



Epidemiological Profile of Infectious Diseases Notified in a Municipality Integrated into the Bioceanic Route in Brazil

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The Bioceanic Route and its economic integration will have tremendous impact within the cities under management. The state of Mato Grosso do Sul and interior municipalities of the Paraguay-Brazil Border are standouts. The permanence of these workers in Brazilian territory will lead to a rapid increase in population in the border towns connected by the corridor and consequently, in the incidence of infectious diseases.

Methods: This is a cross-sectional, quantitative and descriptive study of documentary approach that aimed to analyze the prevalence of tropical infectious diseases such as arboviruses and Diseases Related to Inadequate Environmental Sanitation (DRIES) notified and stored in the National System of Notifiable Diseases (SINAN). The sample consisted of new cases of these

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pathologies in the municipality of Porto Murtinho registered between January 2017 and December 2020.

Results: Within the period analyzed, an increase of 10% in the total number of diseases occurred. The number of dengue cases increased 36 times its previous rates; there was a maintenance from cases of Leptospirosis, Yellow Fever, Zika, Chikungunya, whereas the incidence of Syphilis, HIV and HPV decreased.

Conclusions: Actions aimed at preventing the increase of Arboviruses and DRIESI before, during and after the construction of the Bioceanic Route are needed in view of the changes that will be imposed by it. Faced with the increase in the flow of people that is inevitable with the construction of this project, several outcomes are expected based on previous experiences already mentioned in this work.

Keywords: Bioceanic route; Infectious diseases; Economic development; Public health.

1. INTRODUCTION

The physical integration of South America is part of a project conceived for a long time by countries that make up Mercosur. The aspired integration will take place through a Bioceanic Corridor that will connect the Atlantic Ocean to the Pacific, crossing four countries: Brazil, Paraguay, Argentina and Chile [1-2].

The route will link the Brazilian territory to the Chilean and Peruvian coasts, allowing access to the Pacific Ocean and not only to the Atlantic, as it is currently done [3]. However, such an undertaking could also cause a series of losses for the local population in general. Some of them in the social sphere, such as the distortion of the age pyramid, the occupational profile of the region, increase in violence and prostitution. Added to this is the fact that such works can cause environmental damage, mainly harming the local riverside population [4].

The intensification of interaction between the construction workers, many of them foreigners, with the Brazilian population and its territory may lead to an exacerbation of the transmission of pathologies such as arboviruses and Sexually Transmitted Infections [5]. The permanence of these workers in Brazilian territory will lead to a rapid increase in population in the border towns connected by the Bioceanic corridor. The occurrence of population increase, without prior planning or compatible structural adjustments, such as the expansion of basic sanitation, will lead to an increase in the incidence of "Diseases Related to Inadequate Environmental Sanitation (DRIESI)" [6].

In Brazil, the Bioceanic Route will go through the cities of Campo Grande and Porto Murtinho, both in the state of Mato Grosso do Sul. In Paraguay,

it will cross the cities of Carmelo Peralta, Mariscal José Félix Estigarribia, Boquerón and Pozo Hondo. In Argentina it will cross the cities of Misiones La Paz, Tartagal, Jujuy and Salta, finally arriving in Chile, more specifically the ports of the cities of Mejillones and Iquique reaching its end: the Pacific Ocean [1].

Regarding benefits that such an undertaking will bring, the possibility of access for Brazilian exports and imports to the Chilean and Peruvian coast stands out, thus allowing Brazilian exports not to be limited to the Atlantic Ocean (port of Santos/SP and Paranaguá/PR), and enabling the follow-up of such imports via the Pacific, which is the main objective of the corridor. In this way, there would be the formation of a direct exit route to the Asian and Middle Eastern markets, providing greater fluidity in the circulation of goods and lowering transportation costs [3].

In the specific scope of the State of Mato Grosso do Sul, its present and strong agribusiness will benefit from an outlet to the Pacific Ocean, "[...] allowing both the flow of production and the direct import of inputs at more competitive prices [3]. In this State mentioned above, the route will pass through the municipality of Porto Murtinho (MS), on the border with Paraguay, located in the south of the Pantanal, on the banks of the Paraguay River. The municipality has more than 15 thousand inhabitants, with 80% of the municipality's population living mainly from fishing tourism. In this location, there are plans to build a road bridge that will connect Brazil to the city of Carmelo Peralta, in Paraguay [7].

However, direct impacts of the Bioceanic Route are also predictable, part of the population, including small businessmen in the city of Porto Murtinho, attribute to the arrival of the project in the city a new factor of environmental

degradation, taking into account the new works linked to the Paraná Paraguay Waterway brought by the route, thus directly affecting the health of the Paraguay River and its tributaries [7]. The construction of dams and the formation of reservoirs and irrigation systems in tropical areas can cause rapid environmental degradation and health risks they can increase even before any precautions are taken or even realized about their dangers.

In this regard, the construction of the waterway will involve the retention of water by the more than 120 dams built, under construction and planned in the upper part of the basin, will cause great social impacts due to the effects on fish reproduction and, consequently, on fishing. The different types of activity are the biggest generators of work and income in the Pantanal. The most affected species will be the migratory ones [8]. It is also emphasized that the Paraguayan side of the Ayoreo indigenous people will be the most affected, as they survive from fishing, from capturing baits for the tourist fishing and subsistence farming [7].

Furthermore, indirect impacts are related to deforestation for the expansion of agriculture and livestock in the region's municipalities, in the Paraguay River basin, and especially in the Miranda River sub-basin, one of the main rivers that drain into the Pantanal [7]. Regarding this expansion of the agricultural frontier, the rapid deforestation resulting from the construction of the Bioceanic route will cause, in addition to the contamination of the tributaries, the displacement of vectors or etiological agents of various diseases, thus affecting the populations directly involved with the enterprise and the communities located near the area. It also tends to affect, in a second moment, even entire populations [8].

It should also be noted that the isolation of more than 545 species of arboviruses has already been carried out, among which more than 150 are the cause of pathologies in human beings. Some epidemiologically most important examples for Brazil are: dengue, Zika, Chikungunya and yellow fever [9].

Also, the large Investment Projects became the cause of territorial intervention. Despite variations in its effects, the distortion of the age pyramid, the disruption of family and neighborhood ties, increased violence, prostitution, trade and drug use, temporary change in the occupational profile without

planning for recomposition or maintenance stand out. from previous economic activities or to create new activities after the works, remodeling the territory with the conversion of the area or city [4].

There is also a great possibility of social problems such as sexual exploitation, urban violence, basic sanitation and lack of access to goods and services. Thus, places impacted by major works, in general, show an accelerated increase in cases of sexual violence against children and adolescents, establishing a relationship inversely proportional to the State's capacity to meet and resolve this new demand [4].

On the other hand, prostitution and drug use mentioned above, such practices involve risk behaviors for contracting Sexually Transmitted Infections (STIs) such as Syphilis, Trichomoniasis, Hepatitis B, Gonorrhea, Human Papilloma Virus (HPV) and the Virus of Human Immunodeficiency (HIV) as the establishment of multiple sexual partners and the inconsistent use of condoms [5].

The lack of basic sanitation resulting from the large population increase without prior planning and adjustments, may also affect the population of the cities involved, causing several negative impacts on the population's health. The so-called "diseases related to inadequate environmental sanitation (DRIESI)" are related to the lack or insufficiency of environmental sanitation and precarious housing conditions. DRIESI involve pathologies such as diarrhea, leptospirosis, Chagas disease, taeniasis and hepatitis A [6].

Another important impact will be in the area of health care, since with the arrival of tourists brought along the route and even foreign workers involved in its construction who eventually contract some pathology in Brazilian territory, such individuals can be assisted, in an emergency, by the Unified Health System (SUS) highlighting the fact that care can be precarious depending on the location and the care post, further overloading the Brazilian health system.

Therefore, the construction of the Bioceanic Route involves the generation of a wide variety of possible impacts to be exerted mainly on the Health of the population of the cities most involved in this process, such as the population of Porto Murtinho. Thus, there is an evident need for studies carried out before, during and after

the completion of this work, aiming to identify the existence of changes in Health indicators and thus better clarify the dynamics of environmental and population changes that involve the construction of large works, like this one, within the State of Mato Grosso do Sul and in Brazil as a whole.

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2. METHODS

This is a retrospective, cross-sectional and quantitative study, with a descriptive and documentary approach. This method is indicated in order to understand logical reasoning and all measurable information about human experiences, generating accurate results and ensuring greater security in relation to the inferences obtained [10].

The sample consisted of all cases of arboviroses and DRIESI notified by the health services and stored through the Notifiable Diseases Information System (SINAN), in the municipality of Porto Murtinho, state of Mato Grosso do Sul, in the period from January 2017 to December 2020. The study inclusion criteria were diseases occurred and reported within the period from January 2017 to December 2020 in the Municipality of Porto Murtinho-MS, through a notification form of grievances. Diseases notified as suspected, but discarded later, were excluded.

The data obtained were analyzed regarding the following variables: ICD-10 of the health problem, Type of notification, date of notification of the health problem, date of onset of the first symptoms, Race/Color of the patient, Education, Presence of Pregnancy, Gestational Age, Age and Gender. As this is a census, sampling techniques and sample size calculation were not necessary. Data tabulation was performed using the Excel 2016 program and data analysis and crossing using the GraphPad Prism 7 software. With the information obtained by the database,

the results were described through statistical quantification of absolute value (N) and percentage (%) of the respective variables analyzed from sample as stated above, described in the text and in a table crafted by the author.

3. RESULTS

From January 2017 to December 2020, the following cases of STIs were reported: 35 cases of Acquired Human Immunodeficiency Syndrome (AIDS/HIV); 148 cases of syphilis; 1233 cases of Condyloma Acuminata (HPV- Human Papilloma Virus) and no cases of Hepatitis B and Gonorrhea.

The annual distribution of reported diseases are as it follows: in 2017, 11 (31.14%) of the 35 total cases of HIV were registered; 1 (12.50%) of the 8 total of Chikungunya; 294 (23.84%) cases of 1,233 of HPV; 13 (2.65%) of the 489 dengue cases; 1 (100%) suspected case of Yellow Fever; 1 (33.33%) of the 3 cases of Leptospirosis; 53 (34.19%) of the 155 for Syphilis; 1 (14%) of the 7 cases of Zika virus and 1 (100%) suspected of Chagas. Furthermore, in relation to Diseases Related to Inadequate Environmental Sanitation (DRIESI), there were 3 cases of leptospirosis, 1 suspected of Chagas disease, which was later discarded, and none of hepatitis A.

Regarding STIs, the etiology with the highest incidence was HPV, diagnosed in these cases through the manifestation of condyloma acuminatum. The highest incidence occurred in 2018: 402 (32.6%) cases; followed by 321 (26.03%) in 2019; 294 (23.84%) cases in 2017 and 216 (17.51%) in 2020. With this, in relation to HPV notifications, there is an increase in the number of cases in 2018 followed by a gradual decrease in incidence until reaching the lowest number of cases in 2020, thus decreasing by 26.53% compared to the number of cases registered in 2017.

In the context of arboviruses, the etiology with the highest number of reported cases in the period from January 2017 to December 2020 was dengue, with 489 (100%) cases (Table 1).

The second largest etiology was Chikungunya, with 8 cases, 1 (12.5%) in 2017, 2 (25%) in 2018, 4 (50%) in 2019 and 1 (12.5%) in 2020. A most diagnosed: 6 (75%) were men. Regarding the need for hospitalization, 2 (25%) of the patients needed to be hospitalized, with the other 6 (75%)

being treated at home. A total of 6 (75%) cases progressed to cure; 1 (12.5%) died and 1 (12.5%) did not have this information informed. The third highest number of notifications was of Zika virus, with the highest number of incidence in 2020, with 3 cases (42.86%). The proportion of cases by sex was 3 (42.86%) cases in men and 4 (57.14%) in women, and of these, 3 (75%) were not pregnant and one (25%) was pregnant in the first quarter.

The only case of yellow fever that was recorded in the period occurred in 2017, in a self-declared brown man aged between 31 and 40 years, where education was ignored. In his vaccination card there was a record of a single dose in January 1993. The patient required

hospitalization, but died due to sepsis caused by *Staphylococcus*.

Among Diseases Related to Inadequate Environmental Sanitation (DRIESI) the only one that had notification and confirmed case was leptospirosis, with three notifications in the period. The 3 (100%) notifications of leptospirosis were of the individual type, with no outbreak being recorded in the period, with 1 case occurring, respectively, in the years 2017, 2018 and 2019, with no notification in the year 2020. All (100%) they were men and adults. Of these 3 cases, 2 (66.66%) required hospitalization and 1 (33.33%) died from the disease directly related to the disease, while 1 progressed to death due to other causes.

Table 1. Distribution regarding the sociodemographic profile of patients infected with dengue between 2017 and 2020

Variável	N = 489	%
Gender		
Men	219	44,78
Women	270	55,22
Color/race		
White	208	42,54
Black	9	1,84
Yellow	4	0,82
Brown	264	53,99
Indigenous	1	0,20
Ignored	3	0,61
Age		
Child (0 a 11 anos)	23	4,70
Teenager (12 a 18 anos)	76	15,54
Adults (19 a 59 anos)	329	67,28
Above 60 years	61	12,48
Scholarity		
Illiterate	18	3,68
Elementary school	150	30,67
High school	93	19,02
University education or above	209	42,74
Ignored	19	3,89
Notification year		
2017	17	3,48
2018	32	6,54
2019	163	33,33
2020	277	56,65
Pregnant		
Yes	8	1,64
No	194	39,67
Doesn't apply	287	58,69
Gestational age (N = 8)		
1° Trimester	1	12,5
2° Trimester	2	25
3° Trimester	4	50
Unknown	1	12,5

Source: data extracted from SINAN (2021).

4. DISCUSSION

In 2018, 512 diseases were registered (26.66% of diseases); in 2019 there were 517 (26.92%) and in 2020 there were 515 cases (26.82%). Furthermore, there is a significant increase in the total number of diseases over the period, reaching a peak in 2019 and practically maintaining itself in 2020. Therefore, there was an increase in the incidence of diseases of 7.54% compared to the year of beginning of the analysis in 2017 to the final year, in 2020.

Therefore, in relation to STIs, there was a significant increase in their incidence, mainly in 2018, decreasing later. This may be a reflection of both the increased diagnosis and the changes imposed by the Bioceanic Route in the social sphere, increasing marginalization, sexual violence and risk behaviors and consequently leading to an increase in the incidence of STIs in the construction of large works in the Amazon [4].

In the context of DRIESI, the highest incidence was of leptospirosis, with 3 cases registered, 1 in each year from 2017 to 2019 and none in 2020 (100% decrease in incidence). With this, in relation to this group of diseases, it is considered that there was a reduction in 2020 when compared to the initial year. This fact can be caused by the non-transmission of such diseases or by the non-detection of them when they occur, noting that some of them, such as hepatitis A and B generally have, in most cases, a benign course, being asymptomatic or oligosymptomatic [11].

It is known that urbanization, when carried out in a disorderly manner, without adequate planning, causes problems in water supply, sanitary sewage and irregular occupations, which considerably increases the risk of infections transmitted by water, and by vectors that multiply in these areas vulnerable, with high risk for urban populations [12].

An inadequate urban infrastructure provides favorable situations for the reproduction of pests and vectors of various pathologies. The main transmitter of arboviruses, for example, *Aedes aegypti*, has its reproduction favored by puddles of water in urban areas, and these environments, with stagnant water, are common in places with accumulated garbage on the streets around the home, with ineffective water supply, and without basic sanitation. Therefore, it can be considered that the population residing in regions with such

characteristics are more likely to be infected by the virus transmitted by this vector [13].

Such phenomenon could already be observed in the population of Porto Murtinho, as evidenced by the study data. On the other hand, in relation to arboviruses, primarily Dengue, there was a significant increase in incidence over the years analyzed. In 2017, 13 cases were registered, in 2018 the incidence increased by 146.15%, reaching 32 cases. In 2019 there were 160 cases, increasing the number of cases by 4 times. Finally, in 2020, 272 cases of the pathology were registered, increasing by 70% compared to 2019.

So, there is a significant increase in the incidence of arboviruses during the analyzed period, mainly due to the increase in the number of dengue cases, a disease that reached a total increase of approximately 20 times compared to the initial value in 2017. It is known that environmental changes generally affect the distribution of pathologies of infectious origin. There is a close connection between economic development, environmental conditions and health, given the fact that human interventions in the vectors' natural environment create conditions for their transmission [14].

With interventions over rapid deforestation, displacement of vectors or etiological agents involved in the transmission of diseases to the human race can occur. The transmission will take place, at first, in populations directly involved with the project and in communities located close to the area. In a second moment, such diseases can be perpetuated to the outskirts of large cities and even entire populations [14].

On the other hand, the number of Chikungunya cases remained the same in 2017 and 2018, increasing by 4 times in 2019 and returning to the initial value in 2020. Finally, the incidence of Zika virus infection was maintained in 2017 and 2018: 1 case, doubling its incidence to 2 cases in 2019 and increasing by 50% in 2020 (3 cases). The number of yellow fever cases was 1 case in 2017, reducing its incidence to no cases in the following years.

5. CONCLUSION

The construction of the bioceanic corridor can influence cities directly involved in its construction and their populations and, thus,

result in an increase in the number of cases of various pathologies. According to this study, over the years 2017 to 2020, in the city of Porto Murinho, which will be directly influenced by the construction of the Bioceanic route, there was an increase in the total number of diseases by approximately 10% compared to the beginning period. from the analysis in 2017 to the end in 2020.

The number of cases of Gonorrhea, Leptospirosis, Hepatitis B, Hepatitis A, Yellow Fever, Zika and Chikungunya was maintained. An increase in the number of dengue cases was evidenced, being the most expressive increase in this research, alerting to the possibility of lack of actions or low effectiveness of these in relation to combating this pathology by reducing the procreation of its vector, *Aedes aegypti*.

CONSENT

Term of Consent granted by the State Health Department of Mato Grosso do Sul and Term of Consent for the Use of Database, ensuring the confidentiality of the research.

ETHICAL APPROVAL

This research complied with the ethical precepts of the Resolution of Research Involving Human Beings contained in Resolution National Health Council (CNS) nº 466 of December 12, 2012 and Resolution nº 510 of April 7, 2016. Exemption from the TCLE, The project was approved by the Ethics and Research Committee – CEP/CONEP system.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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