological Revolution, which incorporates the challenges posed by contemporary economic and social transformations. The final considerations show ways for health and well-being to be thought of as possibilities for overcoming the historical impasse of development, currently faced in Brazil and worldwide, requiring a systemic and structural approach committed to economic dynamism, social needs, and nature.

2. Ongoing Technological, Economic and Social Transformations

Brazil is inserted in a national and global context of profound social, technological, and economic transformations that will have a decisive impact on social welfare systems, and particularly on the health area and the Unified Health System (SUS).

According to IBGE, in the next twenty years, Brazil will have a population growth of 9.5%, accompanied by a profound demographic and epidemiological change. The population over 60 years old will increase from 30 million to 54 million people, representing more than 23% of the population. Within this range, there will be almost 11 million people over 80 years old.¹ Epidemiological complexity will increase, with the predominance of chronic diseases in the burden of diseases, but without a linear transition process (Frenk *et al.*, 1991; Araújo, 2012). Communicable diseases and health emergencies, as revealed by the Covid-19 pandemic, will continue to play a key role in healthcare and in the SUS agenda, especially in a scenario of climate change. Finally, violence and other external causes, such as traffic

1 Based on the projection of the population of Brazil, carried out by the Brazilian Institute of Geography and Statistics (IBGE) for the years 2020 and 2040 (IBGE, 2018).

accidents, can reinforce the pressures on SUS management and financing. The health scenario of the 21st century, therefore, will be characterized by a context of high complexity and a huge challenge for the Unified Health System (SUS) to consolidate itself as a universal system.

The advance of the Fourth Technological Revolution and its pervasive technologies has health as a privileged area for development and interaction, posing enormous threats and showing potential (Schwab, 2017; World Economic Forum, 2019; Gadelha, 2019). Digitization and connectivity between people and things, artificial intelligence, use of large databases (big data), genetics and biotechnology, nanotechnology, neuroscience, new forms of energy generation, and distribution, life in cities and territories, new materials and a whole set of new “combinations” (according to Schumpeter's classic definition of innovation) form a block of innovations with enormous potential to revolutionize the technical bases of capitalism, with an intense automation movement based on the use of intelligent machine networks, without social appropriation of productivity gains (Belluzzo, 2014). The Covid-19 pandemic accelerated the movement to disseminate the use of technologies from the Fourth Technological Revolution, intensifying the dissemination of remote digital technologies in the area of health and social life in general (Magalhães; Couldry, 2020).

Technological progress has significant potential to improve quality of life. It provides opportunities for promoting intelligent epidemiological surveillance, a primary care that takes advantage of digital technologies to expand the tools for healthcare providers, as well as for an overly complex care based on genomics, among other possibilities. On the other hand, the Fourth Revolution also brings the immense risk of losing a collective view of health and solidarity, based on hyper-technification and greater segmentation of health care. Science, technology, and innovation are not neutral. Society guides innovation, which, therefore, may generate benefits, but also increase fragmentation, exclusion and inequality, according to the pattern and direction of technical progress and its social use.

The Fourth Technological Revolution also erodes the boundaries between fields of knowledge, between the biological and material worlds, and between sectors related to the production of goods and health services, causing a

radicalization of the systemic character of health that can no longer be ignored. The production of health innovations becomes more complex, as it involves a set of distinct knowledge bases, the boundaries between the industrial and health services sectors.

The possibility of a structuring, systemic, and, at the same time, effective and efficient public intervention, which takes advantage of the opportunities of the new technological paradigms to promote the sustainability of SUS and welfare systems in this new context, demands the understanding of these processes and the approximation of different fields of knowledge, involving, in particular, the political economy and the field of public and collective health, as well as several areas of the social, human, exact, and biomedical sciences. Guiding these transformations only to a fragmented mercantile logic means, on the one hand, losing effectiveness in the policies of economic and technological development in health and, on the other hand, perpetuating only a compensatory pattern – when possible – of public policies in health, which reinforces the segmentation of society.

The described social and technological trends are intrinsically linked to the ongoing economic transformations in recent decades. The increasing role of markets, agents, and financial institutions in health systems, in a phenomenon of “financialization” of health (Braga, 1985; Bahia *et al.*, 2016), is intense and different among countries and regions of the world. The predominance of financial logic reorganizes the productive forces, strains the course of the Fourth Technological Revolution and limits productive development in several regions of the globe, with impacts on the well-being of several groups, especially the most vulnerable ones, which do not have access to social protection systems. Therefore, it is essential to update the political economy that discusses dialectically the capitalist dynamics in health and the specificity of the periphery in the current context of transformation, articulating the financial logic inherent in capital with the concrete spaces of capital accumulation, innovation and social protection systems.

Deepening the movement of internationalization and concentration also presents challenges for the articulation and development of the productive and technological base of health, particularly the effort to develop local capacities. The contemporary panorama reveals growing economic and power

asymmetries that reiterate the central-periphery pattern in multiple themes and geographic scales.

As a result, the relation between national development pattern and the possibilities and structural limits to make a universal health system viable in Brazil is consolidated.

In this context, it is essential to understand the current set of transformations that impact universal access, at the risk of perpetuating ineffective public policies that are incompatible with the current context. Therefore, the analysis of these trends is essential not only to think about the future of welfare systems, but to guide actions in the present that aim to transform the future by guaranteeing social rights to knowledge and development.

3. The Dialectic of Capitalist Development and The Endogenous Articulation between Economic and Social Dimensions

The perspective on which the HEIC approach is based is related to an effort to think about health from the references of schools of the political economy of development. Regarding this topic, the intention is to “take a step backwards” to recover the classic basic lines of this approach and then demonstrate how it “works in health” based on the concept of HEIC.² The starting point refers to the vision of capitalist development as a process of permanent transformation in the economic and social structure (Marx, 1996; Schumpeter, 1983). The system develops as it transforms, incessantly destroying old structures to create new ones. This incessant process of transformation of the productive and social base, captured in the concept of

2 This topic intends to establish a dialog with readers in the field of collective health who have not experienced the theoretical path of the political economy of development. At the same time, economists who follow this tradition emphasize the leap that needs to be made, returning to the classics, to analytically integrate the field of social policies according to development, beyond an isolated, compensatory and exogenous perspective of its relationship with structural economic change.

innovation, was observed both in the Marxist perception and in the Schumpeterian process of “creative destruction”.

The historical, concrete movement of capitalism can be understood by analyzing how social and political forces dealt with the contradictory dynamics between capital expansion and accumulation, and the immanent tendency of the capitalist system to generate asymmetries, exclusion, inequality, loss of social legitimacy, and unsustainability.

Keynes, in turn, under the influence of the spirit of his time, theoretically demonstrated the contradictions between the determinants of investment – defined in conditions of uncertainty, not subject to probabilistic calculations – and effective demand, providing the conceptual basis for the formation of a pact between market and society, manifested in the conception and policies that originated the post-war welfare state.

Without entering the enormous diversity of the experiences of developed capitalist countries, the tragic experience of the first half of the twentieth century led to the formation of a post-war convention that associated the acceleration of capital accumulation, growth, innovation, and mass consumption with the promotion of state intervention in sustaining investments and guaranteeing rights and social protection. This convention extended throughout the second half of the twentieth century, although the impulses of the immanent logic of capital already manifested themselves after the “thirty glorious years” (Erber, 2007).

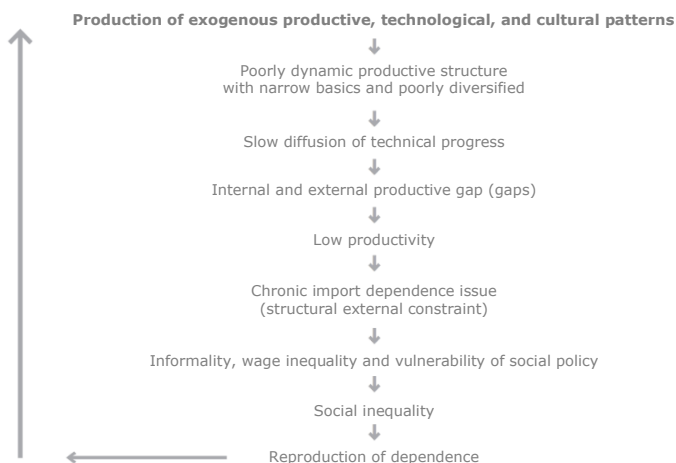
At the international level, this experience of virtuous convergence proved to be quite localized in a small group of leading countries, albeit opening space for some developmental experiences, such as the Brazilian one, and with the incorporation of a few countries in the “developed” group, always involving decisive strategic geopolitical factors (such as Japan, South Korea and, more recently, China). In a way, inequality and capitalist polarization manifested themselves more explicitly in the conformation (or reaffirmation) of an essentially asymmetrical and unequal global order.

The ECLAC school was the one that best captured these global asymmetries long before the “modern” theories of economic complexity. Underdevelopment is understood as a peculiar form of integration into global capitalism and not a stage that all countries have gone through or must go

through in their development process (Furtado, 1964a; Prebisch, 2010). Originally, Celso Furtado was the developmentalist who made the most remarkable advance in the connection between investment, industrial development, and productive transformation with social needs and the model of society. The social and economic structures are intrinsically linked, as revealed in the case of the Brazilian development.

Figure 1 illustrates the vicious circle of underdevelopment in an approach that integrates the productive base with the reproduction of social relations committed to delay and dependence, overcoming any deterministic view of the productive base on the development process that involves, inseparably and by definition, well-being, quality of life and relationship with nature.

Figure 1 - The internal dynamics of peripheral capitalism: endogenous relationship between productive and social structure



Source: Author's elaboration.

The logical-historical chain of reproducing technological-productive dependence then starts from the observation that the Brazilian economic structure is characterized by the external determination of capitalist

accumulation, a heritage that remains even after the effort to internalize sectors carried out in the industrialization process. A disjointed economic system of national interests that historically reproduces a productive base unable to maintain itself and be ahead of technologically more advanced sectors (Furtado, 1999) and that generates structural weaknesses even for social policies.

On the one hand, the reproduction of this economic structure limits the growth potential of the Brazilian economy and makes social policies vulnerable to external relations. The external constraint is structural, and the balance of payments is the great expression of dependence and delays in technology. On the other hand, it is simultaneously reflected in the chronic problems of the labor market³ and in the vulnerability of social policy, encapsulating the social area in its compensatory functions, without the ability to constitute itself as a dynamic element.

In its dynamic movement, the Brazilian economic structure inexorably leads to the reproduction of a social structure based on dependence and inequality, engendering a vicious circle. Economy may present cycles of growth, according to the experiences of the periods of industrialization in the twentieth century. More recently, in the 2000's, however, the structural problems related to technological-productive dependence persistently show themselves, restoring – in an exacerbated way – the condition of economic and social vulnerability.⁴

Overcoming underdevelopment necessarily involves understanding this reality and overcoming old epistemological boundaries that split the social, economic, and environmental world into different dimensions. The growing international, national and regional asymmetries derive from the dialectical “nature” of the capitalist development process and suggest the existence of an endogenous relationship between the productive and the social structure. From this perspective, economic, and social delays are understood as distinct dimensions of the same problem, underdevelopment, which is expressed

3 Marked by informality, founded on low wages and with very few qualified jobs associated with the middle class.

4 The collapse in the supply of mechanical ventilators at the peak of the Covid-19 pandemic crisis was, at the same time, consequence of economic and social vulnerability, showing the clear endogenous interdependence between these dimensions. The pandemic crisis was necessary for this perspective to be seen more clearly by economists.

internationally as asymmetries between countries and nationally as structural heterogeneities.

The analysis of the work of the exponents of Latin American structuralism reveals that it is a huge mistake to generalize that development thinking was associated only with the idea of industrialization at any price, without incorporating the social and environmental dimension of development. In almost of Furtado's works, the dilemma between the transposition of a pattern of exogenous consumption and the reproduction of the conditions of marginalization of the population regarding technical progress appears at the core of his vision. His statement that industrialization and growth alone are not sufficient conditions for development was explicit and recurrent and may represent enclaves that strengthen only the mimetic consumption of the elites of underdeveloped countries (Furtado, 1992).

Nevertheless, the symmetrical error is to disregard the logic of capital, the productive transformation and the capacity for innovation as essential factors of sovereignty and development of the productive forces for the design and implementation of national development projects in their economic and social aspects. One could say that this dialectical characteristic of development was largely neglected, engendering simplistic dichotomies that place in antagonistic positions the social practice and the generation and absorption of technologies or economic and socioenvironmental development, as if they were “worlds” that could be understood in isolation and whose state intervention could be compartmentalized, even under the most comprehensive mantle of social policies, on the one hand, and economic policies, development, and science, technology and innovation (ST&I), on the other.

The quote below by Celso Furtado summarizes the dimensions of the development process, incorporating social transformation, innovation, and meeting human needs:

it is necessary to define economic development as a process of *social change* by which the growing number of *human needs* – pre-existing or created by change itself – are satisfied through a *differentiation in the productive system*, resulting from the

introduction of *technological innovations* (Furtado, 1964b, p. 29, my emphasis).

To oppose the project of submitting society to the imperatives of the deregulated market, it is necessary to have a courageous project, to overcome our theoretical insufficiency. In this context, the role of organic intellectuals in the progressive field is decisive: an accurate, combative, theoretical and political analysis of the present to build an alternative vision of the future that allows integrating the economic, social, territorial, environmental, and national dimensions of development and that provides, for our society, a solid basis for the emergence of utopian energies – in the sense suggested by Habermas (1987), who treats utopia as concrete projects of change – necessary for transformation.

In another work, together with José Gomes Temporão, we pointed out that

if, on the one hand, history plays a primary role, since there are no general models of organization of society and the market that lead to expansion and convergence; on the other hand, the intentionality of agents and the action of society and the state have a decisive weight in transforming prior conditions, without which the productive and social system can be locked in the past (lock-in effect). (Gadelha; Temporão, 2018).

Figure 2 shows, in a straightforward and simple way, the theoretical and political challenge for dealing with the relationship between economic dynamics and political, social, institutional, and environmental transformations. It does not only involve the understanding that economic growth and income distribution contribute to social policies or that these are functional to economic development with the notion of providing externalities. It has to do with thinking about how the capitalist dynamic is reproduced within social welfare systems, conditioning public policies. In other words, the welfare state has a concrete material basis – in the health captured by the HEIC concept – which is intrinsically linked to the dynamics of capital and all its contradictions.

Figure 2 - The development process: endogenous dimensions



Source: Author's elaboration.

This perspective incorporates the processes of structural change within the welfare systems, being a decisive source of long-term development, going far beyond the recognition of the multiplier effects of social spending, which have an impact on the expansion of income by linking the production chains and the effects resulting from the consumption expenses of the people and families benefited (social spending has an almost two-fold multiplier effect, according to recent estimates). Thus, the construction of a society and a welfare state emerges simultaneously as an essential condition of citizenship and a process of structural change that opens opportunities for investment, innovation, job, and income generation, public revenues and long-term sustainable growth. This is the systemic and structural perspective that originated the HEIC concept and that has strong developments to rethink public policies with the articulation of the economic, social, and environmental dimensions of development.

4. The Health Economic-Industrial Complex (HEIC)

Following the perspective of the previous topic, the health field, due to its inherent praxis, has significant potential to contribute to an integrated vision of global and national development. Health is a privileged cognitive and political space to analyze how the dynamics of capital are reproduced in the social field, transforming the material and social basis of the production of goods and services, and simultaneously generating exclusion, inequality, and

social risk that undermine the humanist objectives of a good and healthy life in the collective and individual sphere.

It is now a matter of defining and inserting the approach and concept of the HEIC based on a dialog between the approach of the political economy of development with the tradition public health thinking. The history of the development of the field of collective health, social medicine and the conception of SUS, the largest universal public health system in the world, created by the Brazilian Constitution of 1988, had remarkable contributions from the theoretical-practical performance of organic intellectuals such as Mario Magalhães da Silveira, Sérgio Arouca, Hésio Cordeiro, Cecília Donnangelo, Carlos Gentile de Mello, among others (Hochman; Lima, 2015), who went beyond the pure exercise of criticism to think about the transformation of the health system from a conceptual basis close to that of political economy (strong influence of Marxist and structuralist thought).

The tradition of collective health and social medicine have been combined with diagnosis and strategic intelligence to associate the general problems of Brazilian underdevelopment with the democratic issue, universal access to health and the need for policies aimed at reducing dependence associated with “health supplies.” In this long journey, a broad process of mobilization of political forces and social organizations was fundamental for the constitutional recognition of the universal right to health as an obligation of the Brazilian state to become a reality.

The HEIC research program establishes an investigation agenda about the relationship between health and development within the capitalist context (Gadelha, 2007; Gadelha; Temporão, 2018), seeking to capture the economic, technological, political, and institutional interdependence present in the health field. This critical approach seeks to integrate the fields of political economy and collective health, overcoming, on the one hand, reductionist, “economicist” and “technical” visions that focus only on production chains and isolated sectors of activity and, on the other hand, on perspectives isolated from the field of social protection and well-being and from the health area. The great challenge is to capture, in the field of health, the relationship between the development of the productive and technological base with its contribution to society in an equitable, integral, and universal

way.

The systemic perspective should be a natural consequence of the perspective of collective health. If SUS is thought of as a system, its productive, material and knowledge base would also have to be analyzed systemically to capture the interdependencies and interaction with the health system. Restricting the theme of the productive base to 'health inputs' inadvertently means assuming an unacceptable relation that the industrial 'good' is the 'input' and health – or even services – is its natural result (the final product) (Gadelha; Temporão, 2018, emphasis in the original). As mentioned in the previous topic, the conceptual foundation of the HEIC is based on four approaches to development: the Marxist, the Schumpeterian, the Keynesian and the structuralist one. The combination of knowledge of these schools allowed the consolidation of theoretical and political aspects that are central to the HEIC approach: the systemic view of the production and innovation space; the dialectical analysis of the development process; innovation as a process of political and social transformation; the generation of asymmetries in the development process, the importance of national sovereignty to achieve the sustainability of the SUS (political and academic objective of the construction of the concept), and the decisive role of the state to coordinate and give direction to the activities of the HEIC and promote development.

As a result, health expenditure is now understood as an investment in health. To the detriment of allocative statics, emphasis was placed on dynamics and innovation instead of focusing on sectors. The systemic dimension prevails; the economic and social structure are interconnected; asymmetries and hierarchies between people and social groups, regions, and countries are emphasized, and the world of knowledge is confronted with social and human needs (Gadelha; Temporão, 2018).

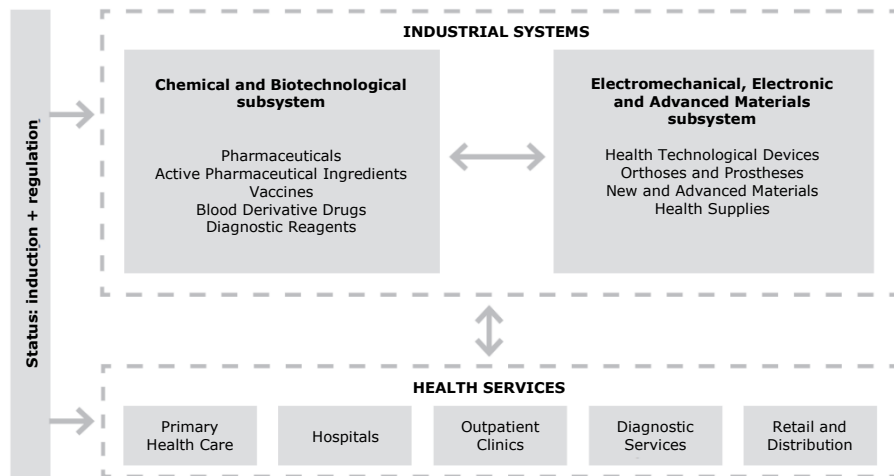
Analytically, the HEIC constitutes a delimited institutional, political, economic, and social space, in which the production and innovation in health are carried out. The dynamics of production and innovation of activities related to the health field are interdependent, characterized as a system that captures the interface between national health systems and national innovation systems. The productive and innovation space of HEIC is the

central arena in which there is tension between the interests of the capital and the social objectives in health.

Figure 3 shows the morphology of the HEIC, from its original conception, which delimited the system and the industrial and service subsystems in the context of the Third Technological Revolution (Gadelha, 2003). Health production involves a broad spectrum of industrial activities, with a set of sectors that adopt chemical and biotechnology-based paradigms, and another set whose innovations are based on mechanical, electronic and material-based paradigms. The production of this set of segments converges to the productive space for the provision of health services, strongly articulated, which involves primary care, hospital and outpatient services, diagnostic and treatment services, conditioning the competitive and technological dynamics of the HEIC.

The systemic approach of HEIC deals simultaneously with the perspective of health as an inherent right to citizenship and as a strategic space for the development of the productive and technological base, value creation, and generation of investment, income, employment, knowledge, and innovation. Lacking policies that guarantee national sovereignty in health production and innovation, the expansion of the SUS goes hand in hand with the expansion of external restrictions, generating obstacles to sustaining economic growth and the universalization of access to health. The role of the state, therefore, is central to guarantee the objectives of productive and technological training, as well as universal access, overcoming the simplistic opposition between state and market.

Figure 3 - Morphology of the Health Economic-Industrial Complex in the context of the 3rd Technological Revolution



Source: Author's elaboration, adapted from Gadelha (2023).

5. Contemporary Transformations, HEIC 4.0, and a New Research Agenda

The economic, technological and social transformations shown above have led to the need to update the HEIC approach to especially contemplate the disruptive movement in economic, social, and political terms associated with the Fourth Technological Revolution, regardless of the formal designation of this profound transformation process. Since its inception, the HEIC research program sought to articulate the generation of knowledge with its concrete application in public health policies and in the management of production and science, technology, and innovation organizations in health (with Fiocruz as a great model and inspiration). Organic connections were established among theory, intervention proposals and the search for change in concrete reality,

allowing virtuous, coherent and convergent interactions within a research program with a strong link with social transformation, leading to praxis.

The close dialog with the social, economic, and political context, in turn, has fueled and strained the theoretical view, imposing a growing search for evolution in the research program, which involves defining objects, formulating hypotheses and analyzing the evaluation of reality, constantly and endlessly trying to overcome dialectically the results obtained at each moment.

When advancing in the theoretical-conceptual dimension of the relationship between health and development, from the perspective of the HEIC concept, it was evident that it was necessary to deepen the research agenda related to the impact of global transformations. Demographic and epidemiological changes; increasing globalization and financialization; Fourth Technological Revolution; deepening of economic and technological asymmetries; climate change and the job world. The set of changes in progress poses new challenges for the discussion of the relationship between development and health in the capitalist context, since it has the potential to radically transform health, both in its social and productive base. Therefore, contemporary trends generate new research problems and demand new answers and new theoretical formulations, following a contextualized perspective of the social sciences, such as economics.

The vertiginous scale of the interconnectivity of information among people and with the real, physical, and biological productive world is the decisive characteristic of the Fourth Technological Revolution. If one maintains a rigorous perspective of innovation as a process of political, economic and social transformation, it is essential to grasp its impact on the forms of production, innovation, and consumption in health that condition universal care and access.

The erosion of the boundaries between sectors and fields of knowledge is one of the consequences of technological transformations and causes a radicalization of the systemic character of health. The emergence of new paradigms and technological trajectories simultaneously entails major transformations in the field of health, opening new spaces for accumulation and technological opportunities and generating risks of disruption of universal

systems and the collective and public dimension of health in favor of a fragmented, individualistic and stratified organization of care, eroding inside as well as the structure of the objectives of universality and equity.

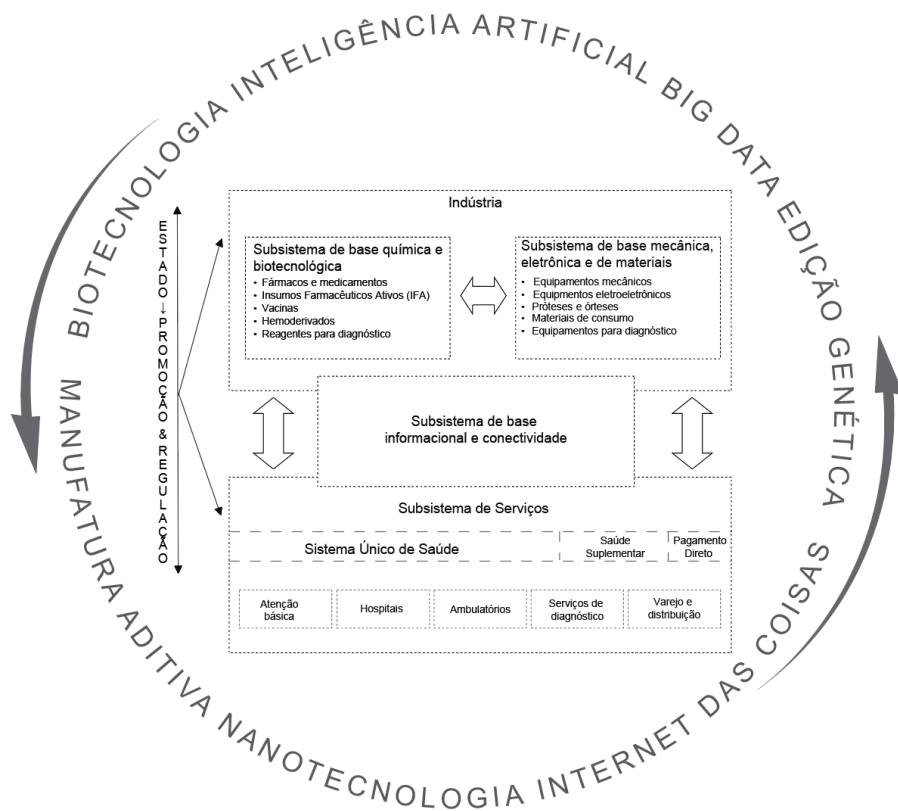
Figure 4 updates the original morphology of the HEIC (Gadelha, 2003) for the context of the Fourth Technological Revolution with the emergence of an information-based and connectivity subsystem and a modern design for the health service subsystem. In this new context, the systemic character of the HEIC is reinforced and the boundaries between its various subsystems and segments are blurred, highlighting the interdependence between all economic, productive and technological activities in health, configuring a clear simultaneous space of capital accumulation and critical innovation for the well-being and sustainability of SUS and universal health systems in general.

HEIC subsystems are defined from a key knowledge base that gathers different activities that are important to the dynamics of innovation and production in health and to their economic and social relevance to public policies (Gadelha, 2003; Gadelha *et al.*, 2013). In addition to the pervasive impacts of technologies associated with the Fourth Technological Revolution, it is possible to identify a set of activities that share a knowledge base used for the large-scale digitalization and connectivity of the productive base of health goods and services and for the production, management, and exploitation of health data. While this new space of accumulation in health emerges, the relevance of actors associated with this new knowledge base grows, with high economic and political power in the productive and innovation health system, conditioning all HEIC dynamics beyond the borders of the information and connectivity subsystem itself.

In this analytical effort, institutional and monetary forms of organization of activities between agents and economic structures were also introduced within the scope of the HEIC. Access to health and monetary relations of production within the HEIC are conditioned by the organization of SUS, Supplementary Health and the direct relationship of users in the purchase of goods and services. This institutional and monetary environment constitutes the concrete social substrate in which the dynamics of health production and innovation takes place. Thus, the typical political and institutional nexus of a political economy approach that treats the HEIC as a system that is

simultaneously economic, social, productive, and technological that incorporates a certain view of the relationship between health and development is evidenced.

Figure 4 - Health Economic-Industrial Complex 4.0 (HEIC 4.0)



Source: Author's elaboration.

Deepening the movement of internationalization and concentration of capital in this interdependent systemic space, according to a financial logic inherent to capitalism, represents enormous challenges for the articulation

and development of the HEIC, especially in the periphery. The contemporary panorama reveals growing economic and power asymmetries that conform to the reiteration of the central-periphery pattern in multiple themes and geographical scales. As a result, the link between national development pattern and the possibilities and structural limits to make a universal health system viable in Brazil is consolidated.

This perspective that associates the economic, the social and the political elements – that is, the dimension of political economy – also applies to think about regional development. When reflecting on the regionalization of health from the configuration of the health service network in the Brazilian territory, whose structure of supply “freezes” the unequal pattern of health care, the need arises to propose a structuring of the productive base of services that does not reproduce inequalities. Once again, “inside” the general issue of development, in its territorial dimension, health “shows itself” as part of the national project adopted. If health is related to the development of the proposed structural form, the territorial dimension proves to be critical and endogenous to the national pattern, being a starting point and one of the key elements of its transformation.

Technological, productive, and institutional transformations also cause profound changes in the world of job and employment. The emergence of new occupations, skills, training and forms of hiring affect the issue of work and employment in a decisive way, with a tendency to expand the polarization of the social structure. At the same time, the various activities related to health and care remain as major generators of qualified occupations. Thus, it is vital to understand how transformations in the world of work impact the relationship between health and development, especially with the purpose of an inclusive growth pattern, that is, simultaneously pursuing the increase in productivity, real wage and well-being.

The incorporation of the environmental dimension and the challenges posed by climate change are unavoidable issues in the contemporary health research agenda. Approaches that treat the environmental issue as mere externalities should be abandoned by others that allow to capture the interdependent nature of the models of organization of production and society with the environment. At the same time, the dichotomy between growth and

environmental protection is rejected. Development and innovation are key to promoting structural change that ensures environmental sustainability. The reproduction of underdevelopment, the absence of innovations and stagnation reproduce an unsustainable productive structure that harms the environment and expands global assumptions.

There is an accumulation of concrete works and experiences that allowed the construction of public instruments and policies to foster productive development in HEIC activities while ensuring greater sustainability to SUS. The studies showed that the use of state purchasing power enabled the technological incorporation of production processes in national public and private laboratories by guaranteeing the purchase of these products for the public health system. Given the global transformations pointed out, it is essential to investigate what action the state should take in a new generation of public policies that allow the coordination and development of the activities of the HEIC in order to guarantee universal access to health in Brazil. In a certain way, the approach adopted to think about health refers to the need to rethink and advance in the conception of a new developmental state that learns from the experiences and mistakes from the past and that is updated to face the challenges of the future.

In short, we sought to present a synthesis of the knowledge gained and point to new research agendas related to the relationship between development and health from the perspective of the Health Economic-Industrial Complex. The effort undertaken provided greater support to recent public policies related to the development and public health and the sustainability of SUS. At the same time, it allows us to identify a future agenda, including the topics of the Fourth Technological Revolution; financialization; the job world; the environmental and regional dimension of HEIC; and the need to formulate new public policies to deal with the set of ongoing transformations and the challenges to ensure the structural sustainability of SUS in the 21st century.

6. Health and Well-Being as a Structural Way Out Of The Crisis

The current global crisis, whose theoretical and life connections were revealed during the pandemic, highlights the decisive role of welfare states and universal systems, the national productive and innovation base and the sovereign insertion of the country in global geopolitics, elucidating a systemic perspective in which the HEIC concept developed and intends to advance, considering the contemporary challenges of global capitalism and the development of the SUS.

The pandemic evidenced the lengthy process of deindustrialization, of fragility of the national productive and technological base and that this position of dependence is unsustainable not only from the point of view of economic development, but also regarding sovereignty and health security. This discussion should be expanded to include the development of the economic, productive and technological base in health – the HEIC – as a structural factor for sustainability and for the operation of SUS. The Covid-19 crisis anticipated and intensified challenges arising from contemporary transformations, considering the emergence of a new industrial paradigm towards the industry 4.0 and the imperative of socio-environmental sustainability of economic growth. The pandemic has called into question global value chains, international trade, and investments, evidencing broad challenges for developing countries.

Considering the continental dimensions of Brazil and the potential of its internal market to induce the diversification and internalization of dynamic productive sectors (Medeiros, 2015), the decisive question of which social and political base simultaneously conditions the assembly of dense structures of social well-being and technological development is raised. Productive diversification and advancement in more dynamic sectors, related to the demand for activities with higher technological content, are strongly associated with government demand (Mazzucato, 2013), as in the case of the search for the vaccine for Covid-19.

Among the leading areas in the context of the Fourth Technological

Revolution, the social area and health, in particular, have a strong role, and this can be an opportunity to overcome Brazilian historical vulnerabilities. The challenges of the social state of the 21st century involve the recognition of the transformational power of the Fourth Industrial Revolution, as mentioned by Wanderley Guilherme dos Santos (2018).

We are facing a world that opens enormous potential for material abundance amid the risk of relegating a huge contingent of the population to helplessness, misery, and abandonment. During the 20th century, productivity gains were linked in the direction of the construction of the welfare state, the expansion of rights, leading to a development model where economic growth, income redistribution and greater equality could be reconciled. And now? What is the procedure to share the huge productivity gains resulting from the emergence of the new standard? Or are we going to become an even more divided society? The direction depends on the political capacity to guide a pattern of development to face dependence and the attendance of social needs simultaneously.

A new type of development is need, with a dynamic and keen sense of social equity. To achieve this, counter-cyclical and compensatory policies are necessary but insufficient. In the face of the crisis and current challenges, profound structural transformations are needed to make room for the expansive forces that are severely restrained, to the detriment of the vast possibilities for human improvement offered by scientific and technological advances.

Structure transformations require a strategy and the recovery of planning capacity, but assuming the need to recreate a new developmental state. It is necessary to learn from the mistakes from the past to overcome resistance, avoid archaic interests, the bureaucratization of creativity, and the isolation of society, without which the paths to transformation are blocked for the (re)construction of a new future that goes far beyond a late and old normal state that presents itself under the mantle of change.

The health area reveals its power to contribute politically and conceptually to Brazil to overcome the old challenges of underdevelopment. The transformation of the productive and technological base shows its connection with a model of society. Universal access, social inclusion, equity and social

policies are not only compatible, but essential factors to resume economic and social development. The rights not only “fit in the GDP,” but, when they materialize in major national challenges, they are structural sources of demand for the productive sector. They can and should be seen as part of the solution of the current crisis, generating income, employment, investments, innovation and taxes, allowing a progressive adjustment but not a civilization regression of the country.

The contemporary global and national crisis imposes on intellectuals, research institutions and the national state the challenge of taking risks, promoting innovation and experimentalism in public policies and breaking the barriers between social, environmental, economic, and innovation policies. It is time to be bold to incorporate innovative approaches and progressively and collectively seek a vision that provides the foundation for a new development project that incorporates a profound change in how the state acts. This is the primary condition so that society is not deceived by unique solutions and can again have utopias and transformational energies in order to build a dynamic, innovative, inclusive, democratic, and socially and environmentally fair country.

References

ARAÚJO, J. D. de. Polarização epidemiológica no Brasil. *Epidemiologia e Serviços de Saúde*, v. 21, n. 4, p. 533-538, dez. 2012.

BAHIA, L. *et al.* From health plan companies to international insurance companies: changes in the accumulation regime and repercussions on the healthcare system in Brazil. *Cadernos de Saúde Pública*, v. 32, p. e00154015, 3 nov. 2016.

BELLUZZO, L. G. A internacionalização recente do regime do capital. *Carta Social e do Trabalho*, Campinas, SP, IE/Unicamp, n. 27, p. 2-13, jul.-set. 2014.

- BRAGA, J. C. de S. *Temporalidade da riqueza: teoria da dinâmica e financeirização do capitalismo*: Campinas, SP: IE/Unicamp, 1985. (Col. Teses).
- ERBER, F. Celso Furtado e as convenções do desenvolvimento. In: SABOIA, J.; CARVALHO, F. J. C. (Eds.). *Celso Furtado e o Século XXI*. Rio de Janeiro; Barueri, SP: Manole, 2007.
- FRENK, J. et al. La transición epidemiológica en América Latina. *Boletín de la Oficina Sanitaria Panamericana, OSP*, v. 111, n. 6, p. 12, 1991.
- FURTADO, C. *Desenvolvimento e subdesenvolvimento*. Berkeley: Univ. of California Press, 1964a.
- FURTADO, C. *Dialética do desenvolvimento*. Vol. 2. Rio de Janeiro: Fundo de Cultura, 1964b.
- FURTADO, C. O subdesenvolvimento revisitado. *Economia e Sociedade*, v. 1, n. 1, p. 5-19, 1992.
- FURTADO, C. Brasil. *A construção interrompida*. Rio de Janeiro: Paz e Terra, 1999.
- GADELHA, C. A. G. O complexo industrial da saúde e a necessidade de um enfoque dinâmico na economia da saúde. *Ciência & Saúde Coletiva*, v. 8, n. 2, p. 521-535, 2003.
- GADELHA, C. A. G. Desenvolvimento e saúde: em busca de uma nova utopia. *Saúde em Debate*, v. 29, n. 71, p. 326-327, 2007.
- GADELHA, C. A. G. Os desafios de uma tecnologia que sirva ao humano e não que se sirva do humano. (Entrevista concedida a João Vitor Santos). *Revista do Instituto Humanitas Unisinos*, n. 544, ano XIX, p. 8-15, nov. 2019.
- GADELHA, C. A. G. Pandemia Covid-19: a necessidade de retomada de uma agenda estrutural de desenvolvimento. *Jornal dos Economistas*, n. 370, p. 10-11, jun. 2020.
- GADELHA, C. A. G. et al. O Complexo Econômico-Industrial da Saúde no Brasil: formas de articulação e implicações para o SNI em saúde. *Revista Brasileira de Inovação*, v. 12, n. 2, p. 251-282, 2013.
- GADELHA, C. A. G.; TEMPORÃO, J. G. Desenvolvimento, Inovação e Saúde: a perspectiva teórica e política do Complexo Econômico-Industrial da Saúde. *Ciência & Saúde Coletiva*, v. 23, n. 6, p. 1891-1902, jun. 2018.
- HABERMAS, J. A crise do estado de bem-estar social e o esgotamento das energias utópicas. *Novos Estudos*, CEBRAP, v. 18, p. 103-114, 1987.
- HOCHMAN, G.; LIMA, N. T. *Médicos intérpretes do Brasil*. São Paulo: Hucitec, 2015.

- IBGE. Instituto Brasileiro de Geografia e Estatística. *Projeções da população: Brasil e unidades da Federação, revisão 2018*. Rio de Janeiro: IBGE, 2018.
- LOACH, K. The Spirit of '45. Fly Film Company, Sixteen Films, Film4, 15 mar. 2013.
- MAGALHÃES, J. C.; COULDRY, N. Tech Giants Are Using This Crisis to Colonize the Welfare System. *Jacobin Magazine*, 27 abr. 2020.
- MARX, K. *O capital: crítica da economia política*. São Paulo: Nova Cultural, 1996.
- MAZZUCATO, M. *The entrepreneurial state: debunking public vs, private sector myths*. London; New York; Delhi: Anthem Press, 2013.
- MEDEIROS, C. A. de. *Inserção externa, crescimento e padrões de consumo na economia brasileira*. Brasília: IPEA, 2015.
- PREBISCH, R. O sistema econômico e sua transformação. In: GURRIERI, A. (Ed.). *O Manifesto Latino- americano e outros ensaios*. Rio de Janeiro: Contraponto; Centro Celso Furtado, 2010.
- SANTOS, W. G. dos. Gênese dos novos partidos da ordem: o Brasil na dança mundial. [S. n. t.]. Publicado em: 30 set. 2018. Disponível em: <http://necon.iesp.uerj.br/wp-content/uploads/2018/10/Automação-e-revolução-tecnológica.pdf>. Acesso em: 20 nov. 2020.
- SCHUMPETER, J. A. *Capitalismo, socialismo e democracia*. Vol. 2. Rio de Janeiro: Zahar, 1983.
- SCHWAB, K. *The fourth industrial revolution*. New York: Crown Business, 2017.
- WORLD ECONOMIC FORUM. *Health and Healthcare in the Fourth Industrial Revolution: Insight Report*. Global Future Council on the Future of Health and Healthcare, World Economic Forum, 2019. Disponível em: http://www3.weforum.org/docs/WEF_Shaping_the_Future_of_Health_Council_Report.pdf. Acesso em: 16 mar. 2020.

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