THE EFFECT OF PRIMARY CARE POLICY CHANGES ON HOSPITALIZATION FOR AMBULATORY CARE SENSITIVE CONDITIONS: NOTES FROM BRAZIL

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THE EFFECT OF PRIMARY CARE POLICY CHANGES ON HOSPITALIZATION FOR AMBULATORY CARE SENSITIVE CONDITIONS: NOTES FROM BRAZIL

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ABSTRACT

Objective: to assess the effect of changes on Primary Care policies on the trend in hospitalization rates for Ambulatory Conditions Sensitive to Primary Care in the city of Rio de Janeiro, Brazil. **Study design:** It´s an ecological study with data from Brazilian National Health Information System. **Methods:** We performed interrupted time series analysis, comparing 3 different periods due to primary care policies in Brazil: 2008-2009; 2010-2017 and 2018-2019. Dataset included total ACSC and rates for 19 group of conditions. **Results:** There was a non-significant increasing trend in baseline admissions. The reform impacted (policy #1) the change in trend, causing it to reduce in the period significantly. However, the change in the PNAB (policy #2) did not change the trend but reduced the rate of decline. Trends and differences among periods vary due to ACSC group. **Conclusion:** Primary care is sensitive to changes in public health policies. The hospitalization rate for ambulatory care sensitive conditions is an indicator that reflects the changes and the adaptability of the organization of the health service network to guarantee universal coverage and to attend the population's demand.

Keywords: Primary Health Care; Time Series; Hospitalization; Public Health Policy, Epidemiological Methods, Health Services.

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INTRODUCTION

Primary Health Care (PHC) is the World Health Organization´ strategy to achieve increased access and quality of care for populations[1]. It has been used for strengthening health systems in many countries, as the most appropriate response to the epidemiological and demographic transition experienced in these places[2,3]. Brazil has published the first version of the National Primary Care Policy (PNAB) in 2006[4]. This historic milestone expands primary care, from the level of a health program to a strategy, named the Family Health Strategy (FHS)[5]. Its main features are team and territory-based continuous care, with strong family and community orientation and the formal engagement of community members in the teams (Health Community Agents)[6].

Despite the publication of the policy, Rio de Janeiro (second largest Brazilian city) did not adopt it globally at first, but in clusters of extreme poverty and assistance voids. By 2009, only 7% of the population had access to FHS services[7]. The Primary Health Care Reform (RCAPS) of Rio de Janeiro, initiated in 2009, was a response by the city government for this gap[8,9]. From late 2009 to 2016, robust investment in PHC led to expansion of services and increase in population coverage to 60% of the population[10]. However, in 2017, Brazilian Ministry of Health released a new version of the National PHC Policy, bringing a lot of conceptual and operational changes, most of them seen as detrimental for sustainability of the FHS[11,12].

Positive effects of PHC coverage have been documented in recent studies, using selected impact health indicators, such as mortality in special groups (children, chronic disease)[13,14]. Another indicator often used for monitoring PHC quality is rate of hospitalizations due to Ambulatory Care Sensitive Conditions (ACSC)[15]. It represents a set of health problems for which the significant action of PHC would decrease the risk of hospitalizations. According to Macinko et al[16], this indicator is seldom used to evaluate services in low- and middle-income countries. High rates of ACSC can be related to problems of access, coverage, or low efficiency in this level of care[17,18]. Data reliability and accessibility in public databases favors the use of ACSC hospitalization rate to assess PHC services, focusing on implementation and coverage effect, as shown in some author's recent work[19,20].

The effect of Rio de Janeiro's FHS expansion on ACSC hospitalization rate was reported by Santos et al[21] who compared the results before and after the RCAPS and showed a correlation between the expansion of FHS coverage and the decrease in this rate. On the

same way, a comparative study of hospitalization rates due to ACSC in national capitals points out that the municipality of Rio de Janeiro had a more significant reduction in the last ten years, around 13.4%[3].

The city of Rio de Janeiro is the best example in Latin America to demonstrate this rapid expansion. In this sense, this study aims to assess the effect of the Primary Health Care Reform and the effect of recent National Policy changes on the trend in hospitalization rates for Ambulatory Conditions Sensitive to Primary Care in the city of Rio de Janeiro.

METHODS

Study design

It is a time-series study conducted in the city of Rio de Janeiro, Brazil. The city of Rio de Janeiro has a history of expanding primary care coverage that has served as a successful case for the study of primary care in Brazil and the Americas[20]. We use data from the Department of Health, which contains monthly information on the number of hospitalizations in units of the public health system, which has universal coverage, for each disease code, between 2008 and 2019, to assess hospitalization trends in three periods of great importance for primary care in the municipality: the period between January 2008 and December 2009, which corresponds to the period before the reorganization of the municipality's primary care, called Primary Health Care Reform (RCAPS); the period between January 2010 and December 2017, which corresponds to the period of this reorganization; and the period between January 2018 and December 2019, which corresponds to the beginning of the changes brought about by the new National Primary Care Policy (PNAB).

We restricted the number of hospitalizations to 74 causes, according to the two-digit classification of the International Classification of Diseases. We focus on the causes established by National Ordinance No. 221 of 2008, which sets the list of admissions for conditions sensitive to primary care (Supplementary Material #1).

We calculated the hospitalization rate as follows:

$$\text{ACSC rate}_{\text{n}} = \frac{\text{\# hospitalizations due to ambulatory care sensitive conditions by group n}}{\text{\# population at risk for hospitalization by group n}} \text{x } 100{,}000$$

Usually, rates are presented for 10,000 inhabitants. However, as we carry out analyzes by groups of causes, and some are infrequent, we chose to increase the base to 100,000 inhabitants. Also, we highlight that groups 17 and 19 on the list correspond to exclusively female causes. Thus, the denominator of these rates was only the female population. Therefore, the total rate is the result of the sum of the rates of the groups, according to the formula:

$$\mathrm{ACSC}_{\mathrm{total}} = \sum \quad \mathrm{ACSC}_1 + \mathrm{ACSC}_2 + \ldots + \mathrm{ACSC}_{19}$$

We conducted an exploration of the data for the 19 groups of causes in the three periods. To do this, we calculate the means, standard deviations, and measures of variability (quartiles) for each pair at the three periods. In this way, we visually inspect these measurements, using box plots for each group in the three periods. We were able to compare the groups with the average and standard deviation measurements. So that we could assume that this comparison of means was valid, we analyzed the normality of the distribution data using the Shapiro-Wilk adherence test. We used an inferential statistic known as the Levene test to accept the homoscedasticity of data distribution. Finally, we were interested not only in whether there was a statistically significant difference between groups but also in understanding the difference between pairs of groups (period one vs. period 2; period one vs. period three and period two vs. period 3). Thus, we chose not only to use the ANOVA test but a Post-Hoc test. For that, we used the Tukey test.

Once we completed this first stage, we performed a visual inspection of the time series to recognize changes in the pattern of total hospitalizations and groups within the three periods, considering the sequential information from the three periods previously described. We used segmented linear regression models of interrupted time series (ITS) to determine the effect of changes in primary care policy across all ACSC groups. When estimating the effects, ITS models adjust to pre-existing trends before the policy change and can detect changes in the pattern and level of the trend. We built the segmented linear regression models using the Prais method. The models included three segments, referring to the periods previously described. We adjusted the baseline segment (January 2008 to December 2009) with an intercept and a trend estimate variable.

We assume that, due to the different nature of the causes included in the list, some could have an immediate impact due to changes in primary care policy, and others a gradual

change. In this way, we tested two effects between trends: we tested differences in the slope of hospitalizations from an interrupted time series analysis of two groups (ramp effect). We also evaluated the change in the level of trends between groups (step effect).

Since hospitalizations are the result of acute illness or worsening of chronic disease, and the effect can be rapid, we choose not to use time lag between policy change and observation of outcomes. We highlight the results with statistical significance at a level of 5%. Besides, we tested logarithmic trend terms to assess possible non-linear trends obtained by the Prais model. With the results, we used the BIC and AIC aptitude criteria for the choice. Finally, we test the suitability of each model for residual analysis. To detect the presence of autocorrelation in the residue lag (forecast errors), we used the Durbin-Watson statistic. We performed the analyzes in the R program, version 3.6.1.

RESULTS

Initially, we performed a visual inspection of the measures and dispersion measures (Figure 1). We were able to verify six different behaviors, considering the comparison between the baseline (Period # 1) and the RCAPS period (Period # 2), and between the RCAPS period (Period # 2) and the PNA period (Period # #) 3). First, with an initial drop in average rates and subsequent maintenance of the level, the pattern of total rates and groups of hypertension, angina, epilepsy, and female pelvic inflammatory diseases. The second pattern is of groups in which there is a decline in the two comparisons: vaccine-preventable diseases, infectious gastroenteritis, bacterial pneumonia, and diabetes. The third pattern is of groups in which there is an initial increase, followed by a reduction: nutritional deficiencies, gastrointestinal ulcers and diseases related to prenatal and puerperium. The fourth pattern is of groups with initial reduction and posterior increase: asthma and lung diseases. The fifth pattern is grouped with an increase in the two comparisons: cerebrovascular diseases, kidney infection and urinary tract and skin. Finally, the last pattern is that of groups in which there was no apparent change: anemia, ear, nose and throat infections and heart failure.

Visual inspection only suggests changes between periods, but it is not a determining factor in assessing consistency. Then, we checked if the differences in the means were significant (Table 1). The average rates of hospitalization for conditions sensitive to primary care decreased significantly between the previous period and during the reform of primary care in Rio de Janeiro (Post-Hoc p-value <0.001). The average continued to decline in the

period following the publication of the new national primary care policy. However, it was not a significant reduction compared to the reform stage. (Post-Hoc p-value = 0.504). We found that this pattern was similar for specific hospitalizations for bacterial pneumonia, hypertension, cerebrovascular diseases, diabetes mellitus and gastrointestinal ulcer.

The measures presented refer to point estimates. They give us initial suggestions for describing trends. We performed then a visual inspection of the temporal trends in the three periods of study (Figure 2). The illustration of time-series suggests a slight increase in the trend in the first period, with a tendency of reduction during the RCAPS, and maintenance of reduction with PNAB. However, it occurs with a change in the rate level. We point out that RCAPS reflected a reduction in rates for most groups. Regarding PNAB, there was a change in the previous trend. It suggests that, for some causes, the new PNAB changed the flow for detection and treatment.

We observed the magnitude of changes in the trend (Table 2). The most notable changes occurred during the RCAPS period. For the total rate, there was a non-significant increase in baseline admissions. The reform impacted the change in trend, causing it to reduce in the period significantly. The change in the PNAB did not change the trend but reduced the rate of decline. Also, the coefficient is no longer significant, suggesting that the monitoring of the historical series for a long time may show a reversal of the downward trend in some months. Some groups follow the same pattern as the total rate. We highlight vaccine-preventable diseases, nutritional deficiencies, diabetes, and gastrointestinal ulcers. We also highlight diseases with a consistent reduction in the three periods, with a more extended adaptation to changes. It is the case of hypertension, which initially reduced the speed of falls during RCAPS, but substantially increased the speed after implementing the new PNAB. Still, we highlight diseases related to childbirth and the puerperium, which initially tended to increase. The speed of increase decreased during the RCAPS, and the new PNAB changed the trend, becoming a trend reduction.

Finally, we checked if the observed changes were significant, considering the effects of step (change in the level of the result immediately after the policy) and ramp (change of trend in the post-political segment) (Table 3). The data confirm that the most consistent change in the trend occurred between the baseline and the RCAPS. We found that the total rate showed a change in the slope, followed by almost all groups, except the nose, ear and throat infection, lung diseases, epilepsy, kidney and urinary tract infection, skin infection and female pelvic

inflammatory disease. Also, it is essential to note that the change to diseases related to childbirth and the puerperium was an increase in the hospitalization rate, unlike the others, which was a reduction. For nutritional deficiencies, asthma, angina, urinary tract infection and gastrointestinal ulcers, the change was immediate, as seen in the step effect. The change between RCAPS and PNAB was less impactful, significant only for asthma, hypertension, epilepsy, and skin infections (level) and angina, epilepsies and diseases related to childbirth and the puerperium (slope). The verification of the residues shows that the models were well adjusted (goodness-of-fit and Durbin-Watson Statistics).

DISCUSSION

The definition of lists of ACSCs generally comprises systematic reviews of the literature and consensual expert opinions. The Brazilian ACSC list is one of the most complete globally. These causes are an important source of pressure for the health system[22]. The reduction in the overall rate of ACSC associated with RCAPS in the city corroborates findings already documented in studies carried out in Rio de Janeiro[21] and in other places in the country[3]. Some groups can respond more quickly to the implementation of PHC services. In the short term, the most significant access to health services contributes to avoiding hospitalizations in situations with strong social determination, such as nutritional deficiencies; and health problems with clinical management at the PHC itself, such as urinary tract infections; and stabilization of chronic diseases, such as asthma and hypertension[23,24].

The slighter decrease in certain groups suggests less immediate impact due to conditions that require specialized attention, such as epilepsy and lung diseases. The exception to this rule is the conditions already traditionally discussed at this level of care, which has a referenced network, such as asthma[25,26]. On the other hand, the behavior of chronic hospitalizations such as diabetes reinforces their condition as a sensitive cause to the provision of organized PHC services[27]. We believe that the effect on these chronic conditions tends to manifest itself over time[19].

The trend in hospitalizations for obstetric causes 2017 suggests that hospitalizations for such causes increase with the expansion of care coverage at this level of attention. This phenomenon is possibly related to the increase in access to health services, leading to more significant detection of problems that lead to hospitalization[28]. Non-significant changes for conditions such as anemia and infections of the nose, ear and throat reinforce evidence from

previous studies[17,20]. We believe that these causes may not be potentially sensitive to care at this level of care.

The decrease in the general rate of ICSAP showed a slight in its velocity, coinciding with the revision of PNAB in 2017. The trend remains, but with less significance. This evidence suggests that the stagnation or increase in hospitalizations for these conditions may affect the changes caused directly or indirectly by the expected changes in the PNAB, as described in other studies[29]. Since the beginning of the municipal government in force in Rio de Janeiro, the cost-benefit and real impact of PHC coverage implemented in the ten years before its assumption have been questioned by a little experienced technical team. The consequence of this context is the revision of management contracts, the evasion of professionals, difficulty maintaining assistance flows, and population coverage reduction. The impact of this financial and political crisis has been documented in the literature[30,31]. The PHC contributed to the improvement in the ACSC indicator, with effects on access and equity and results almost reaching the levels observed in the Organization for Economic Cooperation and Development countries[32]. Although there is still plenty of room for improvement, the evidence is clear that PHC is a powerful approach to health care organization in Brazil[33].

The study has limitations. There is some difficulty in conducting impact analysis on public policies, especially in low-and middle-income countries, due to two phenomena. First, although policies are designed to reduce inequities, they initially widen disparities between social classes. It is due to that newly introduced health interventions are initially adopted by the population's wealthiest segments, who are likely to need them less. Therefore, we observe that absolute inequalities in health increase in the short term and only decrease as the intervention gradually reaches the population's poorest sectors. This phenomenon is known as reverse equity[34]. However, the study by Guimarães[35] identified that this effect is not observed in primary care. Also, there is a gap in the generation of longitudinal data that allows comparison over time since the quality of the data is compromised with each change in health management systems.

Finally, it is essential to note that the latest change in the PNAB is recent. Therefore, findings without statistical significance for the period after the year 2017 should be viewed with caution. According to many authors, the new document jeopardized the country's model's consolidation, mainly through the flexibilization of the parameters regarding the

number of families covered by each team and its composition. It also left the city government to decide whether to comply with the FHS, allowing it to use other models of PHC[36-38].

The decrease of the ACSC rate in the city of Rio de Janeiro suggests a possible effect of the changes induced by the new PNAB. Federal flexibility of public policies possibly allows for misguided and little evidence-based decision-making for the management of local resources. It directly impacts the population's health and increases the risk of hospitalizations for manageable causes in PHC. We also believe that more studies related to this indicator should be carried out to assess PHC. It allows us to assess groups' suitability as sensitive to care at this level of care, such as anemias and nose, throat, and ear infections. In the end, the world can learn some lessons from the Brazilian experience. Community-based primary care can work if done correctly.

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Authors Contribution: all authors contributed to the design, data analysis, writing and final revision of the manuscript

Ethical approval: Not required (We conducted the study with public, unidentified secondary data, which does not compromise the confidentiality of the population)

REFERENCES

1. Nedel FB. csapAIH Package: The Brazilian List of Ambulatory Care Sensitive Conditions in R. *Epidemiol Serv Saude*. 2019; **28(2):** e2019084. doi: 10.5123/S1679-49742019000200021.
2. Kruk ME, Porignon D, Rockers PC, Van Lerberghe W. The contribution of primary care to health and health systems in low- and middle-income countries: a critical review of major primary care initiatives. *Soc Sci Med*. 2010; **70(6):** 904-11. doi: 10.1016/j.socscimed.2009.11.025.

3. Pinto LF, Mendonça CS, Rehem TCMSB, Stelet B. Hospitalisations due to ambulatory care sensitive conditions (ACSC) between 2009 and 2018 in Brazil's Federal District as compared with other state capitals. *Cien Saude Colet* 2019; **24(6):** 2105-2114. DOI: 10.1590/1413-81232018246.08582019.
4. Duarte E, Eble LJ, Garcia LP. 30 Years of the Brazil National Health System. *Epidemiol. Serv. Saude*. 2018; **27(1):** e00100018. https://doi.org/10.5123/s1679-49742018000100018.
5. Reis JG, Harzheim E, Nachif MCA, Freitas JC, D´Ávila O, Hauser L et al. Creation of the Primary Health Care Secretariat and its implications for SUS. *Cien Saude Colet*. 2019; **24(9):** 3457-3462. https://doi.org/10.1590/1413-81232018249.18612019.
6. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. *Política Nacional de Atenção Básica*. Brasília, 2012. 110 p.
7. Campos CE, Cohn A, Brandão AL. The historical trajectory of the city of Rio de Janeiro's health system: 1916-2015. One hundred years of innovations and achievements. *Cien Saude Colet*. 2016; **21(5):** 1351-64. doi: 10.1590/1413-81232015215.00242016.
8. Soranz D, Pinto LF, Penna GO. Themes and reform of primary health care (RCAPS) in the city of Rio de Janeiro, Brazil. *Cien Saude Colet* 2016; **21:** 1327e38. https://doi.org/10.1590/1413-81232015215.01022016
9. Howe A, Anderson MI, Ribeiro JM, Pinto LF. 450th anniversary of the city of Rio de Janeiro: Primary Health Care Reform. *Cien Saude Colet.* 2016; **21(5):** 1324-6. doi: 10.1590/1413-81232015215.06482016.
10. Ministério da Saúde. *e-Gestor Atenção Básica.* [https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relHistoricoCobertura.xhtml]. Brasília: Ministério da Saúde. Available from: https://egestorab.saude.gov.br/paginas/acessoPublico/relatorios/relHistoricoCobertura.xhtml.
11. Morosini MV, Fonseca AF. Reviewing the Brazilian National Primary Healthcare Policy at such a time? *Cad Saude Publica.* 2017; **33(1):** e00206316. https://doi.org/10.1590/0102-311x00206316
12. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. *Política Nacional de Atenção Básica*. Brasilia, 2017.

13. Basu S, Berkowitz SA, Phillips RL, Bitton A, Landon BE, Phillips RS. Association of primary care physician supply with population mortality in the United States, 2005-2015. *JAMA Intern Med*. 2019; **179(4):** 506–514. doi:10.1001/jamainternmed.2018.7624

14. Macinko J, Harris MJ. Brazil's family health strategy--delivering community-based primary care in a universal health system. *N Engl J Med.* 2015; **372(23):** 2177-81. DOI 10.1056/NEJMp1501140

15. Alfradique ME, Bonolo Pde F, Dourado I, Lima-Costa MF, Macinko J, Mendonça CS, Oliveira VB, Sampaio LF, Simoni CD, Turci MA. Ambulatory care sensitive hospitalizations: elaboration of Brazilian list as a tool for measuring health system performance (Project ICSAP--Brazil). *Cad Saude Publica*. 2009; **25(6):** 1337-49. doi: 10.1590/s0102-311x2009000600016.

16. Macinko J, Oliveira VB, Turci MA, Guanais FC, Bonolo PF, Lima-Costa MF. The Influence of Primary Care and Hospital Supply on Ambulatory Care–Sensitive Hospitalizations Among Adults in Brazil, 1999–2007. *Am. J. Public Health.* 2011; **101(10):** 1963–70. DOI: 10.2105/AJPH.2010.198887.

17. Mendonça SS, Albuquerque EC. Profile of hospital admissions for primary care sensitive conditions in Pernambuco State, Brazil, 2008-2012. *Epidemiol. Serv. Saude.* 2014; **23(3):** 463-474. http://dx.doi.org/10.5123/S1679-49742014000300009.

18. Brasil VP, Costa JSD. Hospitalizations owing to ambulatory care sensitive conditions in Florianopolis, Santa Catarina, Brazil - an ecological study, 2001-2011. *Epidemiol. Serv. Saude.* 2016; **25(1):** 75-84. http://dx.doi.org/10.5123/s1679-49742016000100008.

19. Bastos ML, Menzies D, Hone T, Dehghani K, Trajman A. The impact of the Brazilian family health strategy on selected primary care sensitive conditions: a systematic review. *PLoS One*. 2017; **12(8):** e0182336. DOI: 10.1371/journal.pone.0182336.

20. Pimenta L, Dutra VGP, de Castro ALB, Guimarães RM. Analysis of conditions sensitive to primary care in a successful experience of primary healthcare expansion in Brazil, 1998-2015. *Public Health.* 2018; **162:** 32-40. doi: 10.1016/j.puhe.2018.05.011.

21. Santos LPR, Castro ALB, Dutra VGP, Guimarães RM. Admissions for conditions sensitive to primary health care, 2008-2015: an analysis of the impact of the expansion of the Family Health Strategy in the city of Rio de Janeiro. *Cad Saude Colet*. 2018; **26(2):** 178-183. https://doi.org/10.1590/1414-462x201800020230.

22. Rocha JVM, Sarmento J, Moita B, Marques AP, Santana R. Comparative research aspects on hospitalizations for ambulatory care sensitive conditions: the case of Brazil and Portugal. *Cien Saude Colet.* 2020; **25(4):**1375-1388. doi: 10.1590/1413-81232020254.13502019.
23. Roriz-Filho JS, Vilar FC, Mota LM, Leal CL, Pisi PCB. Urinary tract infection. Medicina (Ribeirão Preto). 2010; **43(2):**118-25. DOI: https://doi.org/10.11606/issn.2176-7262.v43i2p118-125
24. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. *Doenças respiratórias crônicas*. Brasília, 2010. 160 p.
25. Singh G, Sharma S, Bansal RK, Setia RK, Sharma S, Bansal N et al. A home-based, primary-care model for epilepsy care in India: Basis and design. *Epilepsia Open*. 2019; **4:**264–274. https://doi.org/10.1002/epi4.12311
26. Amaral LM, Palma PV, Leite IC. Evolution of public policies and programs for asthma control in Brazil from the perspective of consensus guidelines. *J Bras Pneumol.* 2012; **38(4):**518-25. doi: 10.1590/s1806-37132012000400015.
27. Wolters RJ, Braspenning JCC, Wensing M. Impact of primary care on hospital admission rates for diabetes patients: A systematic review. *Diabetes Res Clin Pract*. 2017; **129:**182-196. doi: 10.1016/j.diabres.2017.05.001.
28. Pitilin EB, Pelloso SM. Internações sensíveis à atenção primária em gestantes: fatores associados a partir do processo da atenção pré-natal. *Texto contexto - enferm*. 2017; **26(2):** e06060015. https://doi.org/10.1590/0104-07072017006060015.
29. O'Dwyer G, Graever L, Britto FA, Menezes T, Konder MT. Financial crisis and healthcare: the case of the municipality of Rio de Janeiro, Brazil. *Cien Saude Colet*. 2019; **24(12):** 4555-4568. https://doi.org/10.1590/1413-812320182412.23212019.
30. Melo EA, Mendonça MHM, Teixeira M. The economic crisis and primary health care in the SUS of Rio de Janeiro, Brazil. *Cien Saude Colet*. 2019; **24(12):** 4593-4598. https://doi.org/10.1590/1413-812320182412.25432019.
31. Silva BZ. Pela DesCrivelização da saúde: reflexões sobre a crise da saúde no Rio de Janeiro-RJ e seu agravo na pandemia. Physis. 2020; **30(3):** e300308. https://doi.org/10.1590/S0103-73312020300308.

32. Macinko J, Mendonça CS. The Family Health Strategy, a strong model of Primary Health Care that delivers results. *Saude debate*. 2018; **42(spe1):** 18-37. http://dx.doi.org/10.1590/0103-11042018s102.
33. Lagarde M. How to do (or not to do)... Assessing the impact of a policy change with routine longitudinal data. *Health Policy Plan*. 2012; **27(1):**76-83. DOI: 10.1093/heapol/czr004
34. Victora CG, Joseph G, Silva ICM, Maia FS, Vaughan JP, Barros FC, Barros AJD. The Inverse Equity Hypothesis: Analyses of Institutional Deliveries in 286 National Surveys. *Am J Public Health*. 2018; **108(4):**464-471. DOI: 10.2105/AJPH.2017.304277
35. Guimarães RM. Does the inverse theory hypothesis apply to primary health care? Evidence from 5564 Brazilian municipalities. *Rev. Panam. Salud Pública* 2018; **42**: e128. doi: 10.26633/RPSP.2018.128
36. Rasella D, Hone T, de Souza LE et al. Mortality associated with alternative primary healthcare policies: a nationwide microsimulation modelling study in Brazil. *BMC Med.* 2019; **17:** 82. https://doi.org/10.1186/s12916-019-1316-7
37. Viacava F, Oliveira RAD, Carvalho CC, Laguardia J, Bellido JG. SUS: supply, access to and use of health services over the last 30 years. *Cien Saude Colet*. 2018; 23(6): 1751-1762. https://doi.org/10.1590/1413-81232018236.06022018.
38. Morosini MVGC, Fonseca AF, Baptista TWF. Previne Brasil, the Agency for the Development of Primary Healthcare, and the Services Portfolio: radicalization of privatization policy in basic healthcare? *Cad Saude Publica*. 2020; 36(9):e00040220. doi: 10.1590/0102-311X00040220.

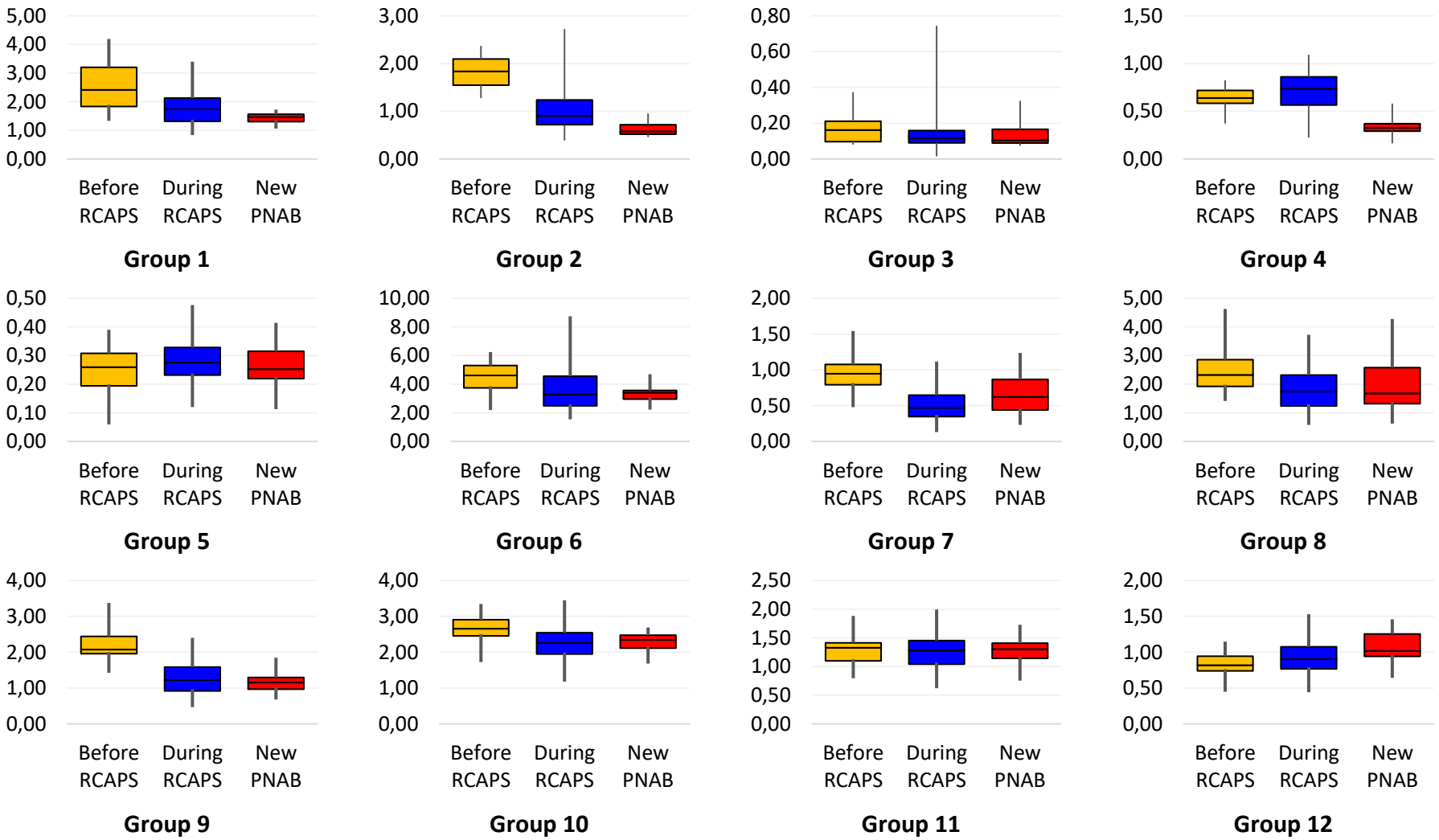

Figure 1: Boxplot of the distribution of hospitalizations by groups of ambulatory care sensitive conditions according to period of the effectiveness of the primary care policy in the Municipality of Rio de Janeiro, 2008-2019.
(cont)

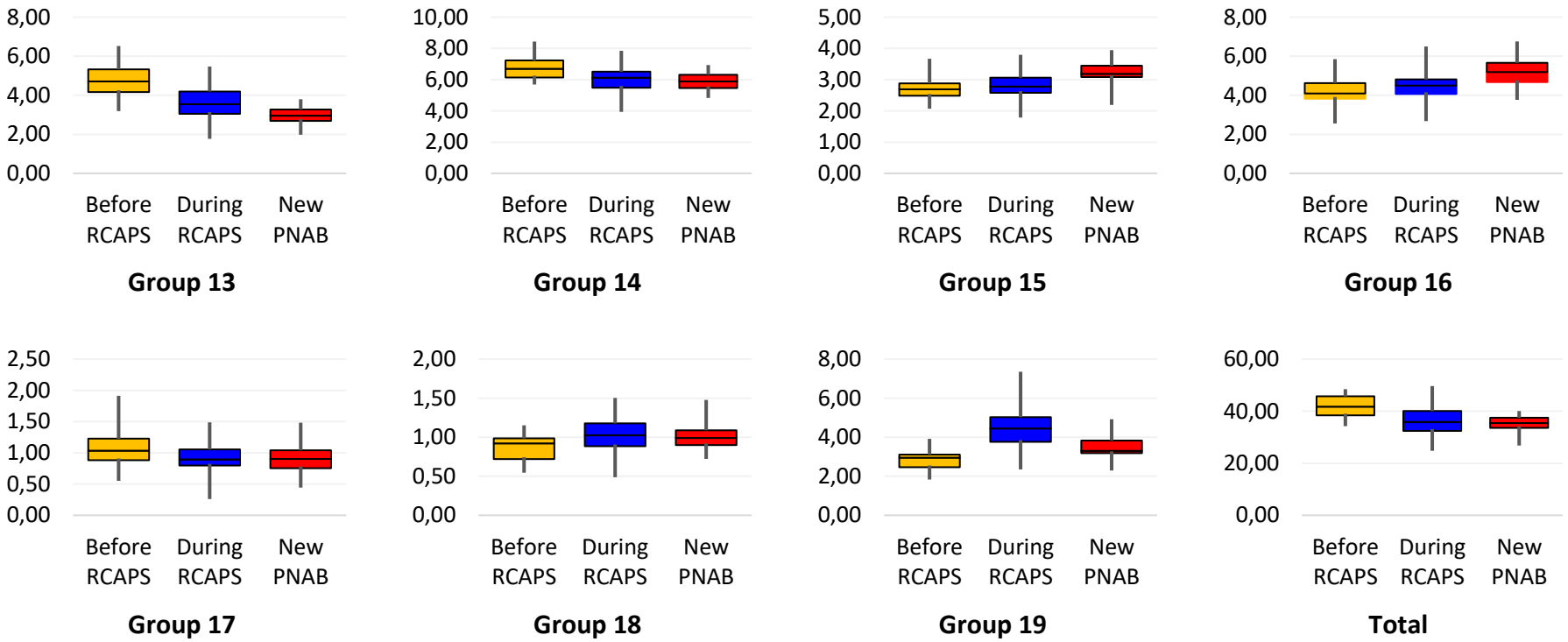

Figure 1: Boxplot of the distribution of hospitalizations by groups of ambulatory care sensitive conditions according to period of the effectiveness of the primary care policy in the Municipality of Rio de Janeiro, 2008-2019.

Legend: RCAPS – Primary Health Care Reform; PNAB – National Primary Care Policy; Group1 Vaccine-preventable diseases and other sensitive conditions; Group2. Infectious gastroenteritis and complications; Group3. Anemia; Group4. Nutritional deficiencies; Group5. Ear, nose, and throat infections; Group6. Bacterial pneumonia; Group7. Asthma; Group8. Pulmonary diseases; Group9. Hypertension; Group10. Angina; Group11. Heart failure; Group12. Cerebrovascular diseases; Group13. Diabetes mellitus; Group14. Epilepsy; Group15. Kidney and urinary tract infections; Group16. Skin and subcutaneous tissue infections; Group17. Female pelvic inflammatory diseases; Group18. Gastrointestinal ulcer; Group19. Obstetric conditions; ACSC – Ambulatory Conditions Sensitive to Primary Care.

Table 1: Description of hospitalization rates due to ACSC groups and period over time. Rio de Janeiro, Brazil, 2008-2019.

	Period #1 (baseline, Jan 2008 – Dec 2009) Mean (SD)	**Period #2 (RCAPS, Jan 2010 – Dec 2017)** Mean (SD)	**Period #3 (PNAB, Jan2018 – Dec 2019)** Mean (SD)	**Shapiro Test**	**Levene Test**	**Post-Hoc Test**			**p value**
						2-1	3-1	3-2	
Vaccine-preventable diseases and other sensitive conditions	0.252 (0.082)	0.176 (0.053)	0.143 (0.015)	0.012	<0.001	<0.001	<0.001	0.028	<0.001
Infectious gastroenteritis and complications	0.183 (0.032)	0.101 (0.041)	0.063 (0.014)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Anemia	0.017 (0.007)	0.014 (0.010)	0.013 (0.006)	<0.001	0.618	0.445	0.446	0.945	0.407
Nutritional deficiencies	0.064 (0.011)	0.068 (0.023)	0.033 (0.009)	<0.001	<0.001	0.555	<0.001	<0.001	<0.001
Ear, nose, and throat infections	0.024 (0.007)	0.027 (0.007)	0.026 (0.007)	0.755	0.813	0.155	0.595	0.805	0.176
Bacterial pneumonia	0.449 (0.103)	0.369 (0.154)	0.330 (0.057)	<0.001	<0.001	0.029	0.007	0.418	0.008
Asthma	0.095 (0.027)	0.050 (0.019)	0.065 (0.026)	0.005	0.025	<0.001	<0.001	0.007	<0.001
Pulmonary diseases	0.242 (0.073)	0.187 (0.075)	0.197 (0.095)	<0.001	0.152	0.006	0.118	0.835	0.009
Hypertension	0.223 (0.047)	0.129 (0.047)	0.118 (0.030)	<0.001	0.033	<0.001	<0.001	0.581	<0.001
Angina	0.131 (0.030)	0.128 (0.031)	0.129 (0.023)	0.036	0.244	0.581	0.968	0.990	0.908
Heart failure	0.474 (0.07)	0.359 (0.076)	0.297 (0.043)	0.797	0.015	<0.001	<0.001	<0.001	<0.001
Cerebrovascular diseases	0.673 (0.071)	0.600 (0.081)	0.589 (0.053)	0.222	0.1411	<0.001	<0.001	0.799	<0.001

(cont)

Diabetes mellitus	0.267 (0.038)	0.227 (0.043)	0.228 (0.027)	0.867	0.072	<0.001	0.003	0.990	<0.001
Epilepsy	0.083 (0.017)	0.092 (0.021)	0.107 (0.020)	0.391	0.416	0.151	<0.001	0.005	<0.001
Kidney and urinary tract infections	0.274 (0.036)	0.281 (0.037)	0.320 (0.036)	0.425	0.823	0.664	<0.001	<0.001	<0.001
Skin and subcutaneous tissue infections	0.418 (0.080)	0.447 (0.067)	0.518 (0.069)	0.189	0.602	0.163	<0.001	<0.001	<0.001
Female pelvic inflammatory diseases	0.107 (0.029)	0.092 (0.021)	0.092 (0.023)	0.011	0.176	0.017	0.063	0.993	0.019
Gastrointestinal ulcer	0.086 (0.016)	0.102 (0.021)	0.100 (0.015)	0.976	0.057	0.001	0.042	0.862	0.002
Obstetric conditions	0.286 (0.049)	0.444 (0.099)	0.348 (0.060)	0.013	0.002	<0.001	0.041	<0.001	<0.001
Total	4.172 (0.444)	3.651 (0.559)	3.521 (0.313)	0.183	0.001	<0.001	<0.001	0.504	<0.001

Legend: RCAPS – Primary Health Care Reform; PNAB – National Primary Care Policy; SD – Standard Deviation. Post-Hoc 2-1: comparison period #2 vs period #1; Post-Hoc 3-1: comparison period #3 vs period #1; Post-Hoc 3-2: comparison period #3 vs period #2.

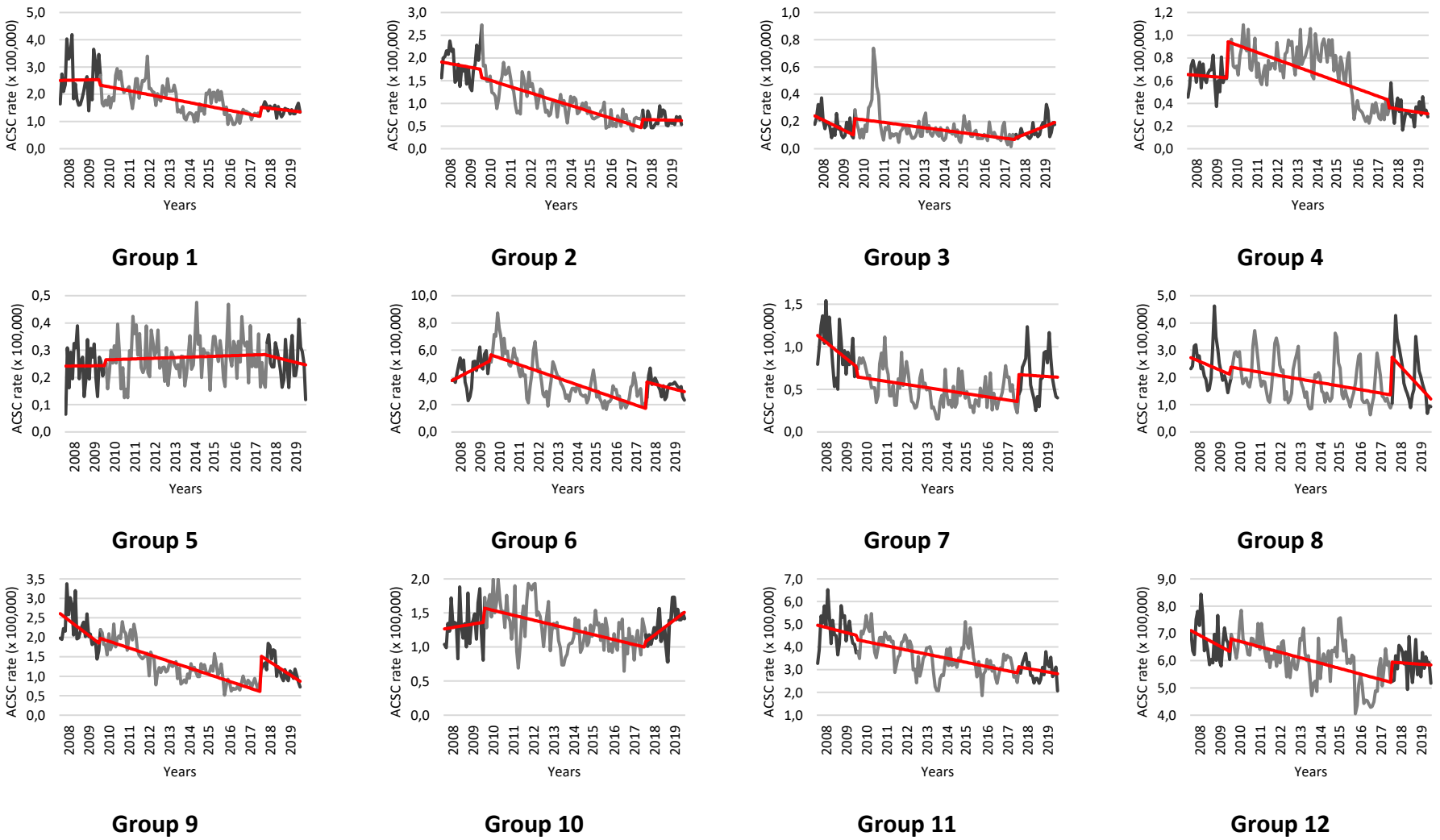

Figure 2: Hospitalization Rates by ACSC groups. Municipality of Rio de Janeiro, 2008-2020.

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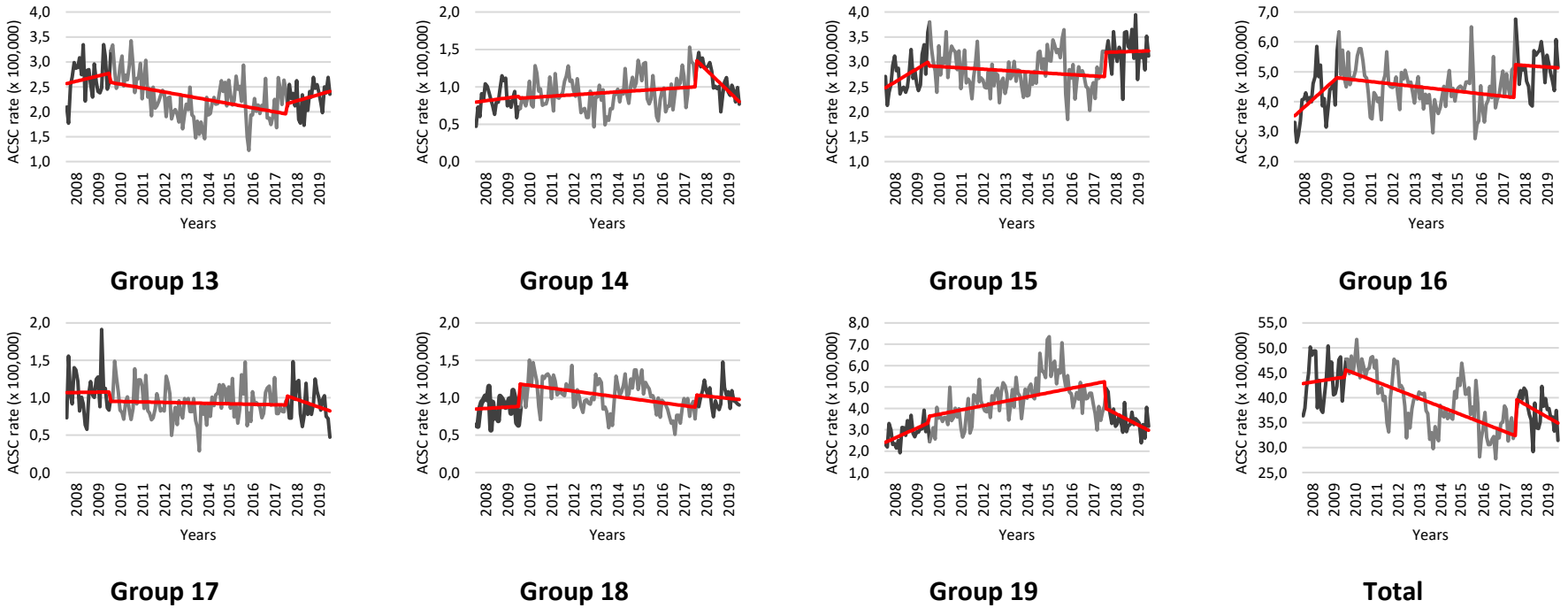

Figure 2: Hospitalization Rates by ACSC groups. Municipality of Rio de Janeiro, 2008-2020.

Legend: Group1 Vaccine-preventable diseases and other sensitive conditions; Group2. Infectious gastroenteritis and complications; Group3. Anemia; Group4. Nutritional deficiencies; Group5. Ear, nose, and throat infections; Group6. Bacterial pneumonia; Group7. Asthma; Group8. Pulmonary diseases; Group9. Hypertension; Group10. Angina; Group11. Heart failure; Group12. Cerebrovascular diseases; Group13. Diabetes mellitus; Group14. Epilepsy; Group15. Kidney and urinary tract infections; Group16. Skin and subcutaneous tissue infections; Group17. Female pelvic inflammatory diseases; Group18. Gastrointestinal ulcer; Group19. Obstetric conditions; ACSC – Ambulatory Conditions Sensitive to Primary Care.

Table 2: Trends in hospitalization for ACSC groups before and after public policy interventions according to Groups of conditions. Municipality of Rio de Janeiro, Brazil, 2008-2019.

	Period #1 (baseline, Jan 2008 – Dec 2009)		**Period #2 (RCAPS, Jan 2010 – Dec 2017)**		**Period #3 (PNAB, Jan2018 – Dec 2019)**	
	Coefficient (CI 95%)	p value	Coefficient (CI 95%)	p value	Coefficient (CI 95%)	p value
Vaccine-preventable diseases and other sensitive conditions	0.197 (-2.779 to 3.172)	0.897	-0.713 (-0.910 to -0.516)	<0.001	-0.420 (-1.007 to 0.168)	0.168
Infectious gastroenteritis and complications	-0.336 (-1.522 to 0.85)	0.579	-0.709 (-0.828 to -0.591)	<0.001	-0.044 (-0.625 to 0.537)	0.882
Anemia	-0.369 (-0.599 to -0.138)	0.002	-0.098 (-0.144 to -0.052)	<0.001	0.331 (0.114 to 0.548)	0.003
Nutritional deficiencies	-0.052 (-0.461 to 0.357)	0.804	-0.325 (-0.409 to -0.240)	<0.001	-0.147 (-0.499 to 0.205)	0.413
Ear, nose, and throat infections	0.013 (-0.271 to 0.297)	0.928	0.024 (-0.011 to 0.059)	0.175	-0.095 (-0.376 to 0.185)	0.506
Bacterial pneumonia	3.999 (0.576 to 7.421)	0.022	-2.515 (-2.995 to -2.035)	<0.001	-1.933 (-4.083 0.218)	0.078
Asthma	-0.948 (-1.867 to -0.030)	0.043	-0.175 (-0.259 to -0.090)	<0.001	-0.067 (-1.135 to 1.000)	0.901
Pulmonary diseases	-1.550 (-4.151 to 1.051)	0.243	-0.616 (-0.943 to -0.289)	<0.001	-4.422 (-7.756 to -1.087)	0.009
Hypertension	-1.952 (-3.477 to -0.427)	0.012	-0.875 (-0.995 to -0.756)	<0.001	-1.837 (-2.742 to -0.932)	<0.001
Angina	0.301 (-0.789 to 1.392)	0.588	-0.333 (-0.460 to -0.207)	<0.001	1.296 (0.540 to 2.052)	0.001
Heart failure	-1.005 (-3.828 to 1.819)	0.485	-0.839 (-1.137 to -0.541)	<0.001	-0.794 (-2.495 to 0.906)	0.360
Cerebrovascular diseases	-1.784 (-4.273 to 0.704)	0.16	-0.839 (-1.160 to -0.519)	<0.001	-0.113 (-2.230 to 2.004)	0.917
Diabetes mellitus	0.658 (-0.707 to 2.022)	0.345	-0.330 (-0.514 to -0.147)	<0.001	0.784 (-0.261 to 1.829)	0.141

Epilepsy	0.231 (-0.394 to 0.856)	0.469	0.143 (0.042 to 0.244)	0.005	-1.565 (-2.052 to -1.078)	<0.001
Kidney and urinary tract infections	1.499 (0.314 to 2.684)	0.013	-0.029 (-0.202 to 0.145)	0.746	0.180 (-1.282 to 1.641)	0.810
Skin and subcutaneous tissue infections	3.609 (1.058 to 6.159)	0.006	-0.252 (-0.556 to 0.053)	0.105	-0.142 (-2.927 to 2.643)	0.920
Female pelvic inflammatory diseases	0.033 (-0.547 to 0.613)	0.91	0.003 (-0.049 to 0.056)	0.9	-0.293 (-0.774 to 0.187)	0.231
Gastrointestinal ulcer	0.123 (-0.473 to 0.720)	0.685	-0.170 (-0.261 to -0.079)	<0.001	-0.140 (-0.747 to 0.467)	0.651
Obstetric conditions	1.336 (0.537 to 2.135)	0.001	0.677 (0.455 to 0.898)	<0.001	-1.513 (-2.623 to -0.403)	0.008
Total	4.002 (-12.145 to 20.149)	0.627	-7.970 (-9.780 to -6.160)	<0.001	-1.935 (-2.461 to 0.591)	0.063

Legend: RCAPS – Primary Health Care Reform; PNAB – National Primary Care Policy; CI 95%: confidence interval 95%.

Table 3: Level (step) and trend (ramp) effects for political cycles in the historical series of hospitalization rates for ACSC groups. Municipality of Rio de Janeiro, Brazil, 2008-2019.

Group	Coefficient	β	SE	p value	R^2	Goodness-of-fit		DW
						F test	p value	
1	Step 1	- 0.229	0.213	0.284	0.238	10.91	<0.001	2.156
	Ramp 1	- 0.011	0.002	<0.001				
	Step 2	0.284	0.318	0.373				
	Ramp 2	0.284	0.020	0.784				
2	Step 1	-0.149	0.119	0.214	0.520	37.7	< 0.001	2.03
	Ramp 1	-0.012	0.001	<0.001				
	Step 2	0.214	0.174	0.221				
	Ramp 2	0.010	0.011	0.378				
3	Step 1	0.089	0.046	0.053	0.073	2.744	0.030	2.055
	Ramp 1	-0.001	<0.001	0.002				
	Step 2	0.016	0.063	0.799				
	Ramp 2	0.006	0.004	0.131				
4	Step 1	0.302	0.075	<0.001	0.281	13.56	<0.001	2.26
	Ramp 1	-0.005	0.001	<0.001				
	Step 2	-0.024	0.108	0.823				
	Ramp 2	<0.001	0.007	0.930				
5	Step 1	0.022	0.023	0.337	0.017	0.621	0.647	1.937
	Ramp 1	<0.001	<0.001	0.517				
	Step 2	0.003	0.037	0.924				
	Ramp 2	-0.002	0.002	0.396				
6	Step 1	0.637	0.528	0.230	0.163	7.084	<0.001	1.862
	Ramp 1	-0.034	0.007	<0.001				
	Step 2	1.180	0.669	0.079				
	Ramp 2	0.024	0.051	0.631				
7	Step 1	-0.265	0.098	0.008	0.210	9.275	<0.001	2.122
	Ramp 1	-0.003	0.001	0.015				
	Step 2	0.309	0.144	0.034				
	Ramp 2	0.001	0.009	0.886				
8	Step 1	0.026	0.394	0.947	0.061	2.276	0.064	1.397
	Ramp 1	-0.009	0.005	0.115				
	Step 2	0.672	0.501	0.115				
	Ramp 2	-0.023	0.038	0.543				
9	Step 1	-0.184	0.128	0.152	0.548	42.06	<0.001	2.209
	Ramp 1	-0.014	0.001	<0.001				
	Step 2	0.836	0.194	<0.001				
	Ramp 2	-0.008	0.012	0.483				
10	Step 1	0.281	0.096	0.003	0.162	6.758	<0.001	2.043
	Ramp 1	-0.006	0.001	<0.001				
	Step 2	0.051	0.151	0.733				
	Ramp 2	0.025	0.009	0.010				

11	Step 1	-0.272	0.307	0.376	0.242	11.15	<0.001	2.056
	Ramp 1	-0.016	0.004	<0.001				
	Step 2	0.464	0.436	0.289				
	Ramp 2	-0.010	0.029	0.721				
12	Step 1	0.129	0.289	0.654	0.263	12.38	<0.001	2.136
	Ramp 1	-0.016	0.003	<0.001				
	Step 2	0.623	0.434	0.153				
	Ramp 2	0.015	0.028	0.585				
13	Step 1	-0.012	0.158	0.937	0.126	5.028	<0.001	2.136
	Ramp 1	-0.006	0.002	0.001				
	Step 2	0.101	0.239	0.673				
	Ramp 2	0.022	0.015	0.159				
14	Step 1	0.013	0.084	0.869	0.079	3.016	0.020	1.96
	Ramp 1	0.001	0.001	0.116				
	Step 2	0.339	0.127	0.008				
	Ramp 2	-0.024	0.008	0.004				
15	Step 1	0.174	0.137	0.207	0.111	4.364	0.002	2.079
	Ramp 1	-0.002	0.001	0.247				
	Step 2	0.435	0.215	0.045				
	Ramp 2	0.005	0.013	0.701				
16	Step 1	0.646	0.308	0.037	0.094	3.617	0.007	2.019
	Ramp 1	-0.007	0.004	0.084				
	Step 2	1.234	0.456	0.007				
	Ramp 2	-0.004	0.030	0.872				
17	Step 1	-0.112	0.077	0.147	0.044	1.614	0.174	1.99
	Ramp 1	-<0.001	<0.001	0.586				
	Step 2	0.129	0.123	0.297				
	Ramp 2	-0.008	0.007	0.278				
18	Step 1	0.318	0.078	<0.001	0.092	3.532	0.008	2.082
	Ramp 1	-0.003	0.001	0.001				
	Step 2	0.194	0.118	0.102				
	Ramp 2	-0.001	0.007	0.875				
19	Step 1	0.572	0.369	0.123	0.193	8.334	<0.001	2.274
	Ramp 1	0.017	0.004	<0.001				
	Step 2	-0.644	0.536	0.232				
	Ramp 2	-0.089	0.035	0.013				
Total	Step 1	2.318	1.855	0.213	0.301	14.97	<0.001	2.089
	Ramp 1	-0.143	0.024	<0.001				
	Step 2	7.00	2.628	0.008				
	Ramp 2	-0.016	0.179	0.924				

Legend: Group1 Vaccine-preventable diseases and other sensitive conditions; Group2. Infectious gastroenteritis and complications; Group3. Anemia; Group4. Nutritional deficiencies; Group5. Ear, nose, and throat infections; Group6. Bacterial pneumonia; Group7. Asthma; Group8. Pulmonary diseases; Group9. Hypertension; Group10. Angina; Group11. Heart failure; Group12. Cerebrovascular diseases; Group13. Diabetes mellitus; Group14. Epilepsy; Group15. Kidney and urinary tract infections; Group16. Skin and subcutaneous tissue infections; Group17. Female pelvic inflammatory diseases; Group18. Gastrointestinal ulcer; Group19. Obstetric conditions; Step 1: changing of level between 2009 and 2010; Step2: changing of

level between 2017 and 2018; Ramp 1: changing of trends between 2008-2009 and 2010-2017; Ramp 2: changing of trends between 2010-2017 and 2018-2019.β – Prais regression coefficient; SE – standard error; R^2: determination coefficient; F Test – model fit test; DW –Durbin Watson Statistics.

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