

Magnitude of notifiable diseases and evaluation of epidemiological surveillance indicators in Brazilian border cities, 2007-2009

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Abstract

Objective: to describe the magnitude and timely reporting of Notifiable Diseases (ND) and evaluate epidemiological indicators in 121 Brazilian border cities. **Methods:** this was a descriptive study using Notifiable Diseases Information System (Sinan) 2007-2009 data on 45 diseases notifiable in Brazil, as well as normative evaluation of selected epidemiological surveillance indicators. **Results:** 405,484 notifications were recorded relating to 36 ND; differences in ND magnitude and distribution were found in border areas in comparison with other Brazilian cities, with heterogeneous performance in the epidemiological surveillance indicators. ND notification and timeliness of case outcome was also poor. **Conclusion:** the country's border area is not uniform. Weaknesses were found in municipal epidemiological surveillance systems, especially in detecting and timely reporting of diseases with epidemic potential, and also in the ability to respond to public health emergencies.

Key words: Border Areas; Disease Notification; Epidemiological Surveillance; Indicators; Epidemiology, Descriptive.

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Introduction

Border areas are geographical spaces for cultural interaction, with social, economic and cultural differences, however, some regions are also marked by armed conflicts, drug trafficking, smuggling, degradation of geographic spaces, unemployment and low human development.^{1,2}

Due to the integration of the South American nations and the current political priority given to the relations between these countries, more attention is being drawn to the strategy of regional integration in order to foster political and economic empowerment in common.³ Thus, the border areas are now regarded as strategic areas for the integration of South American countries and the consequences for national policies.⁴ The regional integration in Brazil is of utmost importance once the country has an extensive border strip, not to mention the phenomena that arose from the intensification of free trade in those areas, already reflecting upon the Health sector.⁵

The border geographical areas deserve a different look in the evaluation and development of health policies, especially for epidemiological surveillance activities.

The designs of health systems and health policies of South American countries, plus the wide variety of border cities worsens the difficulties found by health systems in those territories; the unexpected impacts of the process of regional integration in health services are even more complex.⁶ In Brazil, a country with a myriad of realities and continental dimensions, the challenges of regional integration are related to the required maintenance in health services of constitutional principles of the National Health System (SUS).⁷

The border region of Brazil is composed of 588 cities, and corresponds to the official geographic border delineated by the Brazilian Constitution: 150 km from the international limit. This strip of land is divided in three zones: North (98 cities), Central (72 cities) and South (418 cities).^{8,9} Cities of the border line, adjacent to the cities of neighboring countries, represent a total amount of 121, distributed between the North zone (39 cities), Central zone (25 cities) and South zone (57 cities).^{8,9}

Over the last two decades, an acceleration of world circulation in goods and human flow (products/goods,

services/people) intensified by the process of regional integration between countries brought new challenges to Brazilian health systems, especially in border areas, in view of the lack of training or fragility of local health services to respond to the intensification of risks of spreading diseases in those regions.¹⁰ This topic was object of definition of international standards, established by the International Sanitary Regulations (ISR 2005) and discussed in academic papers about the risk of spreading diseases in border areas and/or through transnational means of transport.¹¹

However, studies that offered an epidemiological view for the cities of the border area or that assessed operational aspects of epidemiological surveillance in Brazilian border cities were not found.

With the purpose of contributing to the strengthening of the organization of surveillance actions in those areas, this study aimed at describing the magnitude and timely reporting of Notifiable Diseases (ND) and evaluating epidemiological indicators in 121 Brazilian border cities.

Methods

This study presents two stages: the first one consists of a descriptive study of the NDs in 121 border area cities of the country, in the period 2007-2009; the second stage is a normative assessment of notification and investigation indicators, prevention and control of NDs in 2009.

In the descriptive stage, the national list of NDs defined by the Government Ordinance No. 104, dated January, 25 of 2011 was used.¹² A comparison was drawn between the average number of cases for each disease and ten NDs with the highest average of confirmed cases to the group of border area cities of each zone (North, Central and South). Then, the average incidence (AI) was calculated (new cases/100 thousand inhabitants) or average detection (the same calculation for AI, in this case, specifically used for leprosy) for each zone, equally, what enabled the comparison of epidemiological attributes between the cities of the different zones and the identification of the diseases that have more impact in each local health services. We decided to evaluate notified cases in the period of three years, from 2007 to 2009, in the attempt to minimize the abrupt increase of any disease in an epidemic year.

Taking into account the indicators of epidemiological surveillance assessed in 2009, three were considered as quantitative attributes. The first one is timeliness, an attribute of epidemiological surveillance that reflects the agility of the system to recognize the epidemiological situation and help in decision making. For this attribute, it was taken into account the calculation of (i) reporting timeliness (date of notification - starting date of the symptoms) for the group of immediate compulsory notifiable diseases, whose goal established was 80% of all of these diseases to be notified in at most 24 hours from its initial suspicion;¹² and the calculation of (ii) the timeliness of case outcome (date of notification - date of conclusion) of five NDs¹³ of highest records in the Notifiable Disease Information System (*Sinan*) in each zone. Its performance was considered acceptable when up to 80% of cases were considered closed within the established period of 60, 90 or 180 days, according to each disease.¹³

The second and third attributes considered were indicators of specific policies on epidemiological surveillance: vaccination coverage (VC) of tetravalent vaccine (DTP + Haemophilus influenzae), representing a basic action towards the prevention of NDs, calculated by the median of VC rate of tetravalent for the group of border area cities for each zone; and the rate of tuberculosis cure in the cities for each zone (for the North zone, it was added the amount of coverage in its 39 cities; for the Central zone, it was added the amount of coverage of its 25 cities; and for the South zone, it was added the same amount related to its 57 cities), then the median of the sum of percentages per zone was identified. The indicator of vaccination coverage was considered acceptable when up to 95% of the population aged < 1 year old had been vaccinated.¹⁴

For the calculation of the indicator of tuberculosis cure proportion rate, the definition of new case of TB of the National Program of Tuberculosis was adopted: the cases of new pulmonary bacillus tuberculosis with closure stage as cured in the period assessed, divided by the total amount of new notified cases in the period, multiplied by 100. It was regarded as acceptable performance when the indicator reached up to 85% of tuberculosis cases with concluded treatment, evolving to cure.¹⁵

The comparison of indicators of epidemiological surveillance was carried out in two ways: (i) verification of accomplishment of national goals by the group of border area cities – per region – and the remaining

cities of the country (excluded the border area ones); and (ii) the comparison of border area cities rate – per region – with the corresponding rate of the other Brazilian cities that have accomplished the set goals.

The following data sources were used: Notifiable Diseases Information System (*Sinan*); Information System of Epidemiological Surveillance of Malaria (*Sivep- Malaria*); Information System of the National Program of Immunization (*SI-PNI*) and the Brazilian Institute of Geography and Statistics (*IBGE*). Softwares used were the following: EpiInfo® (version 3.5.3), Tableau Public® (version 6.0), Tabwin® (version 3.6b) and Microsoft Office 2010®.

This study was approved by the Research Ethics Committee of the Public Health School Sérgio Arouca/ Institute Oswaldo Cruz Foundation, in January, 12th, 2011 – Protocol No. 287/11 – in accordance with the resolution of the National Health Council (CNS) No. 466, dated December 12th, 2012.

Results

During the period 2007-2009, border area cities registered 405,484 notifications of compulsory notifiable diseases, with a total of 36 diseases (Table 1). The peak of data recorded occurred in 2007: 166,057 notifications of 32 diseases. Drawing a comparison between the average of cases notified in the aforementioned period, NDs of expressive magnitude in the border area cities were: malaria (98,459 cases); dengue (15,168 cases); anti-rabies treatment (8,129 cases); viral hepatitis (3,609 cases); injuries by venomous animals (2,354 cases); cutaneous leishmaniasis (1,949 cases); and tuberculosis (1,475 cases); the other conditions presented less than 1,000 average notifications. Two cases of smallpox were notified in 2008, probably due to a typo or case classification, because the global eradication of smallpox occurred more than 30 years ago.

In the stratification per zone, the North zone stood for 58.0% of all notifications, including 31 diseases. The Central zone stood for 34.0% and the South, 8.0% of notification, with 33 diseases for both. Top ten compulsory notifiable diseases registered per zone represented 97.6% of the total amount of notifications in the North, 90.7% in the Central and 67.8% in the South.

When analyzing the notifications per diseases in the border area cities per zone, the average incidence – AI – of malaria in the North was 8,391.1 cases/100 thousand

Table 1 - Amount and average records of compulsory notifiable diseases in border line cities, Brazil. 2007-2009

Condition	Year of notification			Average
	2007	2008	2009	
Malaria	131,231	83,615	82,031	98,959
Dengue	14,684	9,349	21,470	15,168
Anti-rabies treatment	7,781	8,720	7,885	8,129
Viral Hepatitis	3,339	3,286	4,202	3,609
Injuries caused by venomous animals	2,138	2,305	2,618	2,354
Cutaneous Leishmaniasis	1,865	2,072	1,911	1,949
Tuberculosis	1,502	1,448	1,475	1,475
Leprosy	931	887	815	878
AIDS	488	422	638	516
Exanthematous diseases	574	312	140	342
Toxic effect of substances	301	306	317	308
Meningitis	316	291	295	301
Maternal Syphilis	172	289	263	241
Leptospirosis	192	216	291	233
Pertussis	91	126	281	166
HIV-positive pregnant	101	98	113	104
Urethral discharge	29	66	159	85
Congenital Syphilis	60	93	85	79
Unspecified Syphilis	41	75	42	53
Visceral Leishmaniasis	34	36	71	47
Hantavirus	47	32	21	33
Typhoid Fever	49	14	11	25
Tetanus	22	26	17	22
Yellow Fever	10	25	18	18
Acute flaccid paralysis (poliomyelitis)	18	16	18	17
Post-vaccination adverse events	15	17	12	15
Acute Chagas disease	12	11	12	12
Human influenza new subtype (pandemic)	–	–	24	8
Schistosomiasis	4	8	4	5
Diphtheria	4	5	4	4
Spotted fever (tick-borne rickettsioses)	2	2	4	3
Human rabies	4	2	1	2
Congenital rubella syndrome	–	3	2	2
Smallpox	–	2	–	1
Botulism	–	1	–	–
Tetanus neonatorum	–	1	–	–
Total	166,057	114,177	125,250	135,161

inhabitants, representing 88.6% of the ten diseases with greater magnitude. The remaining diseases were: dengue (394.6 cases/100 thousand inhabitants); viral hepatitis (219.1 cases/100 thousand inhabitants); cutaneous leishmaniasis (197.2 cases/100 thousand inhabitants) and injuries by venomous animals (140.8 cases/100 thousand inhabitants). In the Central zone, malaria (3,215.3 cases/100 thousand inhabitants) represented the biggest average of notification per city: 72.8% of the ten diseases with greater magnitude (followed by dengue with 891.0 cases/100 thousand inhabitants) and 20.2% of the total amount of notifications. In the South, dengue (258.0 cases/100 thousand inhabitants) represented the biggest average of notifications in the cities: 48.6% of the ten diseases of greater magnitude (followed by viral hepatitis: 84.5 cases/100 thousand inhabitants) and 15.7% of notifications (Table 2).

When comparing the average incidence of the main diseases, malaria represented 75.0% of cases confirmed in all the zones: in the North, there was an average incidence 2.6 higher than the AI of the Central zone. With regard to dengue, the Central zone presented the highest AI, 2.3 and 3.4 times higher than the ones recorded in the North and South zones, respectively. Viral hepatitis showed higher AI in the North zone, followed by the South and Central zones in this very order. Injuries by venomous animals represented the compulsory notifiable disease with the third highest AI in the South zone, ranking in the fifth position in the North and Central zones. Another noteworthy situation was the cutaneous leishmaniasis and maternal syphilis, ranked among the top ten NDs with the highest number of notification in the North and Central zones, but not even appearing in the South zone's list. A similar situation occurred with regard to AIDS, which was only in the Central and South zones' lists, with the highest AI in the Central zone.

The cities in the border areas notified ten immediate compulsory notifiable diseases, (exanthematous diseases, meningitis, poliomyelitis, hantavirus, influenza, yellow fever, diphtheria, human rabies, acute Chagas disease and congenital rubella syndrome), totalizing 535 records in 2009. When comparing the reporting timeliness in the border area cities with the rest of Brazil, none of the border zones reached 80% of the timely notification goal: the three zones showed lower percentage, resulting in 16.6% for the border area cities group against the 26.3% for the other Brazilian cities (Table 3). When

stratifying the percentage by border area cities, there was poor performance in most cities in all zones. The North zone presented better performance for this indicator: 25.0% of its cities have achieved the goal of reporting timeliness, followed by the other Brazilian cities with 10.8% (Table 3).

With regard to the timeliness of case outcome, attention was drawn to the accomplishment of the national goal of 80% for some diseases. The Central zone stood out for reaching the goal in four out of five diseases of major notification, that is to say: tuberculosis (94.5%), meningitis (91.5%), viral hepatitis (85.2%) and cutaneous leishmaniasis (83.0%). The South zone and the other Brazilian cities showed three diseases whose closure goals were accomplished: malaria (98.4%), viral hepatitis (92.0%) and tuberculosis (88.9%) in the South zone; and in the other Brazilian cities, meningitis (90.7%), tuberculosis (89.9%) and viral hepatitis (85.5%). The North zone had two diseases whose national goal was accomplished: tuberculosis (94.7%) and pertussis (93.0%) (Table 4).

In the assessment of national vaccination coverage for all the border area cities, higher values median were found in the Central zone (100.0%), followed by the South (97.2%) and North (96.3%) zones whilst, for the other Brazilian cities, there was a 98.7% of vaccination coverage. When stratifying the border area cities' rate for each zone, the Central zone presented 96.0% of cities that accomplished the goal, followed by the South zone (71.9%) and the North (53.8%); for the other Brazilian cities, this proportion was 80.0% (Table 5).

Drawing a comparison of the percentage of cure for tuberculosis in the regions of border area with the rest of Brazil, not a single region accomplished the national goal. The North zone presented the highest proportion of TB cure (77.1%), followed by the South (75.1%); and the group of other Brazilian cities presented 72.9% of cure. Assessing the border area cities in each region that have accomplished the goal for cure of tuberculosis, a low proportion in all regions (ranging from 47.6% to 58.1%) could be noticed, as well as for the group of other Brazilian cities (49.9%) (Table 5).

Discussion

The evaluation of incidence of compulsory notifiable diseases in the border area cities drew attention not

Table 2 – Distribution of notifiable diseases, according to median and average incidence of cases gathered by border region, in border area cities, 2007-2009

Type of Condition	Year of Notification						Average (2007-2009)	Average Incidence per 100 thousand inhabitants
	2007		2008		2009			
	N	(%)	N	(%)	N	(%)		
North Zone								
Malaria	86,727	92.5	57,469	87.0	59,571	85.0	67,922	8,391.1
Dengue	1,915	2.0	3,316	5.0	4,354	6.2	3,195	394.6
Viral hepatitis	1,619	1.7	1,467	2.2	2,239	3.2	1,775	219.1
Cutaneous Leishmaniasis	1,526	1.6	1,722	2.6	1,538	2.2	1,595	197.2
Injuries caused by venomous animals	1,101	1.2	1,108	1.7	1,210	1.7	1,140	140.8
Tuberculosis	467	0.5	448	0.7	423	0.6	446	55.1
Leprosy	270	0.3	287	0.4	258	0.4	272	33.6
Pertussis	80	0.1	99	0.1	260	0.4	146	18.0
Urethral discharge	25	0.0	62	0.1	157	0.2	81	10.0
Congenital Syphilis	65	0.1	57	0.1	102	0.1	75	9.2
Total	93,795	–	66,035	–	70,112	–	76,647	–
Central Zone								
Malaria	43,815	85.2	25,973	78.1	22,200	53.2	30,663	3,215.3
Dengue	4,867	9.5	4,271	12.8	16,332	39.2	8,490	891.0
Viral Hepatitis	607	1.2	780	2.3	733	1.8	707	74.3
Tuberculosis	572	1.1	548	1.6	662	1.6	594	62.4
Injuries caused by venomous animals	453	0.9	570	1.7	553	1.3	525	55.2
Leprosy	480	0.9	427	1.3	401	1.0	436	45.8
Cutaneous Leishmaniasis	309	0.6	315	0.9	351	0.8	325	34.1
AIDS	212	0.4	119	0.4	273	0.7	201	21.1
Congenital Syphilis	56	0.1	160	0.5	121	0.3	112	11.8
Meningitis	61	0.1	81	0.2	85	0.2	76	8.0
Total	51,432	–	33,244	–	41,711	–	42,129	–
South Zone								
Dengue	7,895	65.8	1,751	35.0	769	17.3	3,472	258.0
Viral hepatitis	1,110	9.3	1,037	20.7	1,226	27.6	1,124	84.5
Injuries caused by venomous animals	576	4.8	604	12.1	852	19.2	677	51.0
Tuberculosis	459	3.8	450	9.0	387	8.7	432	325
Malaria	689	5.7	173	3.5	260	5.9	374	27.9
Aids	214	1.8	225	4.5	308	6.9	249	18.7
Exanthematous Disease	479	4.0	187	3.7	78	1.8	248	18.5
Toxic effect of substances	234	2.0	235	4.7	226	5.1	232	17.4
Leprosy	181	1.5	172	3.4	154	3.5	169	12.7
Leptospirosis	163	1.4	165	3.3	177	4.0	168	12.7
Total	12,000	–	4,999	–	4,437	–	7,145	–

Table 3 - Number and percentage of immediate compulsory notifiable diseases timely recorded and percentage of border area cities reaching the timeliness of immediate notifiable goal, according to border area region and other Brazilian cities. Brazil, 2009

	Geographic Area			Brazil ^a
	North Zone	Central Zone	South Zone	
Cases of compulsory notifiable diseases timely notified N (%)	26 (61.9)	42 (8.2)	21 (19.1)	7,822 (26.3)
Cities that have reached the national goal and timely notified (%)	25.0	7.7	9.5	10.8

a) Including all Brazilian cities, except 121 ones of the border area.

Table 4 - Number and percentage of cases of five major compulsory notifiable diseases timely closed, according to border area regions and the other Brazilian cities. Brazil, 2009

Type of condition	Timeliness of case outcome	
	N	%
North Zone		
Dengue	2,500	68.0
Viral Hepatitis	1,609	75.9
Cutaneous Leishmaniasis	958	71.2
Tuberculosis	284	94.7 ^a
Pertussis	240	93.0 ^a
Central Zone		
Dengue	9,742	60.4
Viral Hepatitis	615	85.2 ^a
Cutaneous Leishmaniasis	524	94.6 ^a
Tuberculosis	229	83.0 ^a
Pertussis	75	91.5 ^a
South Zone		
Viral Hepatitis	1,125	92.0 ^a
Dengue	544	71.0
Tuberculosis	248	88.9 ^a
Malaria	253	98.4 ^a
Leptospirosis	119	68.0
Brazil^b		
Dengue	369,544	65,3
Viral Hepatitis	88,815	85,5 ^a
Tuberculosis	52,947	89,9 ^a
Meningitis	27,952	90,7 ^a
Cutaneous Leishmaniasis	15,761	78,7

a) Cities that have reached the national goals of timeliness of case outcome, by disease.

b) Including all Brazilian cities, except 121 cities of the border areas.

Table 5 - Median coverage of the tetravalent vaccine and cure percentage of tuberculosis, according to border area regions and the other Brazilian cities. Brazil, 2009

Indicators	Geographic area			Brazil ^a
	North Zone	Central Zone	South Zone	
Tetravalent Vaccine Coverage(%)				
Median	96.3	100.0	97.2	98.7
Cities with national vaccination coverage goal accomplished	53.8	96.0	71.9	80.0
Tuberculosis cure (%)				
Cure (%)	77.1	71.1	75.1	72.9
Cities with national goal of cure for tuberculosis accomplished	58.1	47.6	55.0	49.9

a) Including all Brazilian cities, except 121 border line areas.

only to the similarities, but also to the differences in the epidemiological standards, represented by the high concentration of some diseases in all the zones and by the important diversity in the magnitude of the major NDs registered. Among the 45 NDs, the top ten by zone concentrate more than 90% of confirmed cases in the North and Central zones, and nearly 70% in the South. The ten NDs with the highest number of confirmed cases were: malaria; dengue; anti-rabies treatment; viral hepatitis; injuries by venomous animals; cutaneous leishmaniasis; tuberculosis; leprosy; AIDS; and exanthematous diseases.

The understanding of the spatial distribution of malaria in the Legal Amazon, which includes all the North zone, should not be solely explained by using a specific factor, such as the climate, social, economic or relation with the change of land coverage.¹⁶ However, there are vulnerable conditions for the occurrence of the disease, e.g., the population growth, stream of migration and environment degradation, a result of human intervention, as well as the proliferation of the vector mosquito, whose life cycle is favored by the humidity and regional temperature.

The aforementioned factors, when enhanced by new spatial peri-urban standards of transmission, are also linked with the occurrence of cutaneous leishmaniasis and the distribution of their vectors throughout most part of the Brazilian¹⁷ territory, with different average incidence – AI –, higher incidences in the North and Midwest macroregions.

When it comes to dengue, border areas showed similar patterns in comparison to the ones presented in studies on the distribution of the disease in Brazil, with the highest AI being found in the Midwest and North macroregions of the country in 2007 and 2008.¹⁸

Due to all ethnic, economic and regional diversity, viral hepatitis infection stands out for its huge heterogeneous distribution throughout the country.¹⁹ The South macroregion, for instance, is defined as an area of low prevalence for hepatitis B, on the other hand, Amazon is among the areas of higher prevalence in the world. Nonetheless, some areas of high prevalence of hepatitis were found in the states of Espírito Santo, Paraná and Santa Catarina, and low prevalence even in the state of Amazonas.¹⁹ Another important aspect about hepatitis is that the North, especially the Amazon, is hyper-endemic for the virus of hepatitis Delta (VHD) or hepatitis D, especially Acre state and the southern region of the state of Amazonas.²⁰ VHD needs to be infected by the VHB to properly carry out its pathogenic action, and contribute to the higher incidence of viral hepatitis in the North region.²⁰

Venomous animals are part of a quite diverse fauna, however, only injuries caused by serpents, scorpions, spiders, lizards and bees correspond to objects of surveillance, being recorded in *Sinan*.²¹ The highest AI for injuries caused by ophidians occurred in cities of

the North macroregion, corresponding to AI of injuries caused by venomous animals in the North region. For other venomous animals, the distribution of accidents is diverse: cases of scorpion envenomation represent the highest incident in the Brazilian Northeast region (32.6/100 thousand inhabitants), followed by the Southeast (20.1/100 thousand inhabitants), North (13.6/100 thousand inhabitants), Midwest (10.0/100 thousand inhabitants) and South (3.6/100 thousand inhabitants); spider envenomation had the highest concentration of the deaths in the South region, with an incidence of 55.7/100 thousand inhabitants, mainly in the states of Santa Catarina and Paraná. Injuries caused by lizards also have the highest incidences in the South macroregion of the country.²¹

A research conducted in the border area found higher average incidence of AIDS in the south zone, followed by the Central zone and the lowest AI incidences were found in the North.² In the present study, cities of the Central zone showed an average incidence of AIDS slightly superior to the one observed in the South.

Attention should be drawn to the high incidence of pertussis in the north zone, given that in Brazil, an important reduction was observed in this incidence due to high vaccination coverage with DTP and tetravalent. However, due to a concentration of population groups with low coverage in some states, especially in the Amazon (indigenous population), some outbreaks of the disease were observed in the country.

The high incidence of exanthematous diseases in the cities of the border line of the South zone is due to the residue of cases recorded in the country during 2007 and 2008. The National Vaccination Campaign against Rubella, carried out in 2008, immunized nearly 70 million people. Immediate result was observed: whilst 10,654 cases of Rubella were recorded in 2007 and 2008, Brazil did not confirm a single case of the disease in 2009, suggesting a positive impact of the vaccination campaign over the transmission of the virus.²²

Exposure to toxic substances stood out in the South zone as one of the ten major average incidences in this area, an important discovery. A study on the records of intoxication by pesticide revealed the highest average incidence of this condition in the Brazilian South region (Santa Catarina and Paraná states) and in the North region (Rondonia state), even though those records were regarded as insufficient to *Sinan* for the country as a whole.²³

Finally, the urethral discharge was ranked among the top ten diseases with the highest incidences, even though it presented a low average incidence in the cities of the North zone. The population mobility in the border area regions of Amazon is a permanent and seasonal phenomenon, directly linked with agricultural activities, mining and extraction.^{24,25} This mobility of people also allows the exchange and widespread of pathogenic agents. Mainly in the border area regions, inhabitants of the neighboring countries have to live with the effects of this proximity, originating vulnerable behaviors, such as the possibility of having multiple sexual partners. In those areas, drug trafficking, black market and prostitution are quite intense activities, affecting some specific population groups residents of border area cities.^{24,25}

With regard to the attribute “timeliness of ND reporting”, a low performance of the enforcement of national goals in the three zones of the border area and the other Brazilian cities was noticed. Such attribute allows assessing the ability of the epidemiological surveillance service of timely detecting the disease, enabling the implement of control measures beforehand. In this sense, the results presented shed a light upon the weaknesses of the epidemiological surveillance services, which may imply in the occurrence of epidemics or other emergencies of Public Health.

In a study that aimed to analyze the basic national capacities established by the International Sanitary Regulations (2005) to detect and attend the emergency of Public Health in the 27 states of Brazil and more than 76 cities, focused in the period of 2008-2009, light was also shed upon the capacity of border area cities to attend such emergency when compared to other strategic cities.²⁶

However, in the present study some similar weaknesses were also noticed in the other Brazilian cities. It is highlighted that the development of those capacities in border area regions represents an element of utmost importance for implementing the International Sanitary Regulations in every signatory countries.¹⁰

With regard to the “timeliness of case outcome”, the national goal for tuberculosis in all border area regions was accomplished, but when it came to dengue such goal was not accomplished in any region, not even in the other Brazilian cities. This attribute evaluates the efficiency of the epidemiological surveillance service in closing notified cases and guiding the application and evaluation of opportune measures of control.

Both attributes of timeliness are regarded as reference for a basic epidemiological surveillance activity related to the proper use of processes and information system in Health, as well as for the other activities required to prevent and control diseases.

However, the following activities are not part of all services: (i) process and data analysis and (ii) sensitively and timely spreading information, jeopardizing the effectiveness in the use of *information for action*, one of the goals of epidemiological surveillance.²⁷ In general, such insufficiency is related to the lack of qualification, shortage and high staff turnover and due to the fact that some services lack adequate facilities in order to achieve the development of surveillance. The use of information is more effective when professionals are qualified and kept in services where the facilities fit their attributes.²⁸

The goal of vaccination coverage for the tetravalent vaccine was only achieved when evaluated by zone groups, observing lower performances when this analysis was stratified to the border cities of each zone. In the North zone, almost half of the cities did not reach the established vaccination coverage goal, with a high population group without the protection of this vaccine. Only the central region had a high percentage of cities that achieved – up to 100.0% – the immunization coverage goal for tetravalent, an action possibly related to the vaccination of non-resident population in the cities and/or living in neighboring countries, included in the index numerator.

As for the indicator proportion of cure for tuberculosis, none of border regions reached the national goal, recommended by the World Health Organization, although these regions showed cure rates similar to that one observed in the other Brazilian cities. In addition to the problems faced in achieving this goal by all cities in Brazil, tuberculosis control in these areas is particularly difficult because it depends not only on the efforts of one country, but of all those that share the border area.²⁹ Population mobility between Brazil and neighboring countries makes this region particularly vulnerable. Moreover, one of the difficulties for the recognition of the magnitude of tuberculosis in the border area cities is due to the precarious living conditions of their populations, hindering the diagnosis of sick people.^{29,30}

This study included 121 border area cities in Brazil, representing a part of the border area and regions, not all of them. Another limitation of this

study refers to the attributes used to evaluate the actions of epidemiological surveillance, often unable to reflect specific aspects of prevention and control programs of higher incidence of diseases in the areas and locations studied. We recommend carrying out further investigative work on the same geographical areas, addressing to the border area cities and – in addition – other attributes beyond the ones considered here, so as to allow assessment of different dimensions of epidemiological surveillance.

The magnitude of compulsory notifiable diseases and the quality of surveillance actions in these cities showed important differences between the regions, indicating that we should not consider the region uniformly, from the epidemiological point of view. The quality of the actions of epidemiological surveillance in the border area cities also revealed some differences, compared to the other cities in Brazil, possibly related to the epidemiological differences and the degree of development of health services by region.

Some indicators drew attention to the weaknesses of municipal epidemiological surveillance systems to timely detect and report diseases with great power of spreading in the cities, generating epidemics or other emergencies in Public Health. These weaknesses must be addressed by improving national capacity to respond to such emergencies, as established by the International Sanitary Regulation.¹¹ Despite the negative reviews on the border region in the literature, some satisfactory results of epidemiological surveillance indicators were also observed, some of them were even better than the corresponding ones to other Brazilian cities. The border geographical areas deserve a different look in the evaluation and development of health policies, especially for epidemiological surveillance activities, looking forward to a better comprehension, as the use of strategies closer to their reality, and improvement of the same actions on these regions.

Authors' Contributions

Cerroni MP and Carmo EH contributed in the conception and design of the study, analysis, data interpretation, writing and critical review on the intellectual content of the manuscript.

Both authors approved the final version of the manuscript and are responsible for every aspect of the paper, ensuring its accuracy and integrity.

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