

The Health Economic-Industrial Complex (HEIC): a strategic area for both the modernization of the Unified Health System (SUS) and the creation of future jobs

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Abstract *This article presents the initial results of the ongoing research on the new world of healthcare work in the context of the 4th Technological Revolution. In addition to identifying the profile and volume of employment generated by health activities in Brazil, this investigation also analyzes the main transformations in the world of work and employment caused by new technologies and their potential impacts upon the field of the Health Economic-Industrial Complex (HEIC). The methodology seeks to contribute to a new vision of health professionals, which includes not only the employment profile with its technological content, but also the professionals directly and indirectly assigned to HEIC. Applying this methodology to the databases of RAIS and Continuous PNAD from 2012 to 2019, reveals HEIC's high capacity to generate good jobs, even in a context of economic crisis. The health labor market, both for its scale, complexity, and diversity, and for its dynamism and potential in terms of the incidence of 4.0 technologies, indicates that the development of HEIC can become the engine of the country's development, associating innovation and production with the modernization of the Unified Health System (SUS) and the generation of good jobs.*

Key words *Health Economic-Industrial Complex (HEIC), Development, Labor Market, 4.0 Technologies, Unified Health System (SUS)*

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Introduction

One of the main challenges in the contemporary world is the promotion of development for generating good jobs and guaranteeing access to social rights in face of the new technological paradigms. In the critical tradition of Latin-American economic thinking, it refers to recognizing the concept of development as a process of structural change, in which the productive system, working on a revolutionized technical base, is oriented towards the generalization of rights and the guarantee of environmental sustainability.

Climate changes, as well as demographic and epidemiological ones which bring demands for the Unified Health System (SUS) with new, complex and growing health needs, are happening parallel to the developments known as the Fourth Industrial and Technological Revolution, bringing new analytical and political challenges for the discussions regarding the relationship between development and health in a capitalist context. Biotechnology, artificial intelligence, *Big Data*, genetic edition, additive manufacture, nanotechnology, and Internet of Things are expansion frontlines which affect the health area in a decisive manner, transforming it into one of the most dynamic areas in the contemporary context.

In face of those transformations, Fiocruz articulated the project known as “Challenges for the SUS in the national and global context of social, economic and technological transformation - HEIC 4.0” which is defined by research cooperation in the fields of development, work and social politics, in the scope of the Health Economic Industrial Complex (HEIC), seeking to advance in the production of public policies which are compromised with economic and social transformation, with the SUS and with social and labor rights.

From this perspective, we sought to identify the profile and the volume of jobs generated by health activities in Brazil and discuss the main changes in the universe of work and employment, in the complex reality brought about by the technological changes of Revolution 4.0. The developed methodology provides a contribution for a new and complex view on health professionals, since the identification of health workers includes professionals who are directly and indirectly included into the HEIC.

The identification and understanding of the progress and limitations regarding the impacts of new technology in the demand, supply and in

the work of health professionals is fundamental in order to perceive the potential and the future of the complex, focusing on health services, which are the central element for universal access. Technological changes place an increasingly strong and faster pressure on HEIC, and might increase asymmetry and contradictions between the interests of the capital and the real life world, as it became evident during the COVID-19 pandemic¹⁻³.

This landscape brings threats and opportunities. In a context in which productive and knowledge asymmetry indicate a segmentation of services and the polarization of the labor market, the many activities connected to healthcare remain as important generators of qualified work positions, propelling an actual process of “creative destruction”. In this sense, two kinds of movements can be seen in the HEIC labor market. At the same time as there is substitution in some occupations or part of the activities, new occupations are created, as well as competences, new training or hiring systems, affecting the volume and the occupational contents in a decisive and irreversible manner.

To achieve a universal and integral healthcare service, humanized and with good quality, incorporating the new tools available and the precision capacity of medicine, is something that requires an economic and productive base increasingly more sophisticated, capable of dealing with new technologies, and also requires well prepared health professionals. Those professionals must have new abilities and competencies, and this requires the training of new professionals or the incorporation of professionals from other areas of knowledge, such as the ones related to digital technologies or to advanced math and engineering, in order to perform the new tasks and to make use of the new tools available.

Having the perspective of innovation as a process of political, economic and social change, we seek to present in this article the first results of the impact of the 4th Industrial Revolution, with the central objective of identifying and analyzing which are its potential effects on the universe of work and labor. We sought to identify and analyze the potential of the HEIC in terms of generation of qualified jobs and future jobs, within a strategy of overcoming the historical inequalities which define the socio-occupational structure of Brazil, considering the country’s production dependency, and especially, technological dependency, which have kept it in the position of a mere consumer of technologies and innovations.

In order to achieve this objective, this article is organized into this introduction and four sections. The first presents the theoretical-political perspective of the Health Economic-Industrial Complex. Following lines of investigation which look into identifying health occupations beyond conventional approaches⁴, the second section presents the methodology for investigating the labor market in the scope of the HEIC and the effects of the 4th technological revolution on the so-called "HEIC 4.0". Next, we present the results and discuss the characteristics of the healthcare labor market organized in three different aspects: i) a new view regarding healthcare professionals in the HEIC 4.0 labor market; ii) the centrality of healthcare services in the context of the 4th technological evolution; iii) the importance of healthcare professionals in the context of the technological changes and the pandemic. Finally, the last section, the conclusion, indicates the importance of developing the HEIC as a key element for associating innovation with healthcare, into a national strategy of generation of good occupations and of well-being for the entire society.

The perspective of the Health Economic-Industrial Complex (HEIC)

The 1988 Federal Constitution defined an important expansion of social rights in Brazil, and a particularly relevant point is the universalization of access to healthcare provided by the SUS, indicating the importance of developing a universal and equalitarian system.

The progress in the understanding of the challenges which are faced by the SUS as a universal system led to the development of the concept of a Health Economic-Industrial Complex, which originated from a study initiated by the Fiocruz in the 2000 decade, which established an agenda for investigation into the relationships between health and development in the capitalist context^{5,6}.

Fundamented in the field of political economics and public health, the HEIC definition moves away from approaches which deal with the economic and social dimensions in a separate manner, and seeks to overcome the economist and technical, as well as the isolated health perspectives focused on well-being. The main challenge is to identify, in the healthcare area, the close relationship between the development of an economic and technological base, the generation of jobs and the access to social rights in a universal, equalitarian, and integral manner.

A combination of understandings from four schools of economic thought comprise the theoretical background of the HEIC, used for understanding capitalist development: the Marxist, the Schumpeterian, the Keynesian and the Structuralist (with emphasis on the views of Celso Furtado). The preservation of the diversity of different conceptions regarding development allowed for the consolidation of key theoretical and political aspects: the systemic view regarding economic space; the dialectical analysis of the development process; innovation as a process of political and social change; the generation of asymmetry in the process of development; the importance of national sovereignty for reaching sustainability for the SUS (the academic and political objective of the construction of the concept); and the decisive role of the State in the coordination and guidance of HEIC activities, and in the promotion of development.

From an analytical standpoint, the HEIC constitutes the economic, institutional and social space into which there is production and innovation in health³, according to Figure 1.

The HEIC is a systemic space where we can find an ample set of industrial activities and services, which conform to the competitive and technological dynamics of markets, and are articulated into four subsystems: i) activities and sectors involved in the production of healthcare services, including hospital and ambulatory services, diagnosis and treatment services and services of retail and distribution of healthcare products; ii) activities and economic sectors involved in the development and production of biological and chemical-synthesis medication, active pharmaceutical inputs, vaccines, hemoderivatives and reagents for diagnosis; iii) activities and sectors involved in the development and production of medical-hospital equipment, inputs, prosthetics and orthotics, diagnostic devices, personal protective equipment; iv) activities and sectors created in the context of the 4th technological revolution, involved in the development and production of services to generate, process and transform in knowledge, the data produced by the health sector, reinforcing the connections between the different subsystems.

In this perspective, health is understood as a citizenship right, and at the same time it is an economic area, productive and innovative, with considerable relevance in the current context. Health services and actions, public or private, are responsible for 8 million jobs, 10% of the country's GDP and 1/3 of the national investment in research and innovation^{1,7}.

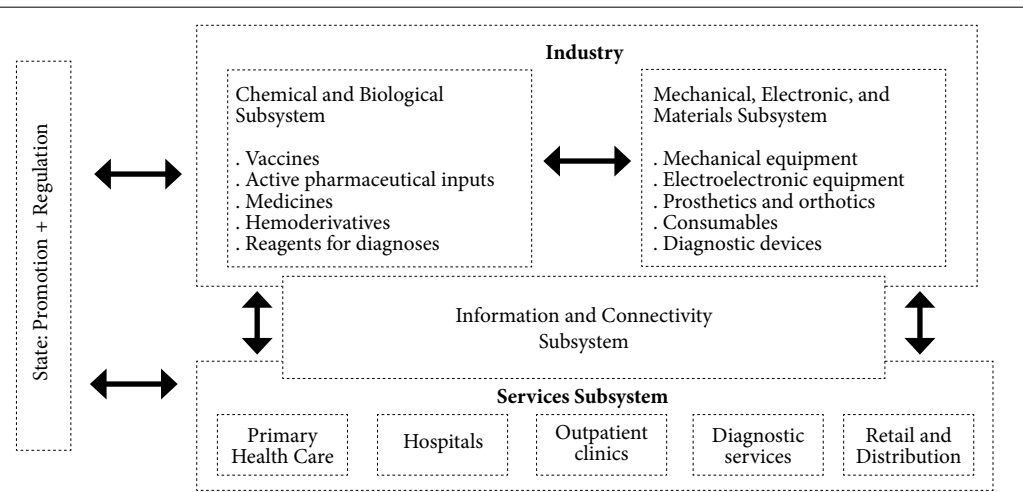


Figure 1. Morphology of the Health Economic-Industrial Complex in the context of the 4th Industrial and Technological Revolution.

Source: Gadelha³.

However, since the 1988 constitutional landmark, which established health as a right for everyone and a responsibility of the State, an uneven situation can be observed between the expansion of universal access and the productive and technological healthcare base, and that has been accentuating the situation of dependency and vulnerability faced by the SUS. This scenario is not exclusive to the health area, but instead a reflection of Brazil's precarious insertion into the globalization process, since the 1990's, and of the systemic regression, in economic and social terms, that has been impacting the country since the 1980's^{8,9}.

The (dis)association between the productive structure and social needs, not restricted to health but having health as its main focus, became clear during the COVID-19 pandemic. Unlikely what has been suggested by restrictive views, which place economy and wellbeing in distinctive fields, the countries with highly productive technology and ample access to knowledge were the ones which were able to respond and be in the frontline in the fight against the disease, meanwhile many other countries were left behind in that race and remained dependent the first ones.

This situation reflects the international division of labor, which makes some countries simple consumers of technology while others define the technological standards in place, constituting a clear center-periphery relationship. As stated

by some economists from the tradition of structuralist thought, with Censo Furtado as the main reference, the diffusion of citizenship rights is closely related to the development of an economic base which is compatible with such a challenge.

The condition of technological-productive dependency of Brazil is associated with the historical standards of development which reproduce an economic system which is not articulated with the national interests, and is centered in the primary-exporting specialization and in a productive structure with little diversification. It is an economic structure which is incapable of supporting itself and staying ahead in the more technologically advanced sectors¹⁰, directly affecting the possibilities of generation of good jobs and of overcoming the compensational character of the social policies.

Overcoming underdevelopment depends, necessarily, on understanding such reality and overcoming old epistemological boundaries which divide the social, environmental and economic universes as distinctive dimensions. In order to rise against the projects of submitting society to the interests of the market, which condemns the country to remain in a passive and subordinate position in the international order, a project is needed, with a social base and a policy of support, so that the country can overcome its theoretical insufficiency and its structural vulnerability.

Methodology

Based on the theoretical focus of the HEIC, a methodology was developed for the investigation of the labor market in the health area, going beyond the traditional views and representing progress in the program of studies about health professionals¹¹. The identification of the workers includes the ones who work in health services and also those who work in the production and commerce of medication, pharmacological materials and medical equipment, as well as all of those who develop research or teach in the health area, or are allocated in the private market of health and insurance plans – this set of activities being denominated “Restrictive HEIC”.

Deepening the pathway taken by Maria Helena Machado *et al.*⁴, the methodology developed here goes beyond sectors of health that relate directly with care and medical services. In a complementary manner, and constituting what is called “encompassing HEIC” other sectors were considered, which are indirectly related to the nucleus of the Complex and have a strong nexus with prevention and promotion of human health, being those: veterinary and zootechny, sanitation and hygiene, social security and assistance, physical conditioning and funeral/burial services.

In face of the challenge of incorporating this ample perspective, there was a need to identify those whose occupations are part of the HEIC, starting, from one hand, by the composition of a double movement of identification of occupations and sectors of activity, and on the other hand, by the combination of data from two primary sources of information on the labor market, the RAIS and the PNAD Continuous, which were conducted by the Ministry of Labor and by the IBGE, respectively. In this phase, the HEIC work market was analyzed, was characterized (qualitative aspects), and its performance was analyzed (quantitative aspect). We took into consideration previous studies and sought to advance in terms of systematization of new concepts, methodologies and information, and that allowed us to indicate the central characteristics of the HEIC work market and to calculate the indicators of the occupational structure, based on occupations and activity sectors, for the years from 2012 to 2019.

Another methodological improvement was the ability to perceive the changes in the HEIC labor market considering the incorporation of new 4.0 technologies, characterizing thus the “HEIC 4.0” work market. Since there are no other such studies conducted in this field, a new methodolo-

gy had to be created, beginning with some choices made by other experts and advancing in the direction of the specificities of the HEIC and the Brazilian context, in terms of the very structure of the work market and in terms of the databases available¹². In this sense, the study was developed from a theoretical-conceptual referential selected about the definitions of the terms related to HEIC 4.0, to 4.0 technologies (or digital) and to precision medicine; as well as about other studies which aimed at identifying and analyzing the impacts of the incorporation of those technologies on the entire work market, being in Brazil, as well as in other parts of the world. In quantitative terms, data was gathered about the years 2012-2019, based on the RAIS CBO (CBO-RAIS), considering that this base allows for the identification of a wide set of occupations, and enables us to identify those with potential connections with new technologies.

Additionally, in this phase the primary sources of data about the North American work market were used, the Standard Occupational Classification (SOC) and the Occupational Information Network (O*NET) (SOC-O*NET), more complete and updated and through which we can already identify the occupations, abilities, tasks and tools which are closely related to 4.0 technologies. In this phase, we analyzed the incidence of 4.0 technologies on the labor market, seeking to characterize and evaluate the functioning of the HEIC 4.0 labor market.

After the definition and application of the two methodological phases on the databases from the RAIS and PNAD-Continuous for the period 2012-2019, we were able to prove the importance of the HEIC labor market, being in terms of its composition, being in terms of its evolution, or even in the context of economic crisis. Moreover, the study shows the reality and the potential in terms of incidence of 4.0 technologies in the scope of occupations, analyzed in terms of tasks performed. The period considered, immediately before the pandemic period, shows the quantity and diversity, as well as the potential, of the availability of health professionals in the country before the economic-health crisis.

Results and discussion

The HEIC 4.0 work market: a new view regarding health professionals

Considering the new view proposed here, in which the healthcare labor market was analyzed

broadly in methodological and conceptual terms, the professionals who work in the HEIC and are absorbed by its segments show its high potential impact in the Brazilian labor market, in terms of employing a significant number of people, as well as for the quality and diversity of the occupations it generates.

In 2019, 8.7 million professionals were working for the HEIC, equivalent to 9.2% of the working population in Brazil. Moreover, the increase in HEIC employment was much higher than in the general labor market, even considering the context of the economic crisis. Between 2012 and 2019, the variation was positive, 33.9% – with a 31.8% growth in the sector of medical services, and of 101.7% in the medical care sector. Meanwhile, there was a 6.1% growth in terms of the general working population, and only 3.9% in terms of the working population outside the HEIC. Therefore, we highlight the anti-cyclic performance of the HEIC labor market, and the fact that a large portion of the jobs created were of high level, much above the average in the Brazilian labor market¹¹.

Meanwhile, even though it is a space for incorporation, the HEIC work market reproduces the patterns of the Brazilian characteristics of development, which are defined by inequality in several aspects. Considering gender inequalities, the occupational structure of the HEIC shows the high presence of women, revealing the feminization characteristic of the healthcare workforce. Gender inequalities go in the opposite direction as what is seen in the general labor market. In 2019, only 44% of those regularly employed were women, according to data from RAIS; meanwhile, in terms of the HEIC, women were 75.4% of those employed in the health sector¹¹.

Regarding racial inequalities, blacks (dark and light-skinned) employed by the HEIC correspond to 44.1%, being that aligned with the general labor market, in which 45.3% of the employed population is black. When gender is associated with race, we can notice that black women correspond to 27.8% of that workforce, compared to only 15.9% of those employed in the general workforce. In terms of income, most of the HEIC black workers earn up to 2 minimum salaries (MS), with more representativeness of women – 64.3% of the black women and 57% of the black men. In terms of employed white women, most (51%) are in this income bracket, as well. So, it is clear that the income of women is lower, being white or black, and especially in the case of the latest, in comparison with that of white men. This is a defining trait of the Brazilian labor market¹¹.

In terms of regional inequalities, the distribution of those employed by the HEIC follows the same trend of the labor market in general: 49.5% of the total working population and 51.2% of the HEIC workers are in the Southeast region^{11,13}.

Besides the fragility and limitations, the positive performance of the HEIC labor market is a result of the combination of other elements, distinctive in comparison to the labor market in general.

The first of those characteristics is the centrality of human work in healthcare, both in quantitative and qualitative terms, since the work is constituted by labor intensive activities, even with the incorporation of new technologies; it is therefore difficult to expand health services without increasing the level of employment; it has a growing tendency of expansion and incorporation of workforce independently of the economic situation; and the dynamism of the jobs in the service sector boosts the growth in employment by other sectors of the complex.

According to the RAIS and the PNADC, in 2019, the composition of the HEIC sectors was: 57.6% of the employed in the area of healthcare and medical services, 8.5% in commerce, 7.5% in care, 7.4% in sanitation, 5.5% in social assistance, 3.9% in physical conditioning, 3.3% in production and maintenance, 2.0% in veterinary and zootechny, 1.4% in insurance and health plans, among others^{11,13}.

The second characteristic reveals that the average income of the HEIC workers is above the average income of the labor market. The working population, according to RAIS, in 2019, had most of the employed (56.1%) in the income bracket up to 2 minimum salaries, 31.5% between 2 MS and 5 MS, and 12.4% in the more than 5 MS bracket. The segment employed by the HEIC also has a significant portion in the bracket up to 2 MS, although the percentage is smaller (50%), and presents larger numbers in other brackets – 34.8% between 2 MS and 5 MS; 15.2% more than 5 MS. In the case of healthcare and services, 48.4% earn up to 2 MS, 36.1% between 2 MS and 5 MS and 15.5% earn more than 5 MS. On the other hand, 92% of the employed in the care sector earn up to 2 MS, and 57.5% of the employed in research and teaching earn more than 5 MS^{11,13}.

The third characteristic is connected to diversified qualification in comparison to the labor market in general. Out of the general working population, 17.2% have up to Elementary education, 55.7% have up to High School education and 27.0% have incomplete College education or

more. In comparison, in the segment employed by the HEIC 7.8% have up to Elementary education; 54.9% up to High School Education; 37.3% have incomplete College education or more (RAIS, 2019). In healthcare and services, 6.0% have up to Elementary education, 56.3% have up to High School education and 37.8% have incomplete College education or more. The workers in the research and teaching area stand out in terms of education, being that 98.7% have incomplete College education or more; in the case of care providers as well, the highest portion (71.9%) has education up to High School level and only 15.1% have up to Elementary education^{11,13}.

It is important to remember that qualification and occupational requirements should not be analyzed only from the schooling perspective, but also in terms of classification of the kind of occupation, of the definition of the occupational profile (abilities, competencies, tasks, tools, among other variables), and the identification of new modalities and/or new professional qualifications required for the work in the healthcare area, related to the incorporation or presence of new technology. Such aspects were incorporated into the methodology developed here¹³.

The fourth characteristic reveals that the typical occupations, or nuclear ones, related to healthcare are regulated and controlled by the public sphere, by the Ministry of Health and by the Professional Councils specific to each professional category. Moreover, HEIC has a relevant number of occupations which are partially regulated and can be performed by professionals not necessarily from the health area, after receiving specific training in the workplace¹³.

The fifth characteristic relates to the fact that the HEIC has a relevant role in the employment generation and in terms of formal work contracts, regardless of the precarization that affects the professionals in the healthcare area, as a reflection of a structural movement which is present in the entire Brazilian labor market. According to the PNADC, in 2019, 42.7% of the employed by sectors other than HEIC and 41.1% of the general employed population were in the informal sector; meanwhile informal employment related to the HEIC was between 20.3% and 35.4%, more likely around 20%^{11,13}.

In case of formal work, according to RAIS, in 2019 the number of people hired by CLT norms represented 79.3%, of the workers, meanwhile 18.0% were employed by the Statutory system. In the case of HEIC workers, 73.6% were in the CLT regime and 22.9% in the statutory regime. With-

in that segment, those who work in healthcare and services, 65.2% were CLT and 31.5% were statutory^{11,13}.

The sixth characteristic deals with the importance of the public sector in generating HEIC jobs, especially in the area of health services and care. In the case of the general working population, 19.9% are in the public sector (RAIS, 2019). In terms of the HEIC, 27.6% are in the public sector, being that in health services and care, the number reaches 37.8%^{11,13}.

The seventh characteristic indicates the capacity of creating new modalities or kinds of occupation, determined by changes in the sociodemographic profile of the population (population aging and increase in need of workers in caregiving for the elderly), in terms of the public policies of healthcare coverage (expansion of Family Care teams) and in the incorporation of technology. This last aspect has two elements: on one hand, new professionals, who have training which is not typical of the health area, and are extremely relevant for the incorporation of new technologies, are absorbed by the HEIC, such as engineers, physicists and mathematicians, among others; on the other hand, new abilities are required by health professionals. In the first case, there is a growth in the presence of occupations which are not related to health and which have strong relation with 4.0 technologies. For example, in 2019, according to RAIS data, more than 80% of the physicists (nuclear and reactors), more than 70% of the physicists (condensed matter), and in varying levels, Statisticians, Technologists, Engineers, are being absorbed in activities related to HEIC 4.0. In the second case, the study sought to identify the incidence of new technologies on occupational qualification through the study of the tasks performed by those who work at the HEIC, and their relationship with the technological content^{11,13}.

The centrality of healthcare services in the context of the 4th technological revolution

The 4th technological and industrial revolution has already produced impacts in the healthcare labor market. Research data shows that 60% of the occupation have been or will be strongly affected, considering the tasks which are performed by health professionals. The occupations with the most potential for incidence of new 4.0 technologies were those in the area of production and maintenance, services and care and research and teaching, showing a variation of +119.1%. This re-

sult suggests a changing trend in the labor market based on the incidence of 4.0 technologies in areas related to HEIC, with high capacity for generating jobs, even in situations of economic crisis¹².

In this context of transformation, the services sector stands out by the scale and by its dynamic components. It corresponds to a universe of 2.8 million jobs in 2019, which had an increase of nearly 20% (more than 390 thousand employees) in comparison to 2012, according to RAIS data. It is the HEIC's most important employer, and besides presenting a high rate of growth, it was also the sector which showed the highest incidence, or at least, potential incidence of 4.0 technologies on occupations¹².

Such a trend was also present in several of its occupations, being them typical of the segment, or being those that are not typical of the health sector and that have already been absorbed, including professions which are more similar, in terms of education, abilities and competencies, of the so-called professionals of the future. Among the professionals with more potential of incidence of new technologies, most of the occupations (50%) and of the number of employed (70%) are connected to medical care and services. In 2019, the growth in that area was 270.6% in comparison to 2012, above the general growth in this sector (+119.1%)¹². Table 1 presents the distribution by sectors, the number of the employed, their participation, and the 2012-2019 variations, for the occupations with high index of technological incidence.

The services and care service sector shows its importance for the HEIC, given the realization of the sector's size, complexity and diversity, as well as its dynamics and its ability to overflow into other sectors, being the central booster for employment generation and incorporation of technology into the HEIC, strongly aligned with 4.0 technologies.

The importance of health professionals in the context changes brought by technology and by the pandemic

In face of the profound changes going on, with the world transforming into what is being called a "digital society"⁹, industrial logic becomes more radical, reaching the health services, which become increasingly more impacted by new technologies. The growth in the sector of digital services relates to an increasingly robust industrial and technological base, indicating a process of "hyper industrialization", which is ca-

pable of intensifying asymmetries at national and global levels⁸.

The industrial base is fundamental in pressing for favorable employment dynamics in the HEIC as a whole, incorporating new technologies in the production of goods and services. It is not just a matter of incorporating technologies in the sense of becoming a consumer-user, but it is rather, acting progressively more as a developer, which requires integration of research activities, development and innovation, in the realm of the companies, of the universities and labs, being them public or private.

In the context of the COVID-19 pandemic, the incorporation of 4.0 technologies and the qualification of professionals were decisive in the fight against the disease, from the medical point of view at first, and from the prevention point of view later, when the vaccines arrived in the market and were incorporated in the healthcare systems.

Some of the situations in which that issue was evident relate to the work of the i) researchers, from different backgrounds and who work in state of the art labs, in the study of the virus genome and in the development and technological incorporation of vaccines (by formalizing a Technological Request) – which are both actions that took place in record-breaking time; ii) the epidemiologists and their teams, including technological abilities and tools for the following up of cases and the identification of mortality profiles and of comorbidities; iii) the health professionals conducting different redirecting of treatment and medication which were already available in search for the most efficient ones for the treatment; iv) of the factories developing medical equipment and PPEs, vaccines, medication, inputs, being those produced with consolidated technology or with new technologies, among others. In that sense, the SUS and the foundations, the institutes and the public laboratories were references, nationally and internationally, demonstrating the capacity and the potential of the Brazilian HEIC. During the pandemic, however, its limitations became evident as well¹⁷.

The incorporation of 4.0 technologies has the potential cross-sectional effect on the health complex occupations, however will impact the most the occupations related to services and medical care – in a direct manner, by changing the tasks performed by the workers, or indirectly, by promoting changes in the routine and the products and services generated by the work of those employed in the industrial sectors of the

Table 1. Occupation at HEIC with highest potential of technological incidence 4.0.

CBO	Sector	No. occupations 2019	Participation 2019	Absolute variation (2012-2019)	Percentage variation (2012-2019)
Biomedical doctor	Services and care	16,998	60.6%	13.200	347.6%
Maintenance Technician - Medical-hospital equipment and instruments	Production and maintenance	3,443	12.3%	1.656	92.7%
Biotechnologist	Research and teaching	1,954	7.0%	189	10.7%
Neurologist doctor	Services and care	1,427	5.1%	339	31.2%
Medical equipment assembler (assembling materials)	Production and maintenance	1,297	4.6%	-1.432	-52.5%
Biomedical systems technologist	Services and care	575	2.1%	414	257.1%
Vivarium technician	Research and teaching	556	2.0%	70	14.4%
Bioengineer	Research and teaching	466	1.7%	354	316.1%
Researcher in human biology	Research and teaching	404	1.4%	112	38.4%
Bioengineering support technician	Research and teaching	329	1.2%	-10	-2.9%
Hospital management technologist	Services and care	297	1.1%	258	661.5%
Radiotherapist doctor	Services and care	126	0.4%	9	7.7%
Geneticist doctor	Services and care	111	0.4%	79	246.9%
Geneticist	Services and care	46	0.2%	-3	-6.1%
Total		28,029	100.0%	15.235	119.1%

Source: Gimenez *et al.*¹², based on RAIS data.

HEIC. The 4.0 technologies, therefore, have the potential of transforming substantially the way in which services and medical care are provided.

However, the technology available should not be considered in isolation. It is fundamental to relate technological progress with the strengthening of the possibilities and the scope of the services of care promotion and prevention in health. These services have a high cost and become even costlier in the absence of early diagnosis, which does not depend necessarily on high technology, but can be improved by it.

In terms of the health professionals connected to the HEIC segment of medical services, there is a need for expansion, qualification and renewal, in the sense of incorporating new professionals who did not perform functions related to healthcare before. This kind of movement requires the expansion of the scope of the professions involved in healthcare services and activities, going from community health agents, to family doctors, from caregivers to physicists, mathematicians, statisticians, engineers, in a way

that all of the workers perform tasks, develop activities and use tools which are more sophisticated in terms of technology.

The incorporation of new technologies, being more simple or more advanced, may improve well being and life quality, and is viable in the SUS context, and are generating many qualified jobs, from primary care to high complexity care. For this reason, it is vital that public policies are created, capable of strengthening the SUS, and having as their target the creation of good quality jobs, aligned with the demands imposed by the technological changes in effect, and aiming to provide universal, integral and equitable access to healthcare.

Conclusion: innovation and care for generating jobs and well-being for the whole society

Development which can generate good jobs and the creation of a social welfare system in a conti-

mental-size country requires a strong productive and technological base, dense and sophisticated, which can support it. Health is a platform for technologies of the future, on the boundaries of knowledge, which are, as research shows, the base for the generation of good jobs. Services of medical care and attention depend on a strong productive base and are being increasingly impacted by new technologies; at the same time, those are activities which require extensive and qualified labor, therefore, there is need for attention regarding health professionals.

Incorporation of technology aimed at collective and humanized healthcare has the potential to generate new occupations, demanding new abilities in the use of new tools, and generating a professional segment that is increasingly interdisciplinary and diverse. Public policies are required, which are able to recognize the importance of the new technology available to healthcare professionals, as well as policies for professional training on a large scale, enabling

the workers to deal with new technology. It is a matter of promoting a sort of symbiosis between caring for those who provide care to people, resulting in the generation of qualified employment and well-being for society as a whole.

The development of the HEIC results in a frontline for the generation of good jobs in a short term and for the jobs of the future, and it may be the key for the country's development, by articulating investment and incorporation of new technologies in the SUS, with the production, scientific development, income improvement and employment generation, to production in the country. Restrictive views, which place economy and well-being in separate fields, must be replaced by a systemic and structural view which recognizes Health as an strategic space, where we can, simultaneously, have a new model of society, and which may help Brazil to overcome its trajectory of economic and social regression, by creating economic dynamism and generating good jobs and well-being.

Collaborations

All of the authors contributed to the stages of the creation of the study, data collection and analysis, the write-up the manuscript, and critical reading. CAG Gadelha contributed with the theoretical-conceptual definition of the Health Economic-Industrial Complex (HEIC), in the elaboration of the project, and in the critical revision of the manuscript. DM Gimenez contributed in the methodology construction and statistical manipulation of data, as well as in the critical revision of the manuscript. JPM Cajueiro contributed in the methodological construction, data collection and statistical manipulation, as well as in the write-up of the manuscript. JDD Moreira contributed in the definition of the study's structure and in the write-up of the manuscript.

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