Article

Healthcare infrastructure and flows in the dissemination and care of Covid-19 patients in São Luís, Maranhão, Brazil*

Allison Bezerra Oliveira

Universidade Estadual da Região Tocantina do Maranhão. Centro de Ciências Humanas, Sociais e Letras. Imperatriz. Maranhão. Brasil

allisonbzr@gmail.com

0000-0003-0320-5661

Adriana Maria Bernardes da Silva

Universidade Estadual de Campinas. Instituto de Geociências. Campinas. São Paulo. Brasil

abernar@ige.unicamp.br

0000-0003-4293-0460

e-194695

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Healthcare infrastructure and flows in the dissemination and care of Covid-19 patients in São Luís, Maranhão, Brazil

Abstract

This work aims to discuss the dynamics of the spread of Covid-19 in Maranhão from the flows triggered, during the pandemic, by people seeking care in São Luís. It also discusses the selectivity with which the territory of Maranhão is used by healthcare companies, resulting in density zones, like São Luís, and sparsity zones, like most of the other centers of the state. In the pandemic, this region generated flows of people seeking diagnosis and treatment, expanding areas of contagion, and weakening the healthcare system. Methodologically, the work analyzes the distribution of medical and hospital equipment and fixed healthcare equipment to discuss the mobility of people, which was aggravated by the pandemic. The data is mostly from the Health Information System and the National Registry of Health Facilities in Brazil (both from Datasus and the Brazilian Ministry of Health) and from the Maranhão State Department of Health. The results indicate that Covid-19 intensified the flow of people to São Luís, expanding the area of contagion and the number of deaths in the capital.

Keywords: Medical-hospital equipment. Flow in healthcare. Covid-19. São Luís-MA.

Fixos da saúde e fluxos na difusão e atendimento de pacientes com Covid-19 em São Luís, Maranhão, Brasil

Resumo

Este trabalho discute a dinâmica de difusão da Covid-19 no Maranhão a partir dos fluxos desencadeados durante a pandemia, por pessoas buscando atendimento em São Luís. Discute também a seletividade com que o território maranhense é usado por empresas de saúde, resultando em zonas de densidade, como São Luís, e zonas de rarefação, como a maior parte dos demais centros do estado. Na pandemia, essa particularidade regional gerou fluxos de pessoas em busca de diagnóstico e tratamento,

ampliando áreas de contágio e fragilizando o sistema de saúde. Metodologicamente, o trabalho analisa a distribuição de equipamentos médico-hospitalares e de fixos da saúde para discutir a mobilidade de pessoas, agravada pela pandemia. Os dados advêm sobretudo do Sistema de Informações de Saúde e do Cadastro Nacional dos Estabelecimentos de Saúde do Brasil (ambos do Datasus, Ministério da Saúde) e da Secretaria de Estado da Saúde do Maranhão. Os resultados indicam que a Covid-19 intensificou o fluxo de pessoas para São Luís, ampliando a área de contágio e o número de óbitos na capital.

Palavras-chave: Equipamentos médico-hospitalares. Fluxos da saúde. Covid-19. São Luís-MA.

Fijo en salud y flujos en la difusión y atención de pacientes con Covid-19 en São Luís, Maranhão, Brasil

Resumen

Este trabajo tiene como objetivo discutir la dinámica de propagación de Covid-19 en Maranhão a partir de los flujos desencadenados, durante la pandemia, por personas que buscan atención en São Luís: densidad, como São Luís, y zonas de rarefacción, como la mayoría de los otros centros de el estado. En la pandemia, esta particularidad regional generó flujos de personas en busca de diagnóstico y tratamiento, ampliando las áreas de contagio y debilitando el sistema de salud. Metodológicamente, el trabajo analiza la distribución de equipos médicos y hospitalarios y equipos fijos de salud para discutir la movilidad de las personas, agravada por la pandemia. Los datos provienen principalmente del Sistema de Información en Salud y del Registro Nacional de Establecimientos de Salud de Brasil (ambos del Datasus, Ministerio de Salud) y de la Secretaría de Estado de Salud de Maranhão. Los resultados indican que la Covid-19 intensificó el flujo de personas hacia São Luís, ampliando el área de contagio y el número de muertos en la capital.

Palabras clave: Equipamiento médico-hospitalario. Flujo en salud. Covid-19. São Luís-MA.

Introduction

Seven human coronaviruses (HCoVs) have already been identified worldwide: HCoV-229E, HCoV-OC43, HCoV-NL63, HCoV-HKU1, and Sars-CoV, which caused severe acute respiratory syndrome, Mers-CoV, which caused respiratory syndrome in the Middle East, and most recently, the new corona virus responsible for causing the Covid-19. At first, this disease was named 2019-nCoV; then, on February 11, 2020, it was named Sars-CoV-2 (Drosten et al., 2003; Ksiazek et al., 2003; Opas, 2020; Osterhaus; Fouchier; Kuiken, 2004).

The Covid-19 pandemic began on December 12, 2019, in the city of Wuhan, China, when a patient was hospitalized with pneumonia caused by a new coronavirus (Sars-CoV-2), not yet identified in humans. Then on January 30, 2020, the World Health Organization (WHO) declared an international public health emergency, and on March 11, 2020, through its director-general, Tedros Adhanom, the WHO declared a global pandemic due to the rapid spread of the virus throughout the world (LI et al., 2020; PAHO, 2020; WHO, 2020).

The first case of Covid-19 detected in Brazil was on February 26, 2020, in the state of São Paulo, in a 61-year-old man who had been in Italy. In Maranhão, the first case was registered on March 20, in the capital, São Luís, in a man who had returned from a trip to São Paulo. The first death occurred on the 29th of that month. Maranhão ranks 26th in the Brazilian municipal human development index (IDHM) and 23rd in the Gini index, which measures inequality in the country (Maranhão, 2021; UND; Ipea; FJP, [2013]).

One year after the first case was detected in Brazil, on February 26, 2021, the country had already registered almost 11 million confirmed cases and more than 251,000 deaths. By the end of 2021, more than 275 million confirmed cases and almost 6 million deaths had been recorded worldwide. The decrease in global contagion only occurred with the beginning of vaccinations, primarily in developed countries.

Easily contagious and rapidly spreading, Covid-19 exploits weaknesses in sanitary control measures as it enters human flows and is subject to the variables of duration, extent, and scale (Santos, 2014). Duration refers to the time of a given event, in this case, beginning in 2019 and not yet completed in 2022. The extent is due to the geographical dimension of the phenomenon, which has affected most of the world on different scales of analysis.

Thus, it is necessary to understand that "events do not occur in isolation, but in systemic sets [...] that are increasingly the object of organization: in their installation, their operation, and their respective control and regulation" (Santos, 2014, p. 149). This leads to reflection on the many variables that influence the spread of contagion in pandemics such as Covid-19.

The spread of the new coronavirus can be understood by the circulation and connection between different places, transforming networks and spatial interactions into significant elements (Sposito; Guimarães, 2020). In this sense, the movement of the population, especially between urban centers, in search of goods and services, and the complex circulation that allows the provision of these services has caused the relevant geographical spread of the Covid-19 pandemic, creating networks of contagion (Bessa; Luz, 2020; Oliveira; Gonçalves; Paz, 2021).

In this context, the basic problem analyzed in the work is due to the selectivity with which Maranhão is used by healthcare companies, resulting in density zones, such as São Luís, and sparsity zones which encompass most of the other centers throughout the state. In the Covid-19 pandemic, this regional particularity led to the flow of people searching for diagnosis and treatment, which expanded the areas of contagion and weakened the healthcare system. Therefore, the objective of this paper is to discuss the dynamics of Covid-19 diffusion from the flows triggered by people seeking care in the city of São Luís.

Methodologically, the paper uses the concepts of density zone and sparsity zone to observe the selective way that medical-hospital equipment (CT scanners, incubators, inpatient beds, intensive care units, lung resuscitators, and mechanical respirators), which is fundamental in Covid-19 treatment, is distributed in Maranhão.

Consequently, six types of healthcare infrastructure were listed for analysis: primary healthcare clinics (PHCC), general hospitals, specialized clinics, polyclinics, healthcare centers, and diagnostic and therapeutic units. Data used are from the Department of Information Technology of the Department of Information Technology of the Brazilian Unified Health System (Datasus), through the Health Information System (Tabnet), and from the National Register of Health Facilities in Brazil (Cnes).

The following were also mapped: (a) Covid-19 cases in Maranhão, in the first year of the pandemic and (b) the flows and origin of people seeking treatment in São Luís, which is the state capital. This step used data from the daily bulletins of the Maranhão State Department of Health (SES-MA) and the Datasus.

In addition to this introduction and the final considerations, the paper is organized as follows: initially we briefly discuss the corporate urbanization of São Luís. Then the areas of density and sparsity in the supply of medical-hospital equipment in Maranhão are discussed, highlighting the issue of healthcare infrastructure and its unequal distribution in the state. Finally, it deals with the capital city in the context of the pandemic and the flows of people toward it.

Brief notes on the corporate urbanization of São Luís

The modernization that occurred in Maranhão in the second half of the twentieth century led to significant transformations in the political, economic, and especially urban structures. Within the international capitalist order, a positivist ideology of progress was created based on efficiency and consumption.

At this time, especially in the late 1970s, the state began a new modernization cycle. The predominantly rural economy of Maranhão had been centered on agriculture (especially rice production). The state entered an *a priori* cycle based on the frontier economy, and later an enclave economy based on large export-based mining and metallurgical projects (Oliveira; Paz; Araújo, 2021).

The development of regional transportation infrastructure is fundamental for the mobility of capital flows necessary for the fully operational productive dynamics of these projects: parts, machinery, workers, inputs, raw materials, services, people, etc.

Spatial planning in Maranhão has become increasingly important with the regional and national integration of transportation, which is nothing more than the integration of capital. This is one of the theories for the existence of a system of cities and has increasingly helped stimulate flows and create a new urbanization model, especially in São Luís.

Thus, monopolistic or oligopolistic cities have been created, with intense concentration and speculation of capital and strong action by the public power in conjunction with private initiative. Corporate metropolises are increasingly established.

For Santos (1993), the promotion of large business projects has led to a corporatism process in large cities on the periphery of capitalism, including those in Latin America. The discussion of Santos (1993) about corporate urbanization argues that, as these companies increase their market power, they also exercise political power to defend their own interests and to the detriment of collective welfare. Norms and machinery are created in the territory to rationalize the operations of large companies to the detriment of smaller companies and the general population.

This corporatization model of cities is a consequence of the pooling of capital necessary for large infrastructure investments, which result in selective uses of territory, modernizing areas to attract large companies and creating hegemonic social strata, to the detriment of historically important regional characteristics (Damiani, 1997; Santos, 1993, 2014).

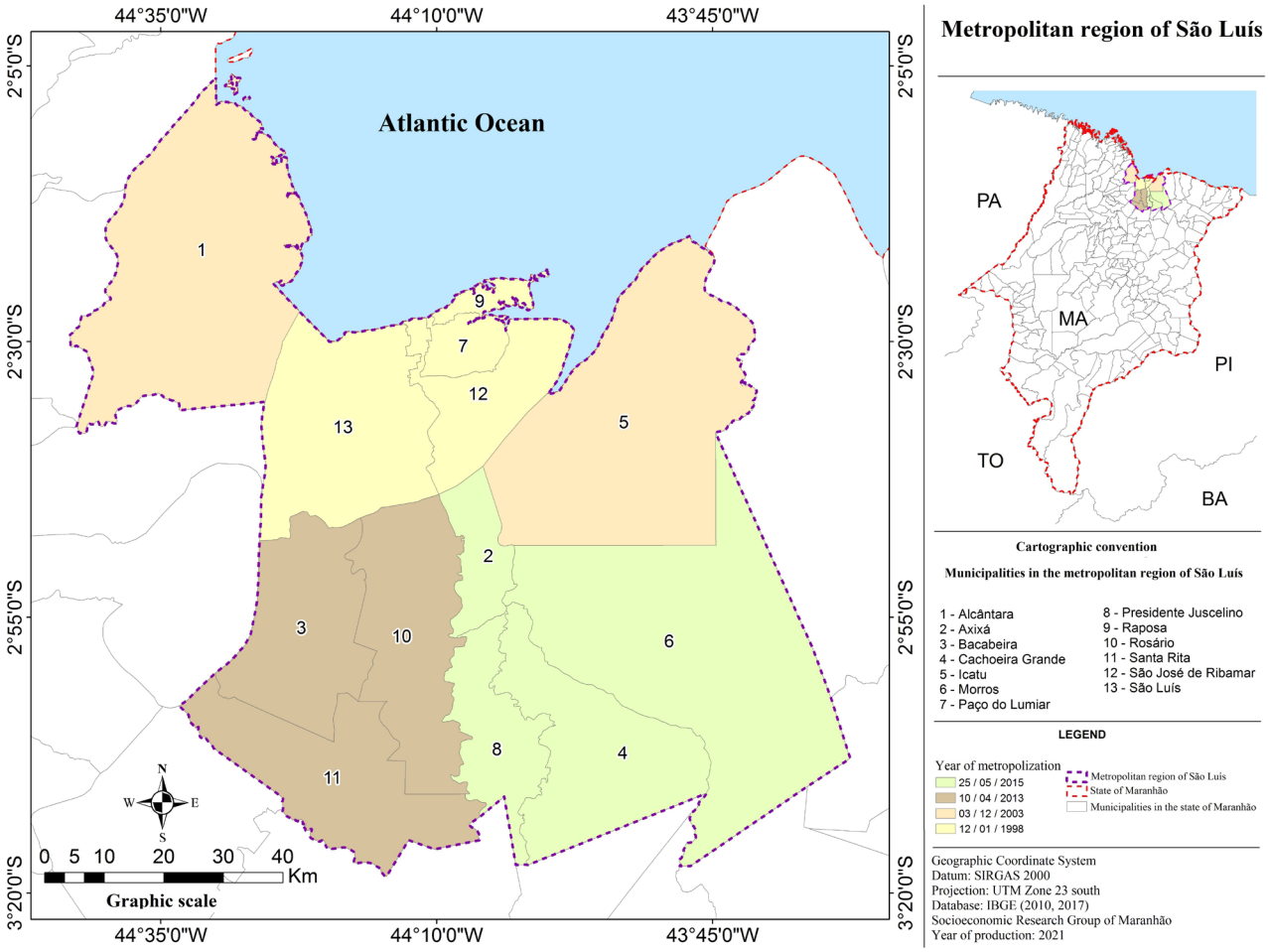
These developments characterize the strong corporatism process in the urban structure of São Luís, evident in the new territorial organization of the city, imposed by urban planners to attract large investments and entrepreneurs. While the gross domestic product (GDP) of the municipality has increased, social inequality and lack of access to public services has also increased. Therefore, "even if the economy grows and globalizes, if public services do not keep up with this growth, it will be difficult to have a harmonious city" (Moura; Ultramari, 1996, p. 53)

This reality is a common characteristic of cities in the so-called underdeveloped/emerging countries. According to Santos, the three economic conditions of cities are the *upper circuit, lower circuit, and upper marginal circuit* of the economy. The first consists of banks, export trade and industry, modern urban industry, modern services, wholesalers, and shippers. The latter consists mainly of *noncapital intensive* forms of manufacturing, non-modern services provided in *retail* and nonmodern small trade.

The industrial, spatial, and population growth of São Luís resulted in a continuous dynamization of the commerce and service sectors, increasing the municipal GDP, but accentuating the income inequality, especially between the capital and the other municipalities on the Big Island. An indication of this is that Brasília, João Pessoa, Maceió, and Recife are the only state capitals in Brazil with a higher income concentration than São Luís (Moreira, 2013).

These dynamics have facilitated the regional metropolization process of the city. Initially, the Metropolitan Region of Greater São Luís covered the four municipalities of the Big Island (São Luís, Paço do Lumiar, Raposa, and São José de Ribamar). The Metropolitan Region of Greater São Luís was established in the late 1990s by State Complementary Law 38/1998. In 2003, the municipalities of Alcântara and Icatu were added by state complementary laws n. 69 and n. 161, respectively. A new regionalization was made in 2013, through Complementary Law n. 153, which added Bacabeira, Rosário, and Santa Rita into the metropolitan region. The current configuration was established by Complementary Law 174, which added the municipalities of Axixá, Cachoeira Grande, Morros, and Presidente Juscelino (Figure 1).

Figure 1 - Metropolitan region of São Luís, Maranhão, Brazil.



Source: IBGE (2017).
compiled by the authors, 2021.

The spatial dynamics of São Luís and the other municipalities of its metropolitan region are characterized by socioeconomic disparities. Except for São Luís proper, the *per capita* income per household is less than one minimum wage (R$1302). In eight of the 13 municipalities, income is less than half a minimum wage (IBGE, 2010). This indicates the existence of an impoverished population, even considering that the *per capita* GDP in all municipalities is above R$3,000. Thus, a combination of impoverishment and extremely high-income concentration is present in all centers.

As Damiani (1997) points out, instead of distinguishing cities by raw demographic data, it is necessary to consider that the enormous income gap that defines cities in the periphery of capitalism deeply reflects the organization of space. The developed activities are qualified, and the types and locations of business are selected with tendencies for strong hierarchies.

Thus, regional disparities that inevitably lead to income differences between individuals help define the tertiary activities, which are accelerated by the modernization of transportation and the technic-scientific-information diffusion, in addition to the corporatization of urban centers, with greater capacity to offer tertiary activities at various levels (Damiani, 1997; Santos, 2008).

This regional characteristic includes the city of São Luís and its metropolitan region as well as many municipalities in Maranhão, which have been selectively targeted by corporate capitalism in several areas, including healthcare services. This creates flows as well as density and sparsity zones, which are intensified in critical situations, such as the Covid-19 pandemic.

Density and sparsity in the supply of medical-hospital equipment in the territory of Maranhão

Historical periods produce forces of agglomeration and dispersion that result in certain technical, political, and economic conditions. These conditions indicate the inevitability of density and sparsity zones that greatly explain the uses and contradictions in the territory.

For Santos and Silveira (2001, p. 260), territory "shows differences in density as to things, objects, men, the movement of things, men, information, money, and actions." These densities are indicators of analysis, reflect references for interpretation, and reveal (un)continuous, broad, or localized overlays that, in the framework of understanding, represent time.

With this perspective, we can say that medical-hospital equipment is not only a system of objects fundamental to contemporary life but also represents methodological variables of density and sparsity analysis that indicate how the State and private initiative regulate the productive process and the territorial uses.

Density and sparsity in the healthcare area can be understood by observing portions of the territory that have a greater or lesser number of healthcare professionals, diversity of specialties, technological level of healthcare inputs and instruments, greater or lesser offer of medical equipment, hospitals, and even access to these services.

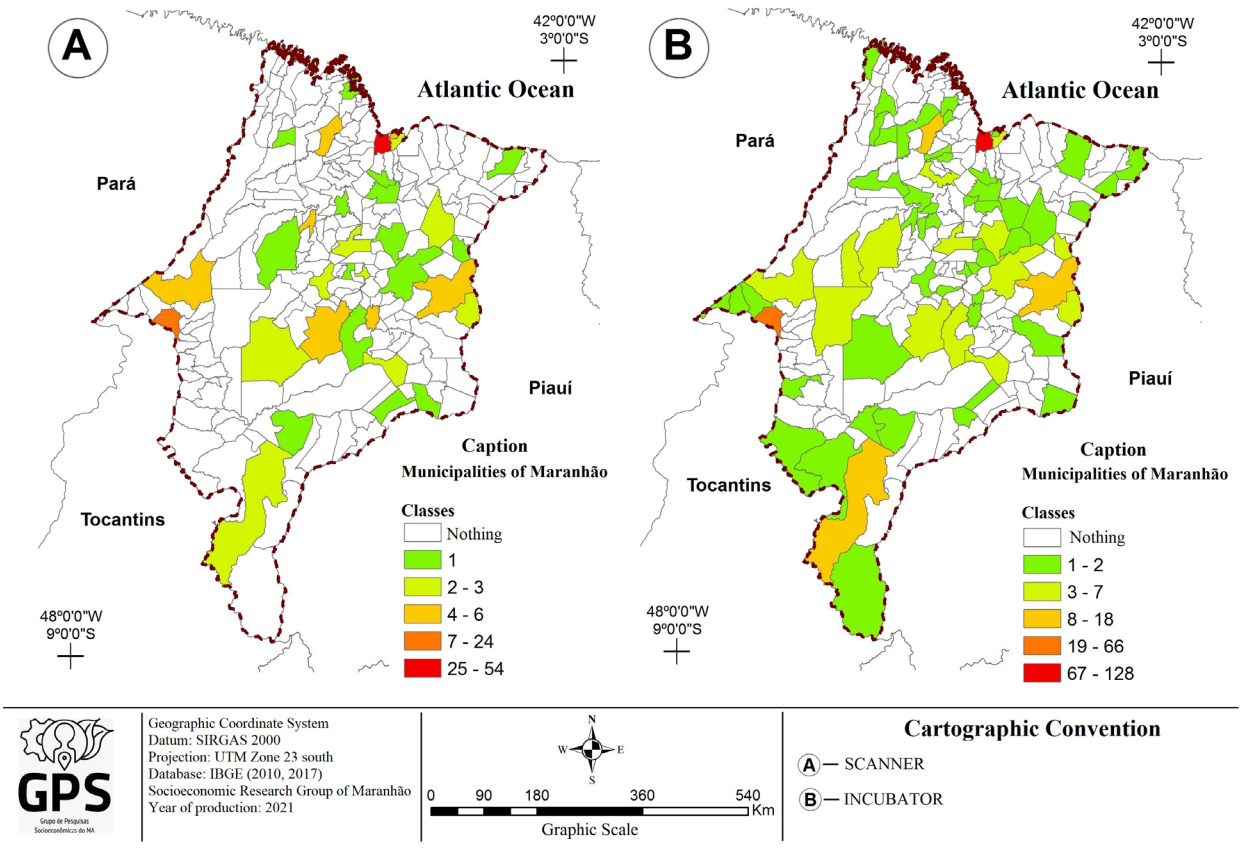
The supply of healthcare services in Brazil, in different degrees of technological incorporation, shows that the technical medical objects (drugs, medical specialties, treatment centers, hospital equipment, pharmacies, and other healthcare establishments) respond to the rationale of the State and companies (Almeida, 2005; David, 2010).

Technical objects are products of social elaboration from innumerable human activities. They can be analyzed based on their respective content, objectification, and normality. However, with technical-scientific-informational advancement, objects become systems that transform human demands and are transformed as they are distributed and used in the territory (Santos, 2014).

Specifically in healthcare, services and objects tend to be dispersed throughout the territory, including in the Brazilian Unified Health System. This dispersion occurs mainly in highly complex services that require highly technological equipment. These tend to be directed to areas of greater fluidity and density, leading to an undeniable selectivity in the territory.

This is common at various levels of technology and healthcare. Analyzing the distribution of incubators and tomographs in Maranhão (Figure 2), only 68 of the 217 municipalities in Maranhão have incubators, and 128 (35%) of the 360 existing incubators are in the capital.[1] In the rest of the state, the two cities that have more than ten units are Imperatriz (66) and Caxias (18).

Figure 2 - Distribution of CT scanners and incubators in the state of Maranhão



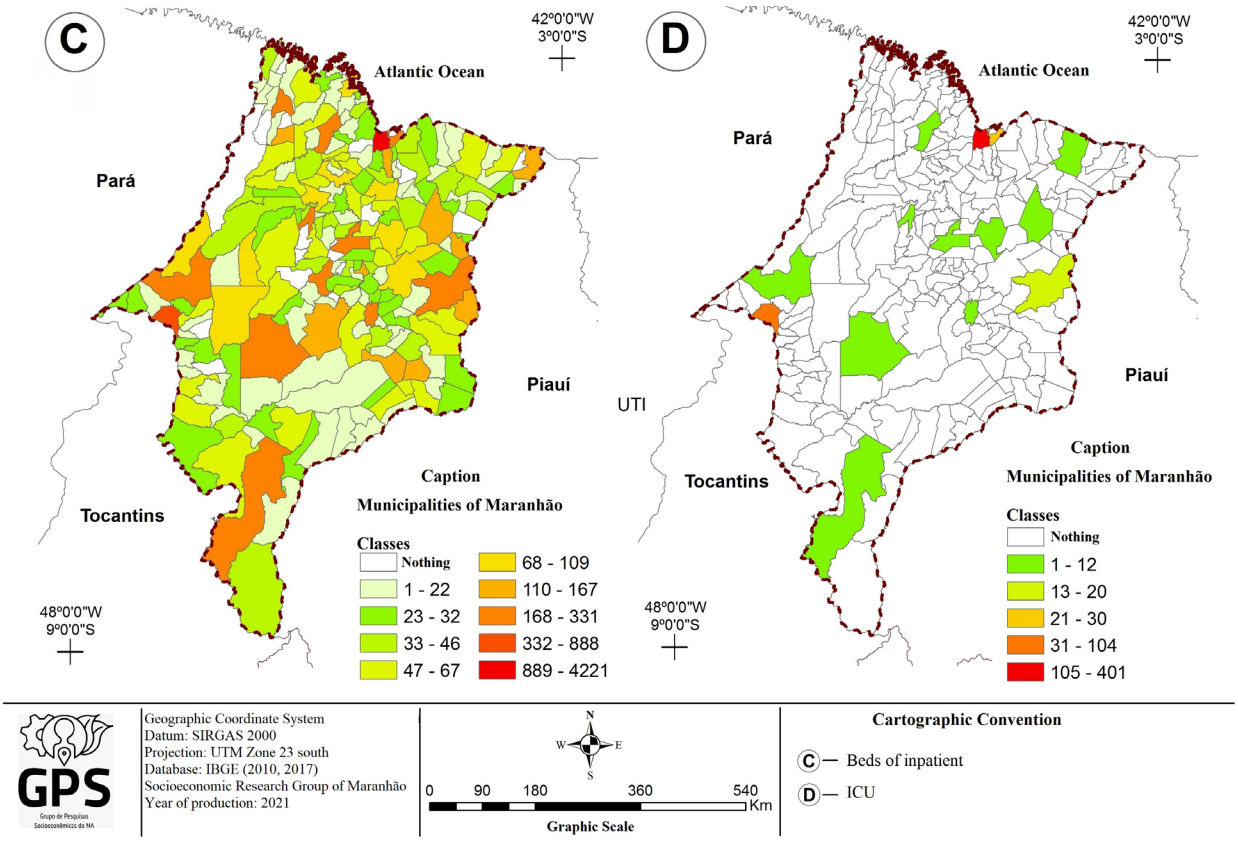
Source: Brasil (2021).
compiled by the authors, 2021.

1 According to data from the Covid-19 Brazilian Obstetric Observatory, approximately 852 pregnant and postpartum women died in the first year of the Covid-19 pandemic in Brazil, 76 of which were in Maranhão alone. Incubators are fundamental equipment to care for this group, (Francisco; Lacerda; Rodrigues, 2021).

As for distribution, there are only 148 CT scanners in 33 cities in Maranhão.[2] Of these, São Luís has 54 (36.5%) and Imperatriz 24 (16%); the other cities have between one and six devices. The apparatus that accompanies the CT scanners (which can cost up to R$ 2 million, in addition to maintenance and personnel training) evidences the selective uses in the territory of certain equipment, especially those with higher technological level, which are commonly located in the main centers, intensifying the relationship between higher density zones and sparsity zones, which cannot afford such technology.

The number of inpatient beds and intensive care units has significantly increased (Figure 3) in Maranhão since the beginning of the pandemic; many municipalities achieved up to 50% increase of new beds for Covid-19.[3] The capital concentrates 28% (4,221) of all existing beds in the state. Inpatient beds are heavily used components in the system of inpatient objects and should always be accompanied by other technical structures; otherwise, the existence of beds, even if significant, may not result in effective patient care.

Figure 3 - Distribution of inpatient and ICU beds in the state of Maranhão



Source: Brasil (2021).
compiled by the authors, 2021.

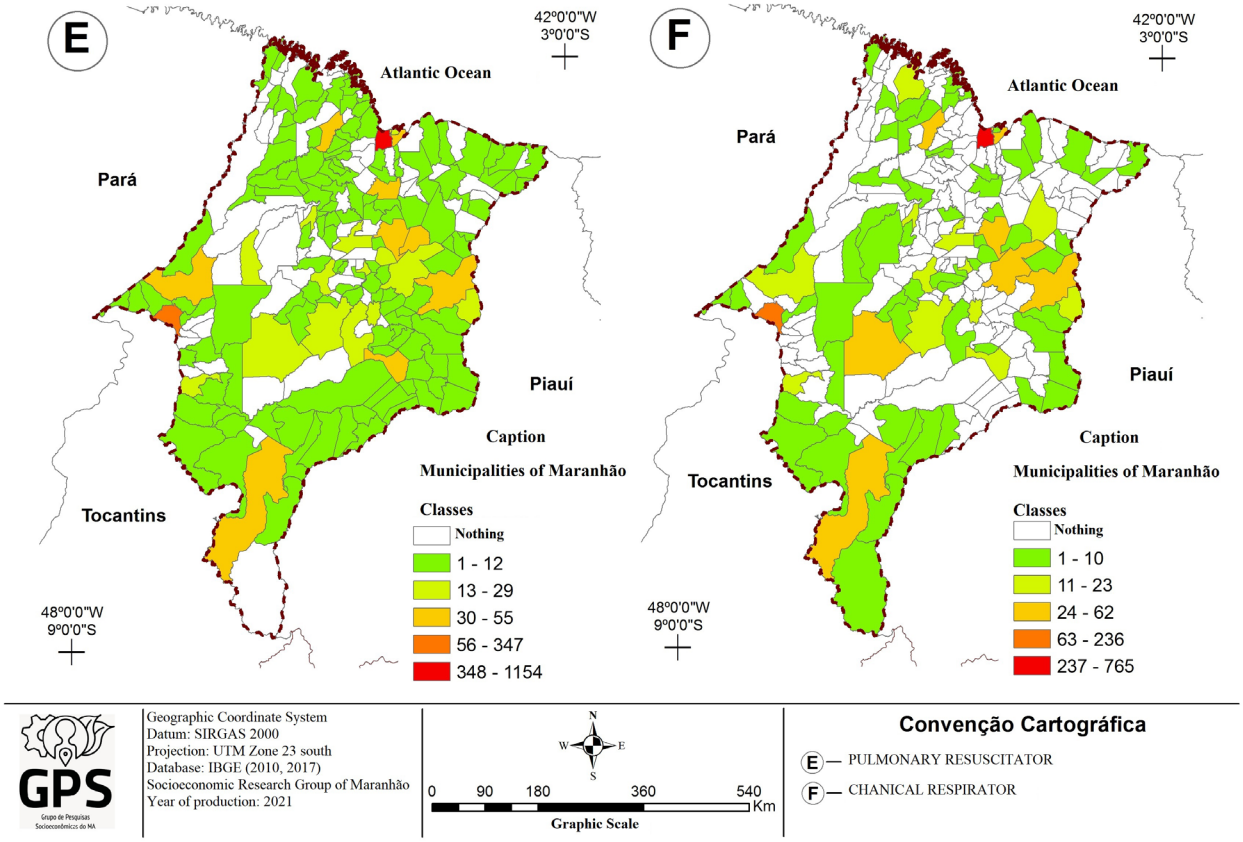
2 A CT scanner is a non-invasive diagnostic imaging procedure that combines the use of X-rays with specially adapted computers. It creates detailed images of various tissues of the human body.

3 The Ministry of Health defines *inpatient beds* as beds intended for the patient admission to a health care facility; they do not necessarily include the system of hospital objects that accompanies this medical care (Brazil, 2021).

The distribution of intensive care units (ICU) can provide an understanding of the systemic relationship between objects. Of the 658 existing ICUs, 401 (61%) are concentrated in the capital. The center with the second largest number is the city of Imperatriz, which has 104 ICUs (15%). The selectivity of uses and concentrations of equipment in the metropolis is a characteristic of Maranhão, which makes São Luís as the main density zone (followed by the city of Imperatriz) and a considerable number of cities as sparsity zones.

Only 72% of the cities in Maranhão pulmonary resuscitators and respirators (Figure 4). Of the 2,631 existing pulmonary resuscitators in the public and private sectors, 1,154 (43%) are in São Luís; 128 municipalities have fewer than ten each.

Figure 4 – Distribution of pulmonary resuscitators and mechanical respirators in Maranhão



Source: Brasil (2021).
compiled by the authors, 2021.

Respirators or mechanical ventilators are frequently used in the treatment of Covid-19, and the state government significantly increased the number of these to fight the pandemic. In February 2020, there were 1,064 respirators in Maranhão, which jumped to the current 1,659, distributed in 90 cities (an increase of 595 new devices). São Luís concentrates 745 (45.5%) devices, followed by the city of Imperatriz, with 236 (14%).

Healthcare infrastructure and its unequal distribution in Maranhão

As Santos (1994) points out, infrastructures are concrete material objects, which have undergone a process of transformation or human creation and have acquired a function. Healthcare infrastructure includes mostly hospitals, specialized clinics, outpatient clinics, and field hospitals. They are concentrators of the main healthcare services and play a significant role in the system of objects destined to care for people with Covid-19.

For Santos (2007), the infrastructures are service points, productive points, commercial houses, hospitals, healthcare clinics, outpatient clinics, schools, stadiums, etc.; they are economic, social, cultural, and religious. Many of them meet the norms of the law of supply and demand, others can be established by the State. In common, all infrastructures are elements of spatial multiplicities and are elements of density with various uses in the territory.

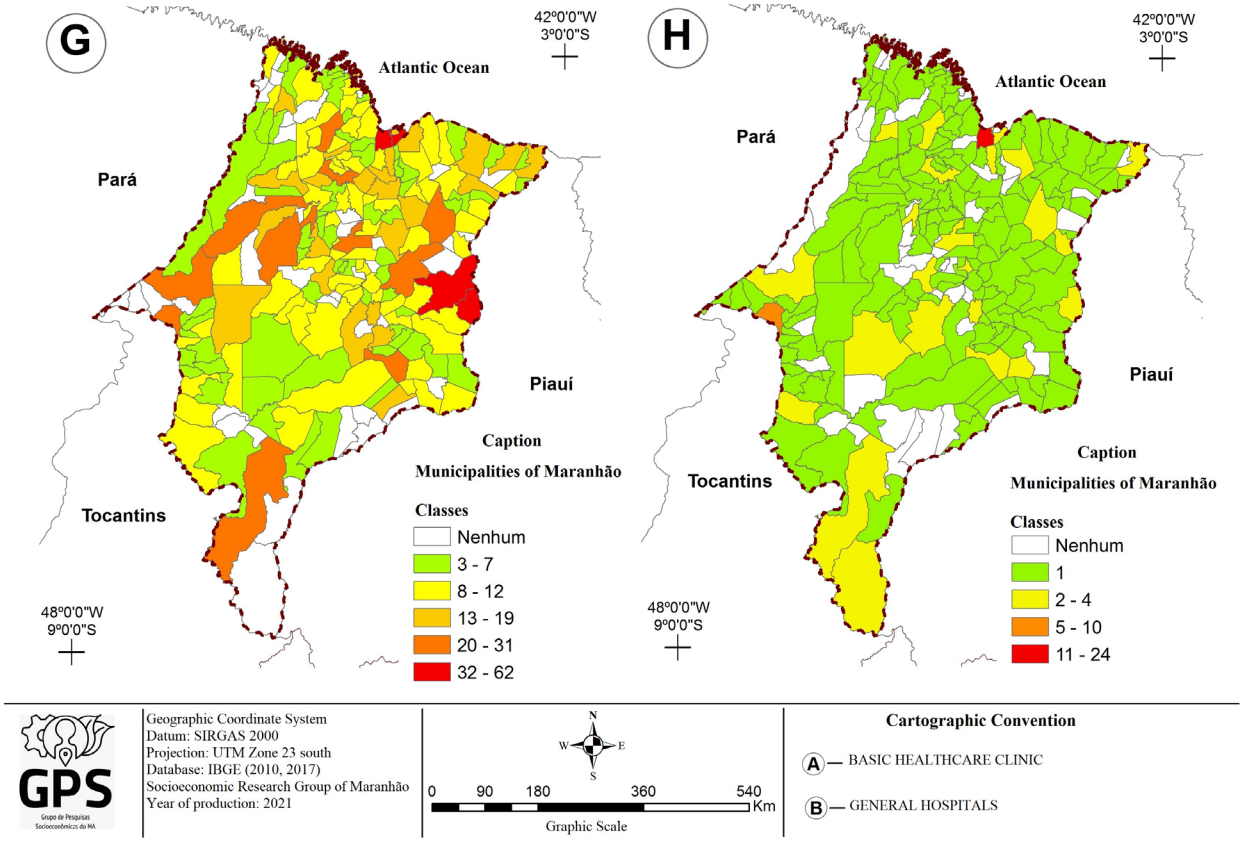
Healthcare structures and all their technical-scientific-informational content (Santos, 1994) are assets that concentrate healthcare professionals, supplies, medicines, medical-hospital equipment, and a series of other elements within an extensive productive chain. Healthcare centers/PHCCs and general hospitals (Figure 5) are examples.

PHCCs are the preferred service centers of the Brazilian Unified Health System and can address most health problems without needing to refer patients to emergency rooms or hospitals. They may offer dental care and other higher-level professionals, such as general practitioners or specialists.

The 1,929 PHCCs in Maranhão are unevenly distributed. Although the logic for this type of infrastructure is established from the geographical distribution in urban centers, 160 cities (73% of the municipalities of Maranhão) have less than 10 PHCCs. The city with the highest number in the state is São Luís, with 62 units, followed by Timon and Caxias which have 40 and 37 PHCCs, respectively.

Maranhão has 244 general hospitals, distributed in 186 centers. Only 21 cities have more than one hospital of this nature, and the capital concentrates the largest number (24 hospitals), followed by Imperatriz, with only ten. The low distribution of this infrastructure creates a social bottleneck, since the services provided in this type of hospital are not limited to the municipality where it is located but serve a wide region.

Figure 5 - Distribution of basic healthcare clinics and general hospitals in Maranhão



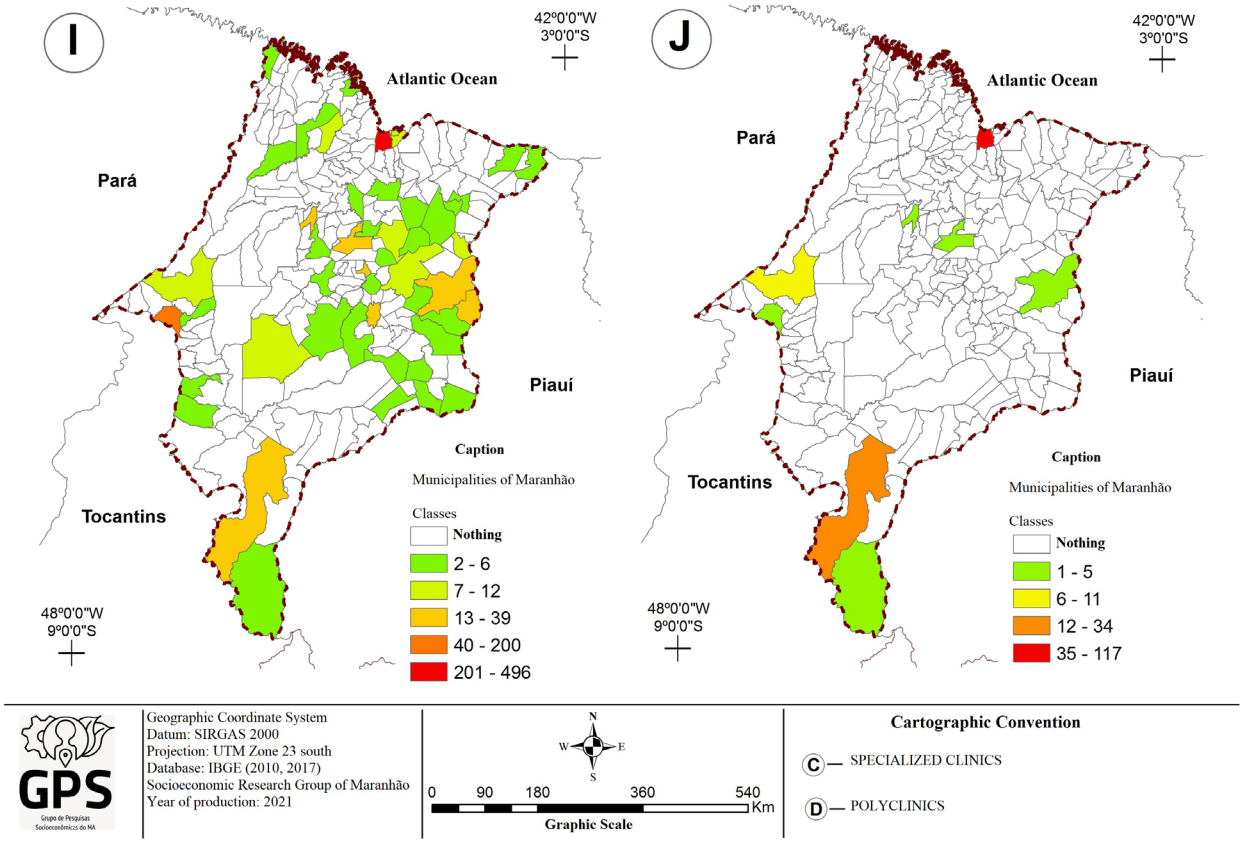
Source: Brasil (2021).
compiled by the authors, 2021.

Other important structures in the care and treatment of patients are specialized clinics and polyclinics (Figure 6). Specialized clinics can perform specific procedures, treatments, and medical specialties, while polyclinics have the capacity to care for several different ailments in different medical specialties. These two important infrastructures attract flows of people, not only because of their performance capabilities but also because they combine medical equipment and medical specialties.

Of the 1,068 specialty clinics mapped, 496 (46%) are in São Luís; the second hub is Imperatriz, with 200 units, equivalent to 19% of the total. The other municipalities in the state of Maranhão that have more than ten clinics of this nature are: Caxias (39), Santa Inês (24), Timon (22), Pedreiras (20), Bacabal (19), Balsas (18), Presidente Dutra (17), and Açailândia (10).

The polyclinics are also concentrated in a few municipalities. In the state, the 194 polyclinics are distributed in only eight municipalities. São Luís concentrates 117 (60%) units, followed by the cities of Balsas (34), Açailândia (11), and Imperatriz (4), which concentrate, respectively, the equivalent of 17.5%, 5.5%, and 2% of the units of this fixed.

Figure 6 – Distribution of specialized clinics and polyclinics in Maranhão



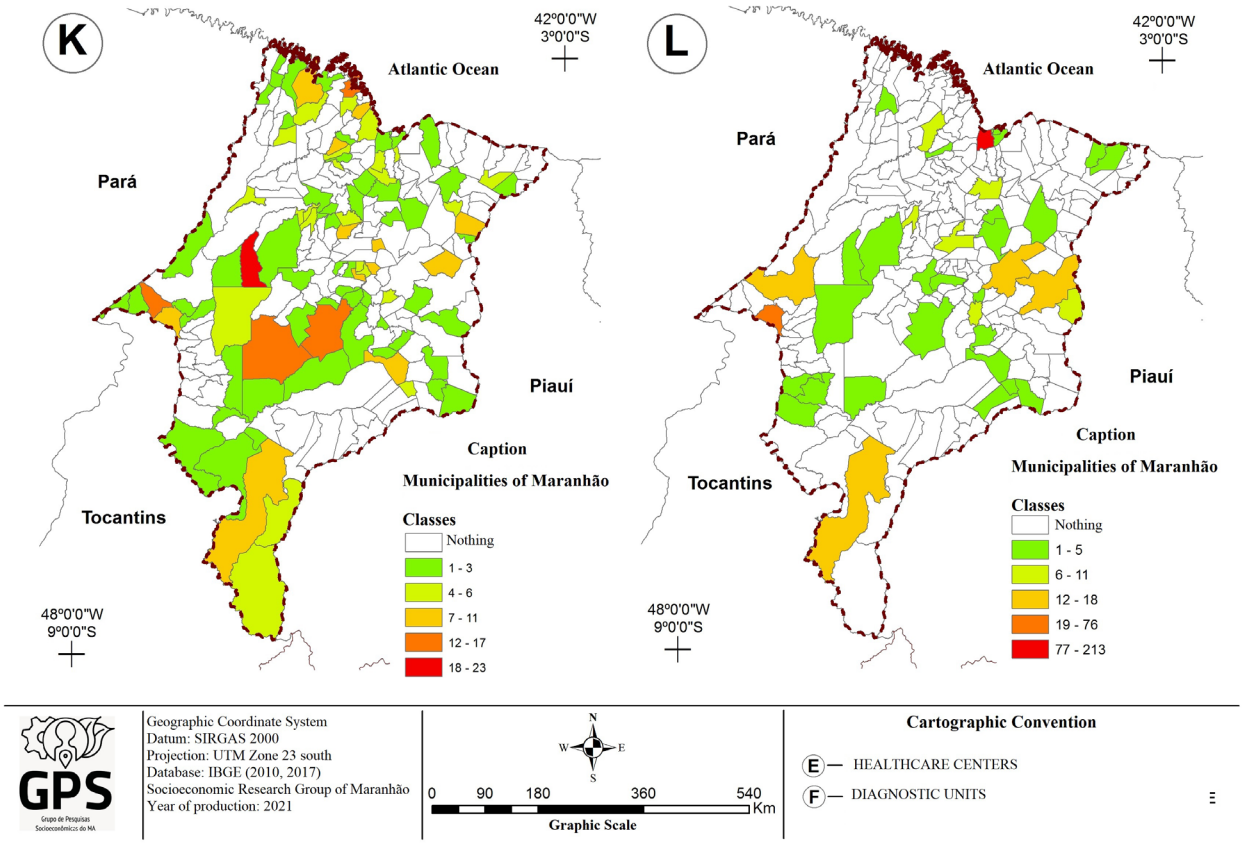
Source: Brasil (2021).
compiled by the authors, 2021.

Healthcare centers (Figure 7) provide assistance to a certain population, on a scheduled or unscheduled basis, by mid-level/technical professionals, with the irregular presence or absence of medical professionals. The main difference from the PHCCs is their limited offer of medical specialties. The presence of healthcare centers reflects the lack of infrastructure with greater medical-hospital diversity, such as general hospitals, emergency rooms, etc. In Maranhão, there are 465 healthcare centers distributed in 121 cities; only seven cities have more than ten healthcare centers.

Diagnostic and therapeutic support service units (Figure 7) are isolated units where healthcare services are provided to clarify a diagnosis or perform specific therapeutic procedures for outpatients, inpatients, or emergency patients of a healthcare facility.

Of the 512 diagnostic units found in Maranhão, 213 (41%) are in São Luís, which is due to the need for multidisciplinary teams of healthcare professionals to act in various segments of patient therapy and rehabilitation. These require both a high percentage of specialized labor and medical-hospital equipment. Only six cities (Açailândia, Balsas, Caxias, Codó, Imperatriz, and Santa Inês) have, on average, ten units of this type, indicating the sparsity found in the other cities of the state.

Figure 7 – Distribution of healthcare centers and diagnostic units in Maranhão



Source: Brasil (2021).
compiled by the authors, 2021.

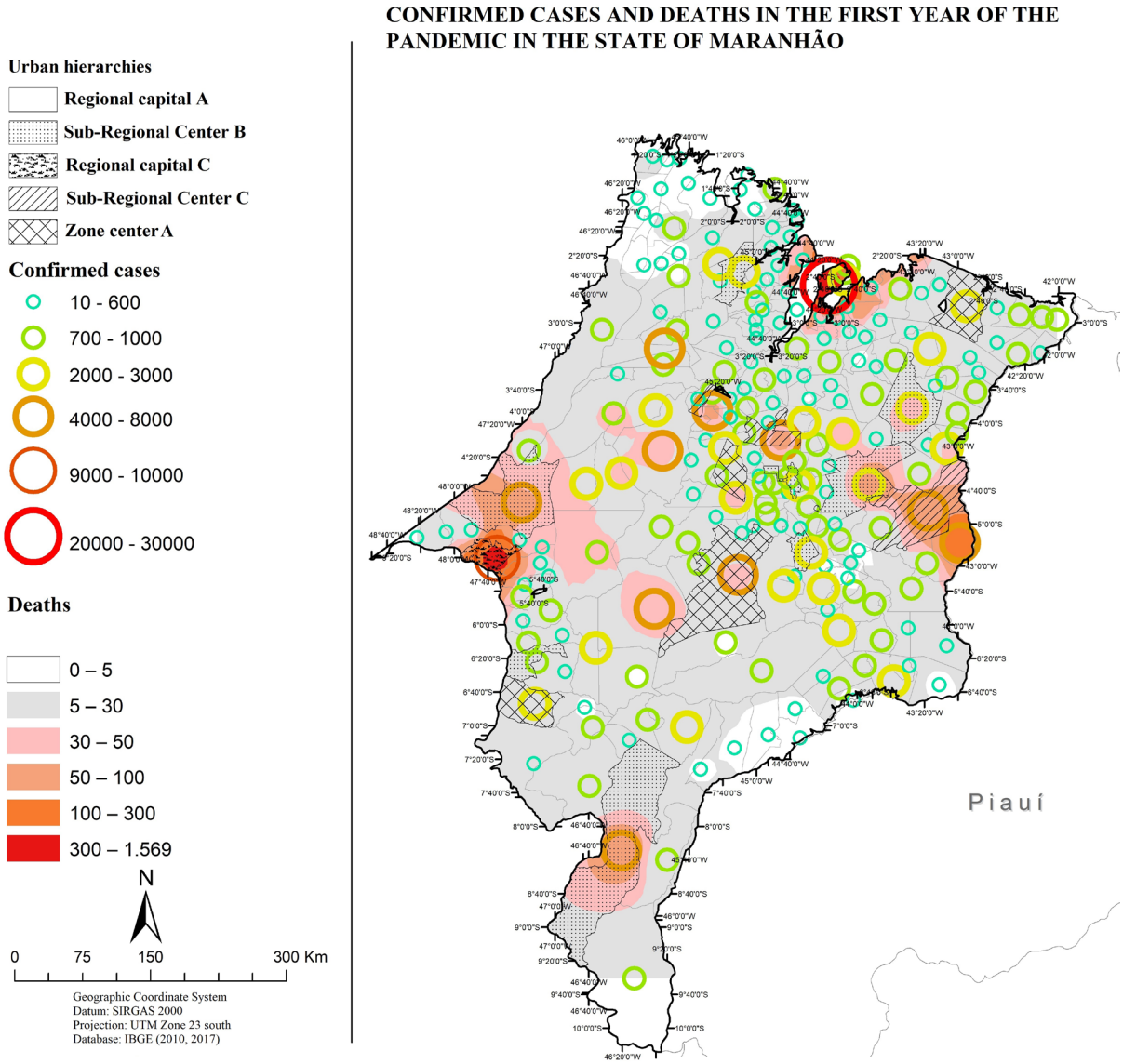
Reflections on São Luís and the flows during the pandemic

Monitoring the spread of Covid-19 in Maranhão officially began on February 28, 2020, with two suspected cases. The first case was detected on March 20, in the city of São Luís, and the first death was registered on March 29. In the initial cases, the flow of airplane traffic (via the two main cities in the state, São Luís and Imperatriz) was fundamental for the spread of the virus, because in both these cities the first cases were in patients who had returned from São Paulo.

Maranhão went into quarantine on March 17, 2020. Flights were canceled and land borders were closed, in-person classes at educational institutions were suspended. The government issued a decree establishing sanitary operating standards, especially for essential services, in addition to border closures, deployment of field hospitals, and even lockdown (Maranhão, 2021).

By March 20, 2021, one year after the first case, Maranhão had registered 233,764 confirmed cases and 5,678 deaths (Figure 8). The distribution of the number of deaths followed to some extent a hierarchical model of the state urban network. The municipalities with the highest concentration of deaths were those that centralize the supply of services, especially healthcare services, and therefore constitute the main density zones: São Luís, Imperatriz, Caxias, Bacabal, and Santa Inês.

Figure 8 – Confirmed cases and deaths in the first year of the pandemic in the state of Maranhão

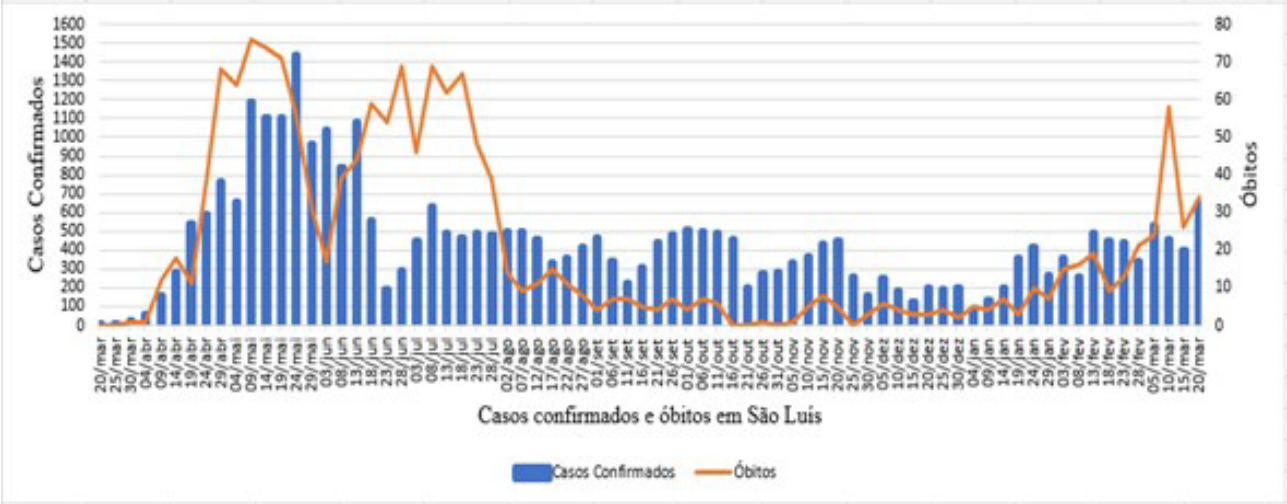


Source: SES-MA (Maranhão, 2021).
compiled by the authors, 2021.

The three main variations in the average number of confirmed cases and deaths in São Luís (Figure 9) were (a) April to July 2020, with an explosion of contagion and deaths, (b) August to December 2020, when the cases and deaths decreased, and (c) January to March 2021, with the beginning of the second wave in the country and state, with the highest numbers of deaths (Maranhão, 2021).

Throughout Brazil, state governments were the primary agents in the fight against the pandemic, which was no different in Maranhão. To confront Covid-19, the state government reorganized patient care logistics in centers with the highest technical-scientific-information density in healthcare. According to the data, the city of São Luís was the main density zone in the state for the supply of healthcare services by concentrating, on average, almost 50% of all medical-hospital equipment, inputs, healthcare professionals, and medical specialties in the state.

Figure 9 – Chart of confirmed cases and deaths from Covid-19 in São Luís



Source: Maranhão (2021).
compiled by the authors, 2021.

This result shows that the selective use of territory in the capital of Maranhão. The greater concentration of healthcare infrastructure inevitably leads to the creation of flows not only of goods, services, and resources, but especially people in search of treatment.

The concept of flow, as the name suggests, is relative to action, movement, and circulation. This practice is understood as a force that gives meaning and/or is a result of the infrastructure in this case, hospitals, polyclinics, specialized clinics, and therapy clinics – places that concentrate technical objects such as respirators, pulmonary resuscitators, CT scanners, and ICUs. Santos (2008, p. 62) admits that "flows are a direct or indirect result of actions, and they cross or settle in the infrastructure modifying their significance and value, while also modifying themselves."

Thus, we can understand flow as that which gives movement to the infrastructure, which is not exactly concrete, but depends on them to exist. Considering the sparse and selective way in which healthcare infrastructure is located, they establish relationships with the individuals who depend on them. In the case of the Covid-19 pandemic, the infrastructure connects with people who, seeking diagnosis and treatment in the pandemic, tend to move not only within the metropolis, but among various centers within the state. As Santos (2014, p. 121) points out, "the infrastructure and flows, interacting, express the geographical reality and it is in this way that they jointly appear as a possible object for Geography."

In this context, the city of São Luís is a strategic center where the supply of services is concentrated, triggering flows of people and goods from various spaces toward the city. In this "dialectic between the frequency and thickness of movements" (Santos; Silveira, 2001, p. 167) conflicts begin between the flows of infected people in various territories and the infrastructure of the pandemic (triage centers, hospitals, ICUs, respirators, etc.) (Aguiar, 2020).

As a result of this selectivity, the regionalization of healthcare services in Brazilian states has intensified over the past two decades (Maranhão, 2021). This organization restructures – albeit very precariously – the flow of patient care, especially for those seeking medium- and high-complexity services.

The organization of the network (Figure 10) shows the dynamics of healthcare in the state's urban network and exposes the levels of intermunicipal dependence to which many cities are subjected in the healthcare area; municipalities with less supply capacity are subordinated to those with greater capacity.

The healthcare network in Maranhão is centered in São Luís. The first level (red) includes the municipalities within the metropolitan region. The next level (yellow) is more distant from the center and includes the Subregional Centers A (Santa Inês, 89,489 inhabitants; Bacabal, 104,949 inhabitants; and Caxias, 164,800 inhabitants); and the Subregional Centers B (Pedreiras, 39,191 inhabitants; Chapadinha, 80,195 inhabitants; Codó, 122,859 inhabitants; and Pinheiro, 84,777 inhabitants). In addition, the network has another 118 centers.

This network contains more than 60% of all municipalities in Maranhão, strongly dependent on the capital for medium and high-complexity services, which require inter-municipal agreements to provide healthcare for their populations.

In the Covid-19 pandemic, this dependency was further aggravated due to the historical and recent shortcomings that presented themselves. Several flows toward the capital were established in search of diagnosis and treatment. The capital assumed a central role in the care of more severe patients, sometimes even receiving air transport from the state government.

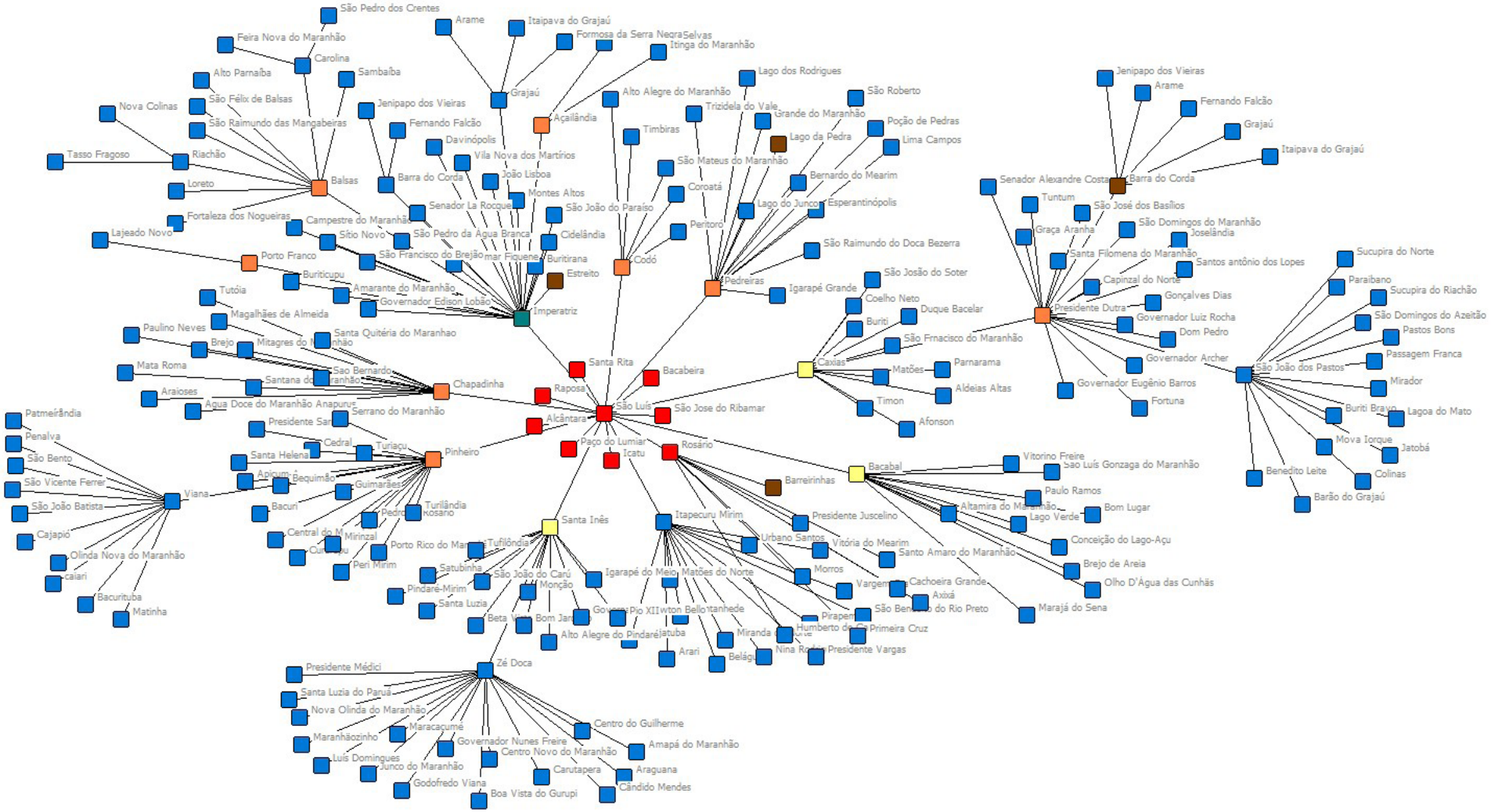
This scenario is represented in Figure 11, which shows the flows of people from other municipalities who were admitted for Covid-19 treatment in São Luís. In the first year of the pandemic, these flows included 14,239 people from other cities who sought care in the state capital. They came from all 217 cities in Maranhão and 152 cities in other regions of Brazil.

In addition to expanding the area of contagion in transit networks, especially in São Luís, the healthcare capacity was inevitably exhausted, especially in the private network, which could not incorporate new equipment and inputs in a timely manner, leaving it up to the public sphere to expand the capacity of care, with the incorporation of field hospitals, beds, respirators, and other inputs.

Because São Luís attracted patients from other municipalities, the capital recorded the most deaths. In the first year of the pandemic, 1,569 deaths were recorded in the capital, which was more than all deaths registered in the 12 main cities of Maranhão: Imperatriz (559), Caxias (119), Bacabal (102), Santa Inês (102), Açailândia (135), Codó (128), Balsas (97), Chapadinha (70), Pinheiro (52), Pedreiras (46), Porto Franco (32), and Presidente Dutra (12).

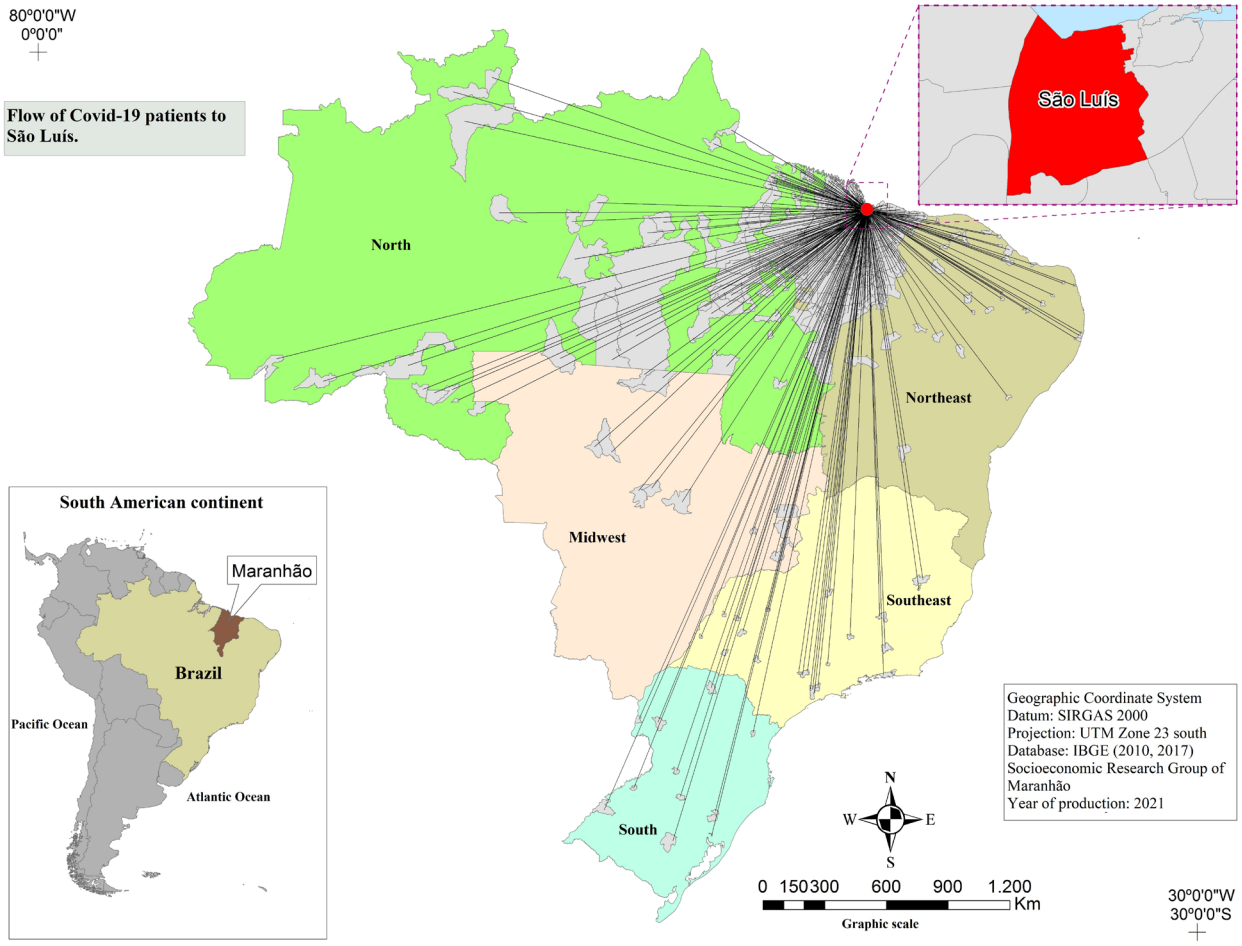
Although the number of elective medical procedures decreased during this first year of the pandemic, 51,602 people were hospitalized from the metropolitan region of São Luís for reasons other than Covid-19, and another 46,807 people hospitalized from other municipalities during the same period. This further amplified the gravitational to the metropolis from throughout the state.

Figure 10 – Regionalization of medium and high-complexity healthcare in São Luís



Source: Maranhão (2011).
compiled by the authors, 2021.

Figure 11 – Flow of Covid-19 patients to São Luís.



Source: Brasil (2021).
Compiled by the authors, 2021.

Final considerations

Understanding the Covid-19 pandemic from the selectivity with which agents linked to the supply of healthcare services occupy the territory sheds light on the differences and regional disparities that multiply on the periphery of world capitalism and have worsened since the year 2020, in the context of the pandemic.

In Maranhão, the way healthcare has developed, especially since the second half of the twentieth century, indicates a selective and intentional concentration of healthcare services in São Luís and reveals, among other aspects, some of the contours that corporate urbanization has assumed in strategic urban centers. In addition to the public healthcare system, private healthcare companies have concentrated their efforts in some territories to the detriment of many others.

This makes São Luís the main density area in Maranhão, concentrating the main healthcare infrastructure (PHCC, general hospitals, specialized clinics, polyclinics, healthcare clinics, and diagnostic, and therapeutic units). Thus, the capital has most of

the medical-hospital objects in the state (CT scanners, incubators, hospital beds, ICUs, pulmonary resuscitators, and mechanical respirators). Both infrastructure and objects are essential in the fight against Covid-19.

This disease is very contagious and its spread depends on the flow of people; therefore, the need for people to travel within the state is a factor that worsened the pandemic. Covid-19 led to an intensification in Maranhão of people seeking diagnosis and care in the state's main density area, São Luís. This expanded the area of contagion and the number of deaths in the capital. The real numbers are much higher, considering the underreporting and the fragility of the records in which each death is credited to the municipality of origin.

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Authors' contribution

Allison Bezerra Oliveira: concept; data collection and analysis; theoretical and methodological discussion of the work and systematization of the final version.

Adriana Maria Bernardes da Silva: Concept and theoretical discussion of the work.

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