Lies can backfire: How exposure of government dishonesty restores accountability despite misinformation *

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Abstract

Do voters punish rulers who spread misinformation when confronted with the truth? We address this question through the lens of the Covid-19 pandemic in Brazil. Despite a massive misinformation campaign in an already polarized society, Bolsonaro lost the elections in 2022. We argue that markers of the true state of the world, i.e. unambiguous evidence that contradicts governmental misinformation, expose the government as dishonest. Since citizens dislike dishonest politicians, misinformation can backfire electorally. We show that voters in polling stations closer to hospitals with more intensive care units (ICUs), which proxy for salient markers of the true state of the world, punished Bolsonaro more in the 2022 Presidential Election. The effect is sizeable, if information exposure had been 5 points lower (on a 10-point scale) the election result would be flipped.

Keywords: Retrospective voting, accountability, misinformation, Covid-19, Brazil

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Introduction

Misinformation as a political strategy is widely used, and often, associated with populist politics. Misinformation threatens the democratic principle of accountability. When collective preferences are based on wrong facts, voters may not recognize a politician's (objectively) poor performance. Consequently, the electorate may choose a leader they would not have chosen if they were correctly informed. Overcoming misinformation is difficult (Jerit and Zhao, 2020; Batista Pereira et al., 2022; Aruguete et al., 2024). Kuklinski et al. (2000) remark "Unless they [people] are "hit between the eyes" with the right facts, they continue to judge policy based on their mistaken beliefs. In fact, likely, even those "hit between the eyes" with facts will eventually return to their original beliefs and preferences" (p. 810). How does it stand about accountability, when elites deliberately spread misinformation to abscond from retrospective punishment at the ballot?

Is it even worthwhile trying to correct misinformation? In this paper, we study whether salient cues about the true state of the world "hit hard enough" to induce electoral accountability. If voters do not change their voting behavior when they face the truth that the government is dishonest correcting misinformation does not improve or restore accountability. If voters punish the government that is proven dishonest by their observation, correcting misinformation works to improve or restore accountability in principle. The question (beyond this paper) is then how to correct misinformation effectively. We provide evidence for the latter. Hence, our research provides a foundation to justify misinformation correction to benefit accountability.

Theories of retrospective voting suggest citizens hold leaders accountable for bad performance during a pandemic and select someone more competent in the future (e.g., Ferejohn, 1986; Fearon, 1999; Przeworski et al., 1999; Ferraz and Finan, 2011; Thomassen, 2014). In Britain, Boris Johnson and the Conservative Party lost major support due to voters' dissatisfaction with the pandemic management (Green et al., 2020). In the US, Republican voters were critical of Trump's Covid-politics. However, stark polarization seems to have inhibited a majority of Republican voters from voting against Trump in 2020, despite disagreement over Covid-19 policies (Mehlhaff et al., 2023). Moreover, selective information-seeking and directional motives obstruct the processing of political information (Healy and Malhotra, 2013; Alt et al., 2016; Weitz-Shapiro and Winters, 2017; Allcott et al., 2020; Graham and Singh, 2023) and jeopardize accountability. The results of Mehlhaff et al. (2023) call into question whether the Brazilian electorate, which is also highly polarized (Calvo and Ventura, 2021; Franco and Pound, 2022), would punish Bolsonaro even when confronted with the fact that Bolsonaro was lying about Covid-19. Jair Bolsonaro created a consequential misinformation narrative: the myth of "Gripezinha" (Engl.: small flu). When confronted by journalists in March 2020, Bolsonaro replied that "the destructive power of this virus is an exaggeration. A small flu (Gripezinha) cannot put young people down. Only old folks will likely die. Therefore, Brazilians should keep on doing things."[1] Following this public statement, he assumed an anti-scientific position, promoting ill-advised medical treatments and neglecting the severity of Covid-19 (Taylor et al., 2021; Fonseca et al., 2021; Batista Pereira and Nunes, 2022; de Oliveira and Veronese, 2023). This caused irresponsible behavior, especially among his supporters, and eventually many preventable deaths (Ajzenman et al., 2020; Mariani et al., 2020; Fonseca et al., 2021).

We argue that markers of the true state of the world, i.e., observable and unambiguous pieces of evidence contradicting the government's narrative expose the government as dishonest. Voters dislike dishonest politicians because dishonesty is a sign of incompetence. Even if dishonesty is deliberate most citizens prefer politicians who do not lie. Consequently, the government is punished at the ballot. Hence, if sufficient

[1] https://www.poder360.com.br/coronavirus/2-anos-de-covid-relembre-30-frases-de-bolsonaro-sobre-pandemia/

markers of the true state of the world exist, misinformation generates backlash. While we cannot observe a counterfactual world where Bolsonaro did not misinform, given the tight margin of victory, it seems plausible that being exposed as dishonest may have cost Bolsonar the 2022 Brazilian presidential election. In a world where truthful information can be strategically discredited (Schiff et al., 2023), markers of the true state of the world are important. If even unambiguous evidence that exposes the government as dishonest did not affect voting behavior, correcting misinformation would not be sufficient to restore accountability. However, our main finding that markers the true state of the world that expose the government as dishonest induce voters to punish the government at the ballot proves that information correction is in principle useful to restore accountability despite misinformation.

In our empirical setup, we use hospitals, especially those equipped with more intensive care units (ICUs) as proxies for makers of the true state of the world. Markers of the true state of the world during the pandemic were highly salient at hospitals. Hospital staff exposed to markers of the true state of the world are more likely to live close to hospitals than further away. Patients living closer to a hospital (with an ICU) are more likely to go there for treatment than patients further away (independent of whether they seek treatment for COvid-19 or anything else). Residents close to hospitals are more likely to observe people cueing in front of hospitals and increased traffic of ambulances. In short, exposure to markers of the true state of the world has a spatial component that we use to measure it.

Our empirical results show that voters in locations with more ICUs punished Jair Bolsonaro more. Misinformation backfired. We find that an inter-quartile range (5 points on a ten-point scale) increase in ICU presence (taking into account the number of beds and their proximity) decreases Bolsonaro's vote share at a polling station by 2 to 8 pp. To investigate how the Brazilian electorate reacted to local variation in ICU presence, we employ the universe of polling stations (seção, Engl. polling station) level results from Brazilian presidential elections 2002-2022, combined with comprehensive data on hospital locations and equipment. The election data accounts for more than 450,000 polling stations nested in over 80,000 geo-coded voting locations. ICUs play a crucial role in treating Covid-19 patients in need of respiratory support. Hence, through the outbreak of the Covid-19 pandemic ICUs gained unforeseen additional importance. We leverage this unforeseen importance to partial-out the effect of pre-Covid-19 ICU presence on voters' decisions in the 2022 Brazilian presidential election.

Using different two-way fixed effects (TWFE) specifications (polling station, voting location, and municipality-specific time trends) we can absorb much of the location-specific confounding variation between infection rates, mortality, and voting. Since parallel trends cannot be easily assumed in our setup, we resort to synthetic difference-in-difference (SDID) methods to obtain a more credible causal estimate (Arkhangelsky et al., 2021; Pailañir and Clarke, 2023). The results of conventional TWFE and SDID are similar, even stronger for SDID. We report both, as this leads us to believe that bias from non-parallel trends attenuates the results of TWFE if anything.

We complement the analysis of observational data with correlational evidence drawn from the Latin American Opinion Project (LAPOP Lab www.vanderbilt.edu/lapop, 2021). Respondents who have been treated for Covid-19 or live in the same household as someone who has received treatment are more concerned about Covid-19, which confirms the assumption that exposure to the true state of the world changed people's perception of Covid-19. Moreover, respondents who have been treated for Covid-19 or live in the same household as someone who has received treatment report less trust in the government to do the right thing, in line with the observational results.

Our research contributes to the larger literature that considers the role of citizens' information for retrospective voting and accountability, e.g., Gomez and Wilson (2001, 2006); Duch and Stevenson (2008); Healy and Malhotra (2009, 2013); Ashworth and De Mesquita (2014); Ansolabehere et al. (2014); Alt et al. (2016); Weitz-Shapiro and Winters (2017). In that literature, we specifically contribute to recent work that engages with procedural intricacies of retrospective voting vis-à-vis polarization (Mehlhaff et al., 2023; Graham and Singh, 2023; Singh and Thachil, 2023). Like our work, this literature is heavily influenced by literature studying biases in political information processing (Kuklinski et al., 2000; Kahan, 2015; Berinsky, 2018; Bisgaard, 2019; Peterson and Iyengar, 2021; Allcott et al., 2020; Jerit and Zhao, 2020).

Theoretical framework

Existing empirical research paints a grim picture of citizens' behavioral response to Bolsonaro's misinformation campaign about Covid-19. Bolsonaro's widely disseminated claim that Covid-19 is not dangerous and can be treated with generic malaria drugs (i.e., Ivermectin and Hydroxychloroquine), for example, caused a sharp decline in social distancing (Ajzenman et al., 2020; Mariani et al., 2020). Such behavior seems to be particularly prevalent among Bolsonaro's supporters. Leone (2021) find that social distancing was lower in municipalities with higher vote shares for Bolsonaro in 2018. This is also reflected in a steeper death rate acceleration during outbreaks in municipalities with higher vote shares for Bolsonaro in 2018 (Rache et al., 2021). While those results represent ad hoc reactions, they raise doubt about whether or not voters were willing and able to recognize Bolsonaro's failures in managing the pandemic and consequently punished him at the polls. This section spells out how contradicting real-world information reduced Bolsonaro's support in the 2022 election. In a nutshell, hospitals served as locations where information that contradicted Bolsonaro's Gripezinha-myth became salient. Exposure to this information, in turn, reduced Bolsonaro's perceived competence as a leader. This caused voters more likely exposed to the contradicting information to turn against Bolsonaro in the 2022 election.

ICUs and markers of the true state of the world

We conceptualize markers of the true state of the world as pieces of evidence that are directly observable and unambiguous. Markers of the true state of the world gain relevance when they carry information that may be surprising. In some cases, markers of the true state of the world contradict popular narratives (political or otherwise). When markers of the true state of the world contradict political narratives they gain political relevance. Participating in Donald Trump's inauguration would be a bad example for a marker of the true state of the world because it is nearly impossible for an individual in a crowd to estimate whether the crowd consists of 600.000 people or 1.5 million people (which the Trump administration claimed). Hence, the direct observability is curbed. However, for someone who would have watched Barack Obama's 2009 or 2013 inauguration and Trump's 2017 inauguration from the same elevated perspective (e.g., a journalistic photographer from a helicopter), those joint pieces of information would constitute a marker of the true state of the world vis-à-vis the Trump administration's claim that Donald Trump's inauguration drew a larger crowd than any other inauguration before. Photographies of the inaugurations, shown in the media, however, are not markers of the true state of the world, because there is no direct observation. There exists an intermediary, a photographer who took the picture (and observed the true state), and media that distributed the picture. Intermediaries can be biased, and therefore information may be ambiguous. It is, however, true that information that originates from a marker of the true state of the world is often channeled through communication.

During the Covid-19 pandemic, several markers of the true state of the world existed, contradicting the Bolsonaro administration's narrative about the "Gripezinha". The fatal consequences of the pandemic are directly visible to hospital both medical and ancillary staff in a hospital. The exhausted capacity of ICUs and other medical facilities was salient to people who sought treatment for themselves or relatives. Several news sources report that people died waiting for treatment in ICUs. In some instances, people were queuing in front of hospitals, observable not only to people working in the hospital but also to people in the neighborhood. The mere fact that hospitals were much more frequently visited than normally may have raised suspicion about the gripezinha-myth. Some people who had followed Bolsonaro administration's narrative and did not take Covid-19 very seriously were inevitably confronted with the harsh reality, which changed their minds. Interviews with several people who had lost relatives to Covid-19, conducted by journalists of G1, a popular Brazilian online newspaper, vividly document this process (Manzano and Rodrigues da Silva, 2021, see in the appendix Section B for a full list of excerpts from the video.). Juliana Sandrini, one of the women interviewed recounts: "Everything is collapsing. People are fighting for having a UTI. My dad passed while waiting for one. This is a nightmare. People need to acknowledge that this is real; Covid-19 is real. You can die if you get infected.". Similarly, Lincoln da Silva, who also had lost his father describes how this experience changed his perception of Covid-19: "Honestly, I was not taking it [COVID-19] seriously. I thought it was harmless. I mean, even if you caught it, you could take some medicine and get away with it. Unfortunately, this has proven not to be true.".

Hospitals, especially those with ICUs, where severe respiratory symptoms could be treated, are places where markers of the true state of the world became highly salient. The larger these hospitals are and the more ICU beds they provide, the more markers can be found. We therefore aim to measure exposure to markers of the true state of the world using both the proximity to and the size of hospitals. The practical implementation of our measure is detailed in the data section. The logic behind distance as a measure of exposure is intuitive. In our case, markers of the true state of the world are salient for people who either get or seek treatment, work in a hospital or live close enough to a hospital to observe what is going on. The last group is defined by proximity already. Even though people getting and seeking treatment often travel far, it seems plausible that people living closer to hospitals are more likely to go there for treatment, and hence are more likely to get exposed to markers of the true state of the world. Lastly, hospital staff is also more likely to reside closer to hospitals than further away.

Markers of the true state of the world and voting

We expect markers of the true state of the world that contradict a governmental narrative to decrease support for the government. Since the evidence is unambiguous, the observation or experience invalidates the government's narrative. This exposes the government as dishonest or incompetent. Following classic retrospective voting arguments, the government will be punished in the next election (e.g., Ferejohn, 1986; Fearon, 1999; Przeworski et al., 1999; Ferraz and Finan, 2011; Thomassen, 2014). In the case of Covid-19 in Brazil, this means that voters more exposed to the harsh truth of the pandemic reality should be more likely to punish Bolsonaro's mismanagement during the pandemic (Ferejohn, 1986) and select a more honest and competent candidate (Fearon, 1999).

Unlike news sources, markers of the true state of the world have a high credibility. Alt et al. (2016) and Weitz-Shapiro and Winters (2017) show, credible information is key to behavioral change. On the psychological level increased anxiety could boost the learning effect of the information disseminated from ICUs. The true state of the world is more terrifying than Bolsonaro's claims suggested, after all. Mehlhaff et al. (2023) show that in the U.S., for Republicans, co-partisan cues did not decrease the support of safety measures against Covid-19, when voters were anxious.

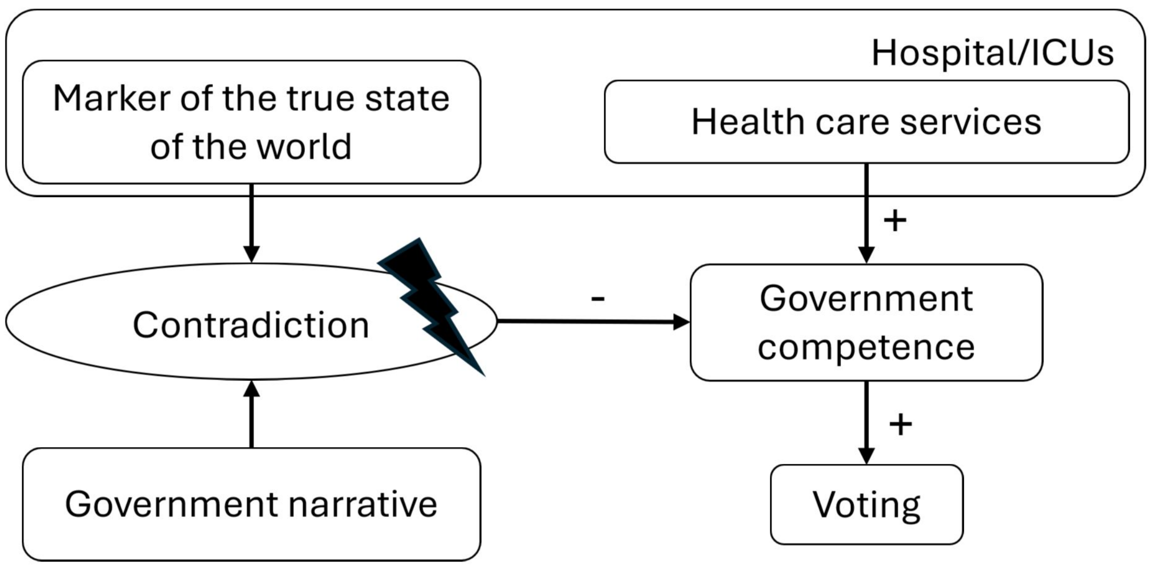
Additionally, the information disseminated from markers of the true state of the world can travel through normal communication channels, from news media to interpersonal social networks. Here it is obvious that sender-receiver dynamics play a role in the credibility of information. Nonetheless, the spread of information has a spatial dynamic, too. When people come in contact with markers of the true state of the world and then tell their experience to people close to them – family, friends, or neighbors – this information is perhaps more credible than something broadcasted on TV. Such a spatial dynamic of credibility could reinforce the spatial effect of salient markers of the true state of the world.

Analyzing the impact of markers of the true state of the world is important. Schiff et al. (2023) show that politicians misinform strategically to invalidate the truth as "fake news". This may be a feasible strategy to denounce and contain the spread of information that stems from a marker of the true state of the world. However, by definition, this strategy cannot invalidate a marker of the true state of the world. In turn, if exposure to a marker of the true state of the world that exposes the government as dishonest does not affect voting behavior, information correction cannot restore accountability. If exposure to markers of the true state of the world affects voting behavior, then correcting misinformation is useful for accountability in principle. The question that remains (and goes beyond this paper) is how to effectively correct misinformation.

ICUs and voting

Since hospitals, particularly those with ICUs, are locations where markers of the true state of the world are salient, we measure exposure to markers of the true state of the world through proximity and ICU capacity. However, hospitals are not only that. Hospitals and ICUs are part of a country's health infrastructure and basic public goods. In the case of the pandemic, those public goods provide potentially life-saving treatment. Therefore, hospitals (with ICUs) are not a pure measure of exposure to the true state of the world. They measure public service access at the same time. The theoretical expectation would be increased support for Bolsonaro due to better and faster treatment. Since both mechanisms have opposite effects on Bolsonaro's support in the 2022 election, we still observe a net effect of both mechanisms and it remains an empirical question, which effect dominates. Figure 1 summarizes how the presence of hospitals or ICUs respectively affects voting, highlighting how the countervailing effects located in hospitals/ICUs affect voting through their net effect on perceived competence.

Figure 1: ICUs and voting



Note: This figure summarizes how the presence of hospitals and ICU beds ultimately affects voting.

Data

Brazilian electoral data

The Superior Electoral Court (Brazilian Portuguese: Tribunal Superior Eleitoral, TSE) supplies publicly available data for turnout and election results for the universe of polling stations (seção, $n > 450,000$) in Brazil. Data is available for presidential and local elections. It contains candidates' total votes, turnout totals, and totals for blank and invalid votes. Polling station-level demographic averages of age, gender, marital status, and education are available in a separate file and can be linked. Since the polling stations are such fine-grained units, a typical voting location groups several seções (polling stations). Geo-coding of voting locations ($n > 80,000$) is provided by Hidalgo (2021).

Covid-19 data

We employ two sources for data on Covid-19. The first is from Cota (2020). This source supplies the officially registered number of cases and deaths on the municipal level. The second source is Oliveira (2023), which collects civil registry information about deaths in municipalities from a government website and publishes them as a unified data set. The latter data allows us to compute excess mortality compared to pre-Covid-19 mortality rates.

Hospital beds and ICUs

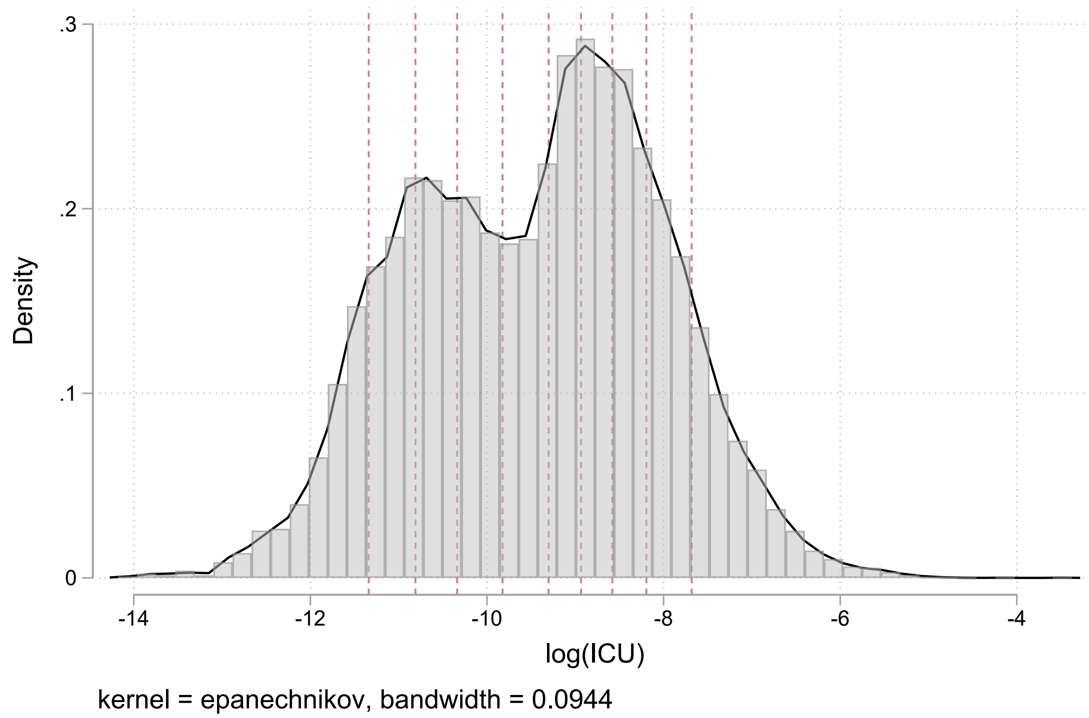
Data on hospital beds in general, and ICUs specifically, is openly provided by DATA-SUS (2018). The database is maintained by the Brazilian Ministry of Health and lists the universe of hospitals in Brazil. Among other things, the data contains the number and type of available care units. Hospital locations are geo-coded by Pereira and

Goncalves (2023). The latest available geo-coding is from 2015. Using official register identifier codes we can match the hospital locations in 2015 to the up-to-date information about care units from September 2018, the month before Jair Bolsonaro was elected president. We choose this point in time to ensure that our measures of ICU presence are not associated with subsequent changes in service provision that may be attributed to Bolsonaro's government. From over 7,000 hospitals registered in 2018, we can successfully match over 99% to the location from 2015, only 48 entities are not listed in geo-coded data from 2015.

The presence of hospital beds

We construct two indices. The first captures the presence of ICUs (which we simply denote ICU). The second captures all hospital beds ABA (all beds available). Both indices are computed in the same way, based on geo-coded hospitals. ICU uses the number of available ICU beds, while ABA uses the number of all available beds in a location. We first find the 10 nearest hospitals for every voting location. While 10 is arbitrary, this is a conservative choice, since the 10th hospital contributes only marginally when weighted by inverse distance. We then construct a measure summing the total number of available beds in those 10 locations weighted by inverse distance. This is our main variable of interest. Using both the distance and the number of beds best captures the information dissemination capacity of ICUs. We then group the raw measure into decile groups, as the raw data does not have a natural interpretation. In Figure 2 we show the distribution of the logarithmic raw values. We opt for a logarithmic display due to the skewness of the distribution.

Figure 2: Distribution of ICU presence



Note: The histogram shows the relative frequency of logarithm ICU presence. Red lines demarcate the deciles later used to group the index values. The solid black line shows a kernel density estimate. We opt to display logarithmic data due to the skewness of the distribution.

Public opinion data

In addition to observational data, we use opinion data from the 2021 wave of the Latin American Public Opinion Project (LAPOP) survey to augment our analysis (LAPOP Lab www.vanderbilt.edu/lapop, 2021). To assess the support for Bolsonaro in the public eye we use the survey question "How much do you trust the national government to do what is right?" from LAPOP. For a more natural interpretation, we reverse the original scale so that the lowest of 4 values corresponds to the lowest level of trust in the government doing what is right, while higher values indicate higher trust in doing what is right. To measure an individual's concern about Covid-19, we look at the question "How worried are you about the possibility that you or someone in your household will get sick from coronavirus in the next 3 months?". The question "Have you or anyone living in your household needed medical treatment for the coronavirus?" serves as an alternative proxy for exposure to a marker of the true state of the world. We also use control variables from LAPOP, i.e., age, education, gender, race, information consumption, urbanization, and state. Finally, we merge the infection and death rates at the municipality level with the LAPOP data.

Empirical strategy

First, we briefly turn to the relationship between voting for Bolsonaro in 2018 and death rates during the pandemic on the municipality level. This shows that Bolsonaro's supporters believed that Covid-19 was harmless, which manifested in higher death tolls. This is an important pre-condition for our analysis. If there is no misinformation in the first place, there will be no contradiction with the true state of the world.

We then turn to the polling station level. Here we examine the impact of a compound treatment, i.e., the presence of ICUs during the pandemic, on the change in vote shares for Jair Bolsonaro between the 2018 and 2022 Presidential Elections in Brazil. The treatment captures the presence of ICUs before the election in 2018 to be free of influences of later politically salient investments or pandemic-related policies. The treatment is compound in the sense that it can affect the population through multiple mechanisms as outlined in Section ICUs and voting. On the one hand, ICU presence reduces individual probability of dying from Covid-19, conditional on being infected. ICU presence also reduces mortality locally, conditional on infection rates, improving the local pandemic outcome. On the other hand, ICU presence affects the local supply of information about Covid-19.

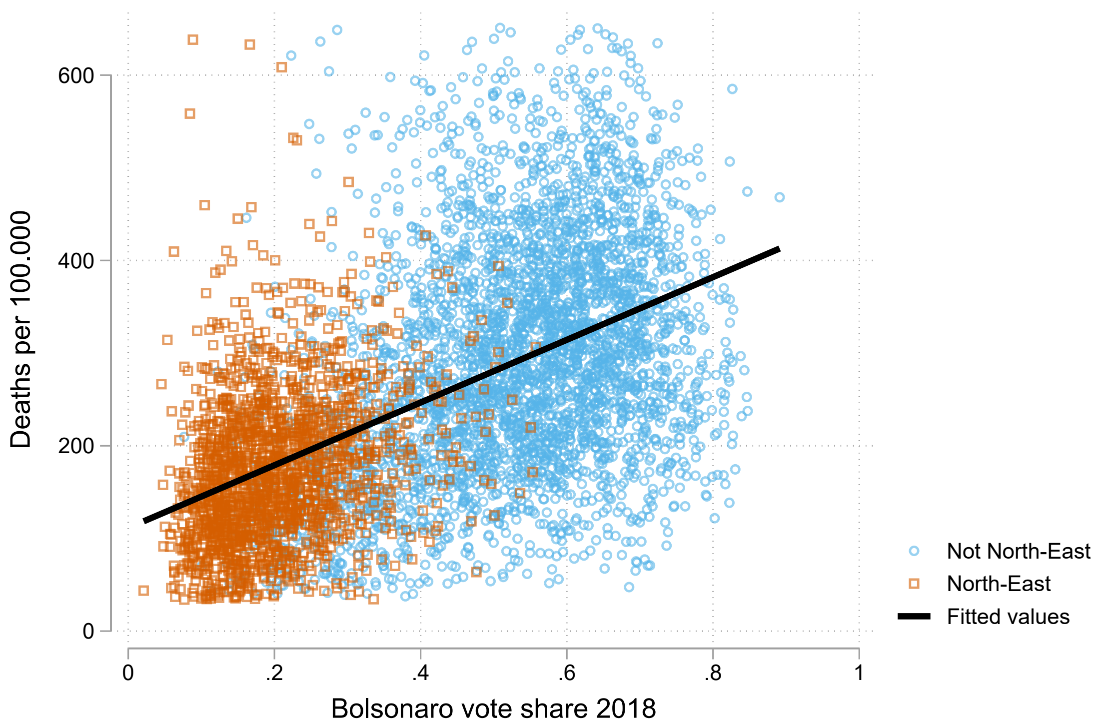
The key feature why pre-September 2018 ICUs as a treatment are attractive is that before the pandemic, ICUs were not an important topic in policy. Arguably, healthcare has always been an important issue in Brazilian politics at various levels. However, through their life-saving function, and consequently the extreme demand for ICUs during the pandemic peak times, ICUs experienced stark politicization and gained social relevance, and salience, unlike any other healthcare services. Hence, the treatment can be understood, not only as the spatial distribution of ICUs but their unexpected emergence as a pertinent issue between the 2018 and 2022 elections.

We complement the analysis using observational data, we use opinion data to substantiate the evidence for our main argument. Based on LAPOP data we find suggestive evidence that people who themselves have received treatment for Covid-19 or someone in their household has received treatment are more concerned about Covid-19. This substantiates our assumption that people who were exposed to markers of the true state of the world become more worried about Coivd-19. Moreover, having received treatment or having someone in the household who has received treatment correlates negatively with trusting that the government does what is right. This is in line with our main observational result.

Voting for Bolsonaro and Covid-19 deaths

We can graphically investigate the relationship between Bosonaro's vote shares and Covid-19 death rate on the municipal level in Figure 3. In Figure 3 we also highlight the geographic difference between the PT-dominated and poorer Northeast meso-region and the rest of the country. Results confirm what the prior research has shown (Ajzenman et al., 2020; Mariani et al., 2020; Fonseca et al., 2021). A simple OLS regression adding state fixed effects (a somewhat more nuanced approach but also picking up meso-region differences) confirms the picture (see Table 1). Depending on the specification we find that with a 10 pp increase in vote share for Bolsonaro in the first round the death rate per 100,000 increases by about 15.0 - 26.5. For the second round, a 10 pp increase is associated with an increase of 12.2 - 22.8 deaths per 100,000 inhabitants. Looking at excess mortality as the outcome confirms the result. All reported associations above are statistically significant at $p < 0.01$. Since our simple estimations here confirm what Ajzenman et al. (2020), Mariani et al. (2020), and Fonseca et al. (2021) have found using much more detailed analysis, we are confident that it is indeed true that misinformation about Covid-19 was indeed widespread, especially among Bolsonaro's supporters.

Figure 3: Bolsonaro vote shares 2018 and Covid-19 death rate



Note: The unit of observation in this figure is the municipality. The x-axis shows Bolsonaro's vote share in the first round in 2018. The y-axis shows death rates per 100,000 inhabitants. The top and bottom percentile of death rates have been removed, because some outliers were suspicious to be false entries, suggesting an absolute death rate larger than 1.

Table 1: Mortality and first round vote share for Bolsonaro 2018

	(1) Deaths	(2) Deaths	(3) Excess	(4) Excess
First round 2018				
Share Bolsonaro	264.8742	150.1019	0.0997	0.1725
	(14.1812)	(15.4116)	(0.0324)	(0.0370)
Second round 2018				
Share Bolsonaro	227.6816	122.3446	0.0829	0.1485
	(12.9799)	(14.0325)	(0.0299)	(0.0340)
Controls added		✓		✓
Mean outcome	255.0340	255.0340	0.3226	0.3226
N	5,418	5,418	4,846	4,846

Robust standard errors in parentheses

Note: This table shows results from an OLS regression, with deaths per 100,000 inhabitants and excess mortality as the outcomes and Jair Bolsonaro's vote share in the first and second round of the 2018 Brazilian presidential election as the regressor of interest. In columns (2) and (4) we control for municipal averages in gender composition, age, education, and marital status.

The myth of electoral Darwinism

A common argument discussed in the public debate states that due to higher death rates in municipalities with larger shares of Bolsonaro supporters, a Darwinistic selection takes place, as more Bolsonaro supporters are more likely to die from Covid-19. We test this argument in a simple back-of-the-envelope calculation. Assume a hypothetical scenario, where voters vote the same way as in 2018. However, the voting population is adjusted by the municipality-specific death rate. For now, also assume that the death rate within a municipality is the same for all voters, i.e., independent of political preferences. The aggregate comparison of the hypothetical to the real 2018 results reveals that the effect of such a selection is negligibly small. Bolsonaro would have lost 0.00012 pp in the first round and 0.00014 pp in the second round.[2] Those numbers are far from having electoral significance.

The positive association between death rates and voting for Bolsonaro on the mu-

[2] The formulas used for the calculations in this paragraph are detailed in the Appendix Section A.

nicipal level suggests that even within municipalities supporters of Bolsonaro may face a higher risk of death from Covid. Therefore, we now assume a scenario, where voters vote the same way as in 2018 (like before) but now we adjust the death rate for Bolsonaro voters upward. To test an extreme scenario, we take the highest estimate from the municipal level association between vote shares and death rate, and then add the death rate corresponding to a 100 pp increase in Bolsonaro vote share to the Bolsonaro voters' specific death rate. In this extreme scenario, Bolsonaro would have lost 0.00134 pp in the first round and 0.00161 pp in the second round. While larger by an order of magnitude, even under the extreme scenario Darwinistic selection would not significantly affect the electoral outcome. We conclude from this exercise that behavioral adjustments to the pandemic and its management by the Bolsonaro administration are much more likely to have explanatory power for the electoral impact of Covid-19 overall than Darwinistic arguments.

Markers of the true state of the world and Covid-19 concerns

Our main argument assumes that people exposed to markers of the true state of the world become more concerned about Covid-19. If they did not, it would mean that people would still believe Bolsonaro's gripezinha myth. From LAPOP survey data we know whether people have received treatment for Covid-19 or someone in their household has. This is valuable information because someone who has received treatment is more likely to be exposed to markers of the true state of the world. Someone who has someone in his or her household who was exposed to a marker of the true state of the world is at least indirectly exposed. We also know to what level respondents express concerns about Covid-19. In a simple linear regression, we can relate concerns to exposure.

In Table 2 we report the results of this regression. We find that in line with our assumption respondents who are more likely (directly or indirectly) exposed to markers of the true state of the world through having received treatment for Covid-19 or living in the same household as a person who has received treatment is more likely to report higher concerns about Covid-19. On average concerns are 0.10 to 0.12 pp higher on a 4-point scale for someone who received treatment or lives in the same household with someone who received treatment. Note that the average concern is already high at 2.4 points on a 0 to 3 scale, where 2 reflects "somewhat worried" and 3 reflects "very worried".

Table 2: Concerns about Covid-19 and exposure to markers of true state of the world

	(1)	(2)	(3)
Treatment	0.1175	0.1023	0.1146
	(0.0343)	(0.0342)	(0.0347)
Control variables	No	†	★
Mean outcome	2.4080	2.4063	2.4073
N	2,995	2,939	2,885

Standard errors in parentheses

† Age, sex, education, race, information consumption, urbanity

★ state, municipality level death and infection rates, and †

Note: This table shows results from a linear regression, estimated by OLS, with reported concerns about Covid-19 as the dependent variable and whether a respondent or someone in the respondent's household has received treatment for Covid-19 as the independent variable of interest. All coefficients of interest are significant at the 1% level.

ICU presence and voting

Moving to the polling station level, we investigate the effect of ICU presence on the change in vote shares for Bolsonaro. We estimate variations of the following regression equation:

$$v^r_{s,t} = \beta\,[ICU_{l,t}, ABA_{l,t}] \times d_{2022} + \gamma\,[ICU_{l,t}, ABA_{l,t}] + FE_{s,l,m,t} + \eta\,X_s + \varepsilon_{l,t} \tag{1}$$

The left-hand side $v_{s,t}^{c,r}$ denotes the vote share for candidate c (either Bolsonaro or any PT candidate, depending on the panel) in round r in polling station s and election year t. The coefficient vector β captures the impact of ICUs and all hospital beds (depending on which index is used) on the change in vote share. The coefficient γ captures the change in voting absent the treatment. Note that depending on the fixed effects specification gamma defaults to 0, as the time-invariant factors on the voting location level will be absorbed. Fixed effects are specified according to our strategy outlined above, including election year, municipality, voting location, polling station, and municipality-specific time trends.

Vote shares for Bolsonaro are available on the polling station level, while the treatment occurs at the voting location level, where multiple polling stations are pooled to cast their votes. Following Abadie et al. (2023), to account for the clustered nature of the data we use clustering robust standard errors in all our models unless otherwise specified.

The data structure lends itself to fixed effects models. We can use fixed effects to absorb time-invariant variation on the polling station level and variation over time that is constant between polling stations. This allows us to isolate the association between ICU presence and the change in voting behavior. The polling station-level fixed effects are especially appealing, since the pandemic environment, e.g., infection rates or mobility restrictions, which potentially inform individual decision-making, are held constant.

We further run models using polling station level and election year fixed effects. This fixed effects specification boils down to the canonical difference-in-difference specification with continuous treatment. Here we compare the change in vote shares within voting locations, while ICU presence varies across voting locations. Note that, since the treatment occurs at the cluster above the polling station, the estimation is equivalent to treatment-level fixed effects, unless polling station-specific controls are used. Additionally, we also include municipality times election year fixed effects to account for municipality-specific time trends in voting, eliminating potential confounding variables on the municipal level.

Hospital location is not random. Therefore selection bias is the main threat to identification. Urban clustering comes to mind as a potential mechanism for selection bias. The decision to reside close to an ICU is likely confounded with other spatial characteristics and individual preferences. Unit or treatment-level fixed effects absorb time-invariant sorting characteristics. Municipality-specific time trends allow us to capture sorting dynamics on the municipal level. Not being able to control for selection effects within municipalities is the main limitation of our identification strategy. However, we propose several sample splits in the robustness section to help ease this concern. If rural-urban sorting confounded the main analysis we would expect at least some visible heterogeneity along the polling stations' voter population. While the absence of such heterogeneities does not completely rule out selection, it corroborates the identifying assumption. If our results were driven by unobserved characteristics that correlate with health infrastructure, including ICUs, we should find no effect of ICUs on voting where non-ICU healthcare is well developed, which is not the case.

Another limitation is that we cannot directly test, whether absent the treatment, polling stations would have evolved along a parallel path. However, we can use a longer panel on PT vote shares as an auxiliary test. This approach is especially valid for runoff elections where voting against Bolsonaro meant voting for PT in 2018 and 2022. Since the PT has competed in all runoff elections in Brazil since the transition to democracy,[3] vote shares are accessible over longer periods (until 2002 without polling stations demographics, until 2010 including demographics), hence allowing checking for

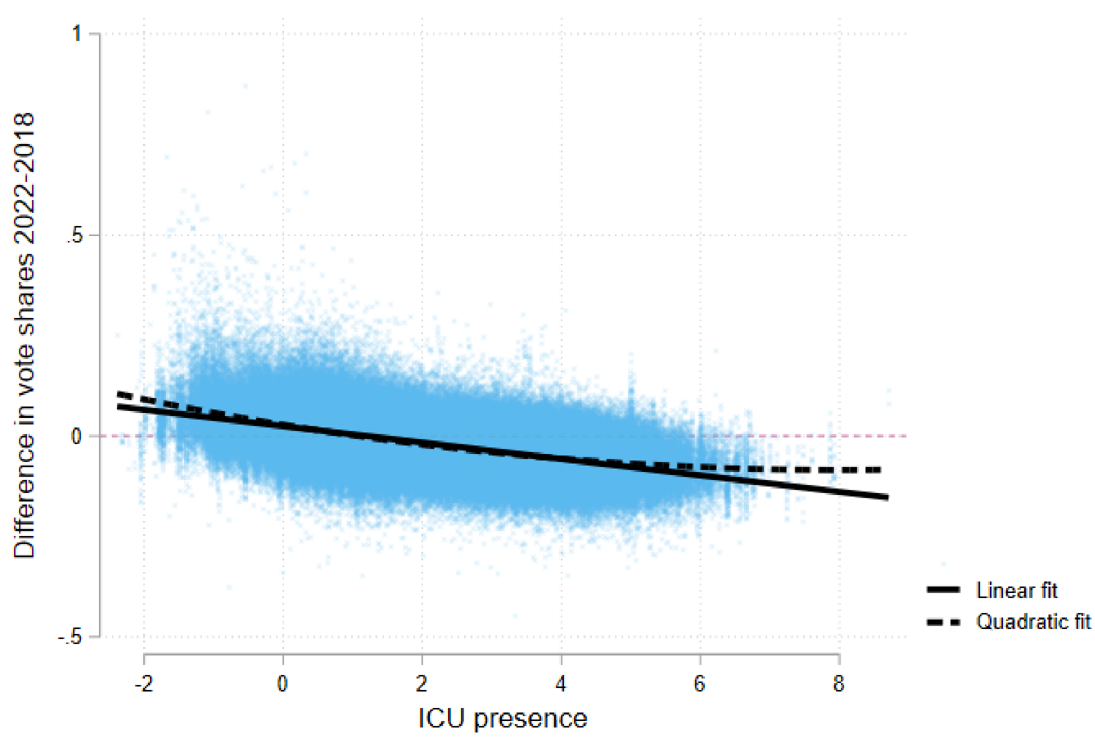
[3] The only remarkable exception is the presidential election held in 1998 when the candidate Fernando Henrique Cardoso (PSDB) secured more the 50% of the valid votes already in the first round.

common trends.

Descriptive statistics

In Table 4 we report the change in vote shares for Bolsonaro between the runoff elections 2018 and 2022 by ICU presence. Here we observe the general pattern that the higher the ICU presence, the more voters voted against Bolsonaro. The polling stations with the lowest ICU presence display increased voting for Bolsonaro. Overall, electoral support for Bolsonaro decreases as ICU presence increases. The correlation we observe here cannot be causally interpreted but serves as a descriptive indication of what we later confirm in the causal analysis.

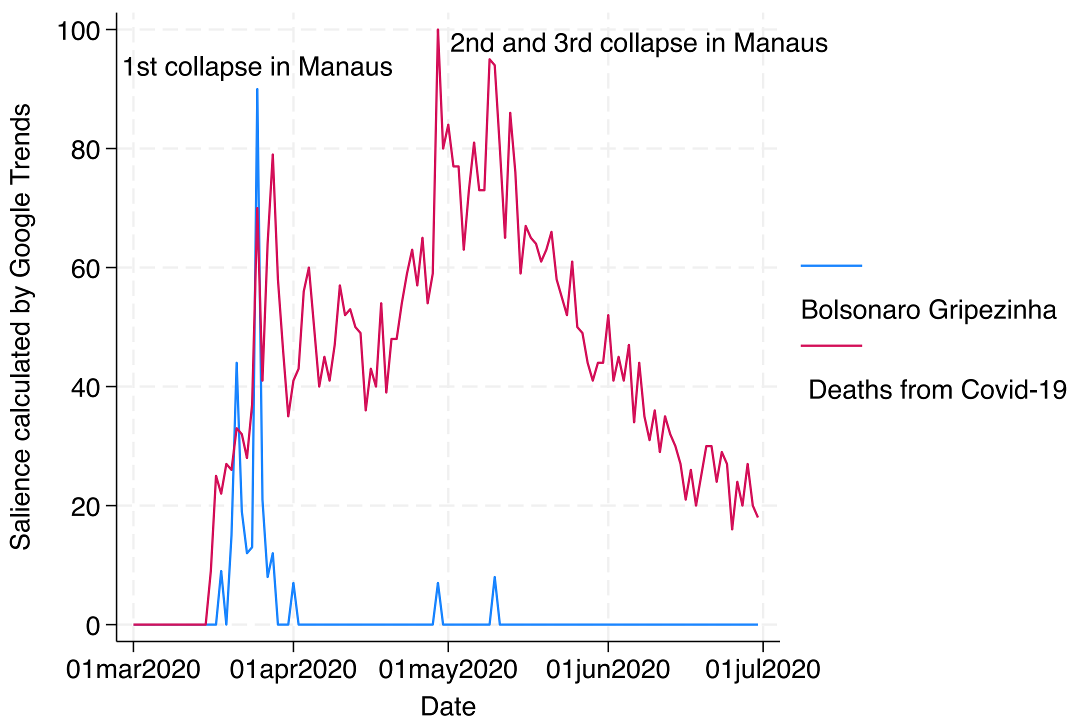
Figure 4: Change in vote share and ICU presence



Note: The y-axis depicts the average change in votes for Bolsonaro in the runoff elections from 2018 to 2022 at each voting location. The x-axis depicts the natural log of ICU presence.

Figure 5 illustrates our argument differently. The blue graph shows Google trends for the term “Gripezinha”, Bolsonaro’s infamous belittling term for Covid-19 that became synonymous with Bolsonaro’s denialism. Obviously, google searches represent both supporters and believers of the Gripezinha myth and the engagement of those fighting against this misleading narrative. What is interesting, however, is that after the first major collapse of the health system in Manaus, the capital city of the Amazon state of Brazil, the buzzword disappeared. A possible interpretation, also in the light of the other evidence we present, is that Brazilians have learned after this catastrophic event that Covid-19 is indeed no ”Gripezinha”, so the term needs no further discussion even when the Covid-19 topic was again rising during the 2nd and 3rd collapse of the health infrastructure in Manaus.

Figure 5: Google trends “Gripezinha” and “deaths from Covid-19”



Note: Data gathered by the authors from Google Trends. The terms of search were “Bolsonaro Gripezinha” and “Mortes por Covid-19”(Deaths from Covid-19). Y-axis proxies issue saliences from March to July of 2020. It is normalized to a 0-100 index, where 0 means no search or very few searches, while 100 is the peak of the searches

Moreover, Bolsonaro's perception in the eye of the public can be inferred from public opinion data. Looking at respondents' trust in the government to do the right thing in relation to a survey-based measure of exposure to markers of the true state of the world suggests that Bolsonaro's support suffered when people were exposed to the true state of the world. In Table 3 we report the results from a linear regression, estimated by OLS, with trust in the government to do the right thing as the dependent variable and exposure to markers of the true state of the world as the independent variable of interest. Recall that exposure to markers of the true state of the world is here measured by whether a respondent has received treatment for Covid-19 or someone in the same household as the respondent has received treatment for Covid-19. The regression reveals that exposure to the true state of the world is associated with lower trust in the government to do the right thing.

Table 3: Trust in government doing the right thing and exposure to markers of the true state of the world

	(1)	(2)	(3)
Treatment	-0.0877	-0.0728	-0.1041
	(0.0439)	(0.0436)	(0.0441)
Control variables	No	†	★
Mean outcome	1.3189	1.3182	1.3191
N	2,995	2,935	2,880

† Age, sex, education, race, information consumption, urbanity

★ state, municipality level death and infection rates, and †

Standard errors in parentheses

Note: This table shows results from a linear regression, estimated by OLS, with reported trust in the government doing the right thing as the dependent variable and whether a respondent or someone in the respondent's household has received treatment for Covid-19 as the independent variable of interest. The coefficients in columns (1) and (3) are significant at the 5% level. he coefficient in column (2) is significant at the 10% level.

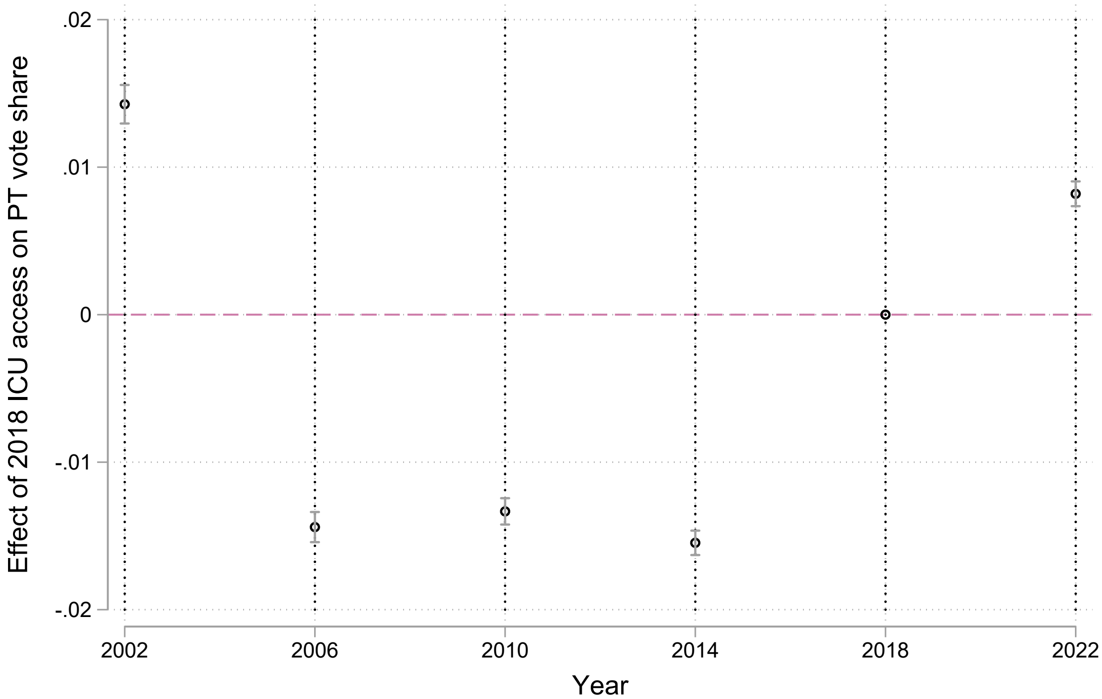
Parallel trends assumption

The two-way fixed effects model identifies an average treatment effect on the treated (ATT) only under the assumption of common pre-trends (Wooldridge, 2021). I.e., the treatment should not affect the outcome in pre-treatment periods. Since our outcome of interest exists only in two time periods we cannot directly test this assumption. However, in both elections, 2018 and 2022, the PT was the main competitor of Bolsonaro competing in the runoff elections. The PT has also competed in all other runoff elections since 1989 when Brazil transitioned to democracy. Therefore, we can indirectly test parallel trends focusing on the PT candidate's vote shares, which are for the runoff elections in 2018 and 2022 the complementary share of Bolsonaro's vote shares. Polling station-level data on vote shares is available from the TSE back until the presidential election of 2002. Before 2010, there are no demographic variables available.

We test parallel trends with the common event study approach since the continuous treatment does not allow us to visually inspect whether pre-treatment vote shares evolve in parallel in the treatment and control group. Figure 6 clearly shows a violation of parallel trends. In the event study framework, the pre-treatment period is fixed as the reference group. We first note that the increase in PT vote share in polling stations with high ICU presence in 2022 relative to 2018 compares well in magnitude to the estimated loss of Bolsonaro in those polling stations. Relative to 2018 all other coefficients on the interactions turn out sizable and significantly negative, except for 2002 which shows a positive coefficient.

Following the recommendation of Wooldridge (2021), we next include control variables (polling station averages of age, education, gender, and marital status), to test whether the data satisfies the conditional common trends assumption. Data for demographics on the polling station level are available from 2010 onward. Hence, we obtain a shorter panel for the event study in this case. The coefficients, reported in Appendix C,

Figure 6: Event study plot



Note: The event study plot shows the coefficients of election year dummies interacted with ICU presence. The specification absorbs polling station-level fixed effects and municipality-specific time trends. Confidence intervals are obtained for the 99% level from clustered standard errors at the voting location times year level to allow for time and location-specific heteroscedasticity. See Appendix C for conditional parallel trends and alternative measures of treatment.

are similar to the coefficients without control variables. Again we have to reject parallel trends. Moving forward we need to adjust for the problem of non-parallel trends using SDID.

Results

Two-way fixed effects

In this section, we report results from panel fixed effects regressions, which suggest that overall voters in polling stations with a higher presence of ICUs punished Bolsonaro more strongly. We first report results from a difference-in-difference (DiD) model with continuous treatment for the simple two-period case. Since treatment is defined by a combination of a pre-determined characteristic (ICU presence) on the voting location level and the unexpected rise to relevance of this characteristic due to Covid-19 between the observation periods, we are worried about confounding variation in ICU presence. We employ demographic control variables (education, age, gender, and marital status) on the polling station level (below the voting location level), corroborating identification by picking up some potentially confounding variation. Moreover, municipality-specific time trends allow us to control for municipality-specific heterogeneities.

In Table 4 we find a stable, negative, and statistically significant ($p < 0.01$) effect of hospital presence on voting for Bolsonaro. We interpret this as evidence that hospital presence during the Covid-19 pandemic led voters to decrease their support of Jair Bolsonaro. The estimates are quantitatively similar when using ICU presence or any care unit. Slightly larger coefficients for ICUs fit the notion that especially ICUs convey relevant information about the true state of the world. Estimates are not sensitive to the inclusion of control variables and are comparable across election rounds (see Appendix Table 5 for first-round vote shares). The effect appears to be somewhat stronger for the runoff election than the first round. This is unsurprising, as voters, who want to vote against Bolsonaro but are not necessarily supporters of PT or any other party, have the strongest incentives to turn out in the second round. One index unit (equivalent to a decile) more presence of ICUs decreases Bolsonaro's vote share by 0.7 to 1.27 pp. Consequently, an inter-quartile-range jump in ICU presence decreases Bolsonaro's vote share by 3.50 to 6.35 pp. One index unit higher presence of any hospital bed decreases Bolsonaro's vote share by 0.53 to 1.13 pp. And an inter-quartile-range jump would decrease Bolsonaro's vote share by 2.65 to 5.65 pp. Those values are substantial in the context of a highly contested election like in Brazil 2022, which was decided by less than 2 pp.

Table 4: DiD health care presence on 2nd round vote shares

	(1)	(2)	(3)	(4)	(5)	(6)
ICU x 2022	-0.0078	-0.0127	-0.0070			
	(0.0001)	(0.0001)	(0.0001)			
ABA x 2022				-0.0057	-0.0113	-0.0053
				(0.0001)	(0.0001)	(0.0001)
age		0.0025	0.0021		0.0026	0.0021
		(0.0000)	(0.0000)		(0.0000)	(0.0000)
education		0.1349	0.1219		0.1504	0.1204
		(0.0019)	(0.0019)		(0.0019)	(0.0019)
education^2		-0.0111	-0.0084		-0.0126	-0.0082
		(0.0002)	(0.0002)		(0.0002)	(0.0002)
sex		-0.0745	-0.0726		-0.0764	-0.0725
		(0.0012)	(0.0012)		(0.0012)	(0.0012)
married		-0.0608	0.0141		-0.0602	0.0139
		(0.0018)	(0.0018)		(0.0019)	(0.0018)
Mun.×year FE	✓		✓	✓		✓
N	872,604	872,617	872,599	872,604	872,617	872,599

Standard errors in parentheses

Note: The outcome is Bolsonaro's vote share in the runoff election. The treatment variable is health care access measured by ICU presence and any care unit respectively. All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).

Synthetic difference-in-difference

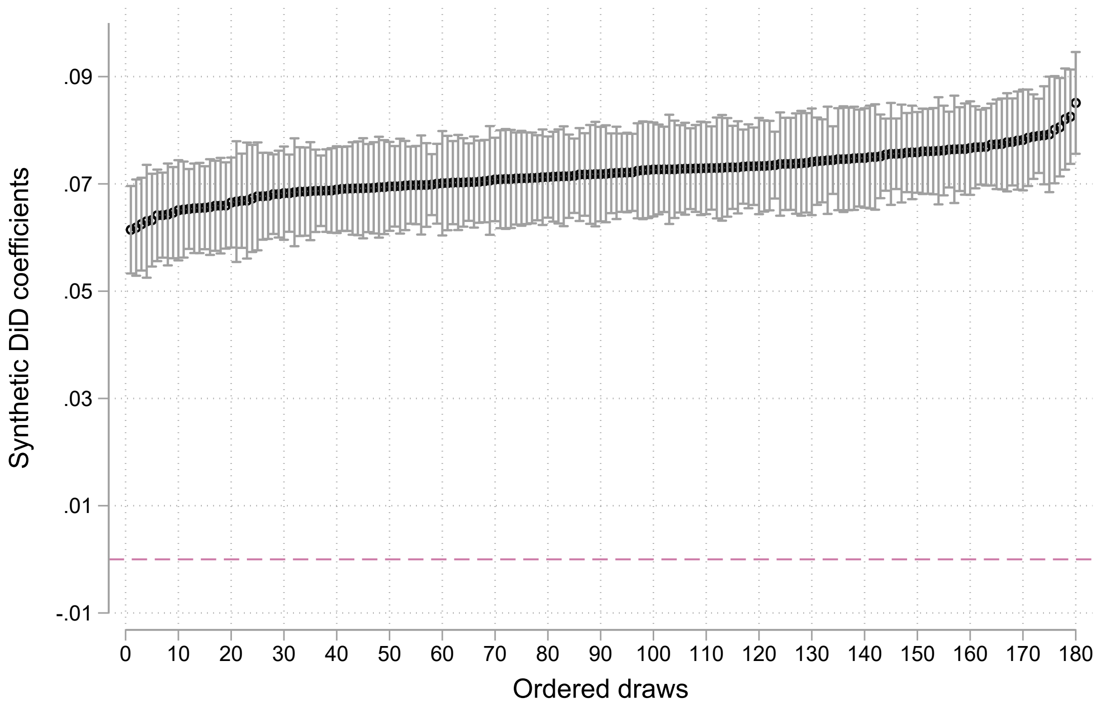
Extensive new literature suggests synthetic control approaches to deal with violated parallel trends (Lindner and McConnell, 2019; Ham and Miratrix, 2022; Wooldridge, 2021; Arkhangelsky et al., 2021; Pailañir and Clarke, 2023). We implement synthetic difference-in-difference (SDID, Arkhangelsky et al., 2021; Pailañir and Clarke, 2023). Intuitively, by weighting untreated units that are more similar to treated units before treatment more, the two-way fixed effects regression becomes more robust to non-common trends. To implement SDID, we have to make some concessions, though. SDID allows only for binary treatments. We therefore use different cut points to define binary indicators based on the original 10-point ICU index. Moreover, SDID does not allow higher-dimensional fixed effects. Thus, we cannot include municipality-specific time trends. Further, SDID is computationally demanding, which prohibits us from running SDID on the full sample. We circumvent the latter problem by using a Monte Carlo cross-validation technique. We draw random sub-samples from the full sample without replacement and estimate the SDID model on the sub-samples. This way we convert the problem of exponentially increasing computing time to linear additive computing time over sub-samples. We first generated a random number $rn \sim U(1, 10)$ for each panel unit. We then split the sample into equally sized intervals (180) along rn and perform estimation on each sub-sample. We plot the distribution of coefficients in Figure 7. The specification reported in Figure 7 is based on the panel of PT vote shares in the runoff elections from 2010 to 2022, to allow including electoral polling station-level controls. The cutoff index value for dichotomizing the treatment is set to ICU > 4.[4]

The results from the SDID are in line with the previous fixed effect models. The magnitudes of the estimates from the SDID are difficult to directly compare to fixed effects models due to the dichotomous treatment. The dichotomous treatment pools index values below the cutoff and index values above the cutoff. Unsurprisingly, the coefficients are somewhat larger in SDID, between 0.059 and 0.075 (or 5.9 to 7.5 pp) loss for Bolsonaro. Those values compare best to interquartile-range jumps in the original index as the average distance between treated and untreated after dichotomization corresponds to the interquartile range. Compared to the estimated effect of an interquartile-rage jump in ICU from the two-way fixed effects regression with unit fixed effects and municipality-specific time trends, which amounts to 1.10 and 3.55 pp, the SDID estimates are still larger but within a reasonable range. We view the larger

[4] See Appendix E for alternative specifications. In Figure 9a we report results for treatment defined as $\mathbf{1}(ICU > 2)$. In Figure 9b we report results for treatment defined as $\mathbf{1}(ICU > 6)$.

SDID coefficients as evidence that bias from non-parallel trends attenuates estimates in conventional DiD.

Figure 7: SDID coefficient distribution from Monte Carlo cross-validation



Note: The SDID model uses PT vote share as the outcome and $\mathbf{1}(ICU > 4)$ in 2022 as the treatment of interest. The model includes time-varying control variables on the polling station level, age, education, education^2, gender, and marital status. Standard errors are clustered on the polling station level. We show 95% confidence intervals.

Robustness

To assess the validity of our results and to probe for heterogeneities in effects we investigate an array of sample splits and alternative treatment definitions, see Appendix F.

The main concern for identification is that ICUs are not placed randomly. TWFE ensures that comparisons are within polling stations over time. Yet, people closer to larger ICUs may react differently to the pandemic because they are different (in unobserved characteristics), which made them settle somewhere with higher ICU presence in the first place. If rural-urban sorting confounded the main analysis we would expect at least some visible heterogeneity along the polling stations' voter population. While the absence of such heterogeneities does not completely rule out selection, it corroborates the identifying assumption. In Table 9 it becomes clear that there is little difference between less and more populated polling stations. If anything, the effect appears to be stronger in less populated polling stations.

We further test the implication of heterogeneity in general hospital access, which may also be indicative of sorting. In Tables 12 and 13 we focus on the impact of ICU presence only within polling stations that have any kind of hospital within 20km distance. We then further restrict the sample by increasing the number of available beds within that distance. If our results were driven by sorting, we would expect heterogeneous effects between polling stations with an abundance of hospital beds in their vicinity. In other words, if our effects were driven by unobserved characteristics that correlate with health infrastructure, including ICUs, we should find no effect of ICUs on voting where non-ICU healthcare is well developed. Again the evidence is reassuring of the main results. There are no substantial heterogeneities even when severely restricting the sample to polling stations with more than 200 hospital beds within 20km.

Other heterogeneities may still exist. Hence, we test the main specification across states independently. Reinforcing the main results, we find that all coefficients are negative and significant across all states, with few outliers in magnitude, see 10. Thus, the general results prove to be valid across states. Next, we look at the Northeast separately, a meso-region traditionally dominated by the PT, displaying the highest poverty rates in the country. Table 6 reveals that the Northeast is not particular when it comes to the effect of ICU presence on voting.

There might be a concern that the informative impact of ICU presence on voting behavior varies depending on how strongly an area was affected by the pandemic. In Table 7 we show that estimates do not vary substantially across the quartiles of municipality-level death rates. The absence of any directional trend along the quartiles further limits concerns about systematic heterogeneities.

Similarly, there may be a concern that strongholds of parties react heterogeneously to real-world information. Therefore, we split the sample along the quartiles of 2018 Bolsonaro vote shares and re-estimate the main model. The results reported in Table 8 suggest that there are no heterogeneous effects across polling stations that depend on the political leaning in the 2018 election.

If our argument holds, we would expect to find similar results when we slightly modify our treatment definitions. In Table 10, columns (1)-(3), we report coefficients from the main models on the raw distance to the closest ICU. The results suggest being 100km closer to the closest ICU decreases Bolsonaro's vote by 4-6 pp. Using a binary indicator for a hospital with an ICU in 20km, 30km, or 50km distance leads to similar conclusions. Having an ICU within 20km reduces Bolsonaro's vote share by 2.1-6.9 pp, within 20km it is 1.6-7.2 pp and within 50km it is 0.12-7.33 pp (see Table 10, columns (4)-(6), and Table 11).

Conclusion and discussion

We study how accountability operates in an environment of large-scale governmental misinformation. We find that misinformation can electorally backfire when it gets contradicted by markers of the true state of the world. This shows that misinformation can be a risky strategy even in polarized societies. This result also shows that there exists an informational stimulus that is indeed strong enough to sway voters in polarized societies, which may be surprising considering that Mehlhaff et al. (2023) found that supporters of Donald Trump in the US still voted for Donald Trump even if they were dissatisfied with his Covid-policies.

We analyze the case of voting in the 2022 Brazilian Presidential Election after Brazil was severely hit by the Covid-19 pandemic. We argue that hospitals especially those with ICUs provide exposure to salient markers of the true state of the world, i.e. unambiguous pieces of evidence. When the true state of the world contradicts the government's narrative, the government is exposed as dishonest. The electorate dislikes dishonest politicians and punishes the incumbent in line with classic retrospective voting theories (Ferejohn, 1986; Fearon, 1999).

Brazil is an exemplary case because the Bolsonaro administration assumed a course of action and rhetoric that rejected scientific consensus and the guidelines of the international medical community (Taylor et al., 2021; de Oliveira and Veronese, 2023; Béland et al., 2021). Bolsonaro popularized the myth of "gripezinha", i.e. Covid-19 being merely a mild flu. This included, for example, the promotion of ineffective Malaria generic as a treatment for Covid-19 (Nowak, 2023; Fonseca et al., 2021). The myth became very popular in Brazil and caused ill-advised behavior, especially among his supporters (Ajzenman et al., 2020; Fonseca et al., 2021). Eventually causing avoidable deaths (Rache et al., 2021).

Analyzing rich electoral data from several Brazilian Presidential elections, combined with geo-located data on hospital equipment, we find that an inter-quartile range increase in our measure for ICU presence (taking into account the size of the ICU and spatial distance), decreases the vote share for Bolsonaro by 2 to 8 pp. This suggests that information based on proximity to ICUs significantly contributed to Bolsonaro's downfall in the 2022 election. Bolsonaro lost the runoff election by 1.8 pp. Hence, an inter-quartile range lower exposure to ICUs would have sufficed to overturn the elections. Darwinistic explanations for Bolsonaro's defeat were discussed in the public debate. We show in a back-of-the-envelope calculation that selection based on higher death rates among Bolsonaro supporters is unlikely to have any substantial impact on the election. The death rate differential required to create any substantial effect is unrealistic. Our main results are corroborated by correlational evidence from public opinion surveys. Respondents who have been treated for Covid-19 or who have someone in their household who has received treatment are more concerned about Covid-19, showing that exposure to the true state of the world changed their perception of Covid-19. Moreover, the same respondents report less trust in the government (at the time the Bolsonaro administration) to do the right thing.

A large literature on political misinformation and biases in political information processing raises serious doubts about whether electoral accountability can be upheld in environments of stark misinformation (Kuklinski et al., 2000; Jerit and Zhao, 2020; Allcott et al., 2020; Bisgaard, 2019; Berinsky, 2018; Peterson and Iyengar, 2021; Mehlhaff et al., 2023). Our analysis contributes to the understanding of mechanisms that help to ensure electoral accountability through retrospective voting, despite misinformation.

It is beyond the scope of this paper to study information (or information correction) mechanisms comparatively. We want to note, however, that information observed in proximity to ICUs has the interesting property, that there is no political actor disseminating information. Typically politically relevant information stems from politically involved actors, including media outlets. Hence, there is always a reason to speculate about the credibility of signals. Real-world observations propagated through inter-personal social networks may be more effective in combating misinformation than traditional information dissemination, since credibility within networks may be high. Relative to (Mehlhaff et al., 2023) we show that there are circumstances in polarized societies, where we can expect that information sways voters. Defining those circumstances requires further investigation.

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A Back-of-the-envelope calculation for electoral Darwinism

The aggregate vote share of Bolsonaro in 2018 is defined as

$$S_{2018} := \frac{\sum_m q^m_{2018}}{\sum_m s^m_{2018}}. \tag{2}$$

The parameter q denotes the quantity of votes for Bolsonaro in municipality $m \in \{1, ..., M\}$ in 2018. The parameter s denotes the number of valid votes in a municipality m in 2018. So the aggregate vote share for Bolsonaro is simply calculated as the total votes for Bolsonaro over all municipalities, divided by the total number of valid votes over all municipalities.

For the first hypothetical scenario, the elements of the sums in the denominator and enumerator are weighted by the municipality-specific survival rate,

$$S^{hypothetical\ 1}_{2018} := \frac{r_m * \sum_m q^m_{2018}}{r_m * \sum_m s^m_{2018}}. \tag{3}$$

The survival rate is defined as $r_m = 1 - d_m$, where d_m is the municipality-specific death rate (in absolute terms, not per 100,000 inhabitants). The difference between the actual result and the hypothetical scenario tells us how much Bolsonaro would have lost in terms of aggregate vote share, due to municipalities with a larger share of Bolsonaro voters having a higher death rate. Compared to the true results, in the hypothetical, municipalities with higher mortality rates, contribute less to the aggregate as they lost more voters between 2018 and 2022. This assumes voters keep their choice constant and that within the municipality, the death rate is equal for Bolsonaro voters and others.

The second hypothetical scenario relaxes the latter assumption. The survival rate in the enumerator is replaced by a lower rate according to $r^b_m = 1 - d_m - d_b$, where d_b is the predicted change in death rate (not per 100,000) for a 100 pp change in municipal level vote share for Bolsonaro. According to our estimates (see Table 1) $d_b = \frac{264.8742}{100{,}000}$. The aggregate share is computed as

$$S_{2018}^{hypothetical\ 2} := \frac{r_m^b * \sum_m q_{2018}^m}{r_m * \sum_m s_{2018}^m}. \tag{4}$$

B Interviews with relatives of deceased

The following quotes are excerpts from a video published on G1, the online platform of the popular Brazilian newspaper O Globo (Manzano and Rodrigues da Silva, 2021). Quotes were translated from Portuguese to English by the authors.

Quote 1 from Juliana Sandrini (min 00.46 to 00.58)

"Everything is collapsing. People are fighting for having a UTI. My dad passed while waiting for one. This is a nightmare. People need to acknowledge that this is real; Covid-19 is real. You can die if you get infected.

Quote 2 from Maria Regina da Silva (min 02:15 to 02:38).

"My husband has always been healthy. So, when he got infected, we thought this would be okay. There was no need to worry. Then, we got a call from the hospital. When I saw my husband, I could not believe it. All of a sudden, he was dead."

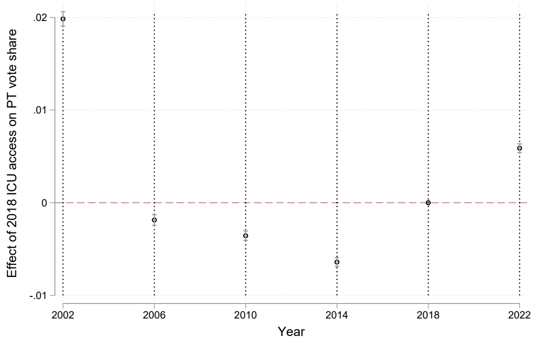
Quote 3 from Lincoln da Silva (min 02:40 to 02:38).

"Honestly, I was not taking it [COVID-19— seriously. I thought it was harmless. I mean, even if you were caught, you could take some medicine and get away with it. Unfortunately, this has proven not to be true."

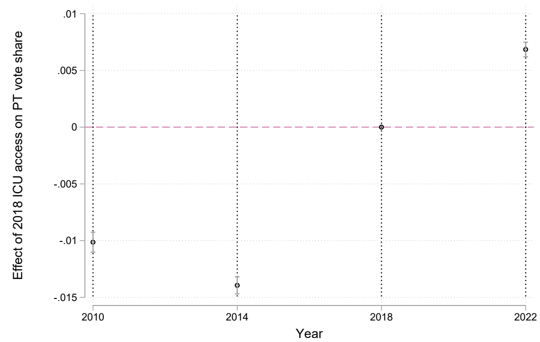
Quote 4 from André Luiz da Rosa (min 02:54 to 03:13)

"My brother died 30 minutes before the SAMU [ambulance] arrived. I beg you, if you are watching this video, please do not undermine the severity of COVID-19. This virus is not here to play. It could be fatal!

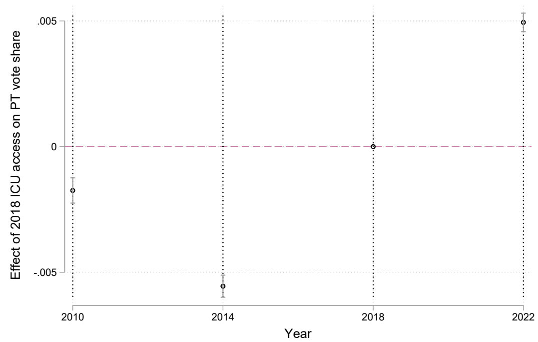
C Alternative specifications for parallel trends test



(a) Any care unit unconditional



(b) r1



(c) Any care unit unconditional

Note: The event study plots shows the coefficients interactions of election year dummies interacted with any hospital beds or ICUs, repsectively. The specification absorbs electoral polling station-level fixed effects and municipality-specific time trends. Panels (b) and (c) also condition on demographic control variables. Confidence intervals are obtained for the 99% level from clustered standard errors at the voting location times year level to allow for time and location-specific heteroscedasticity.

D Main results, first-round vote shares

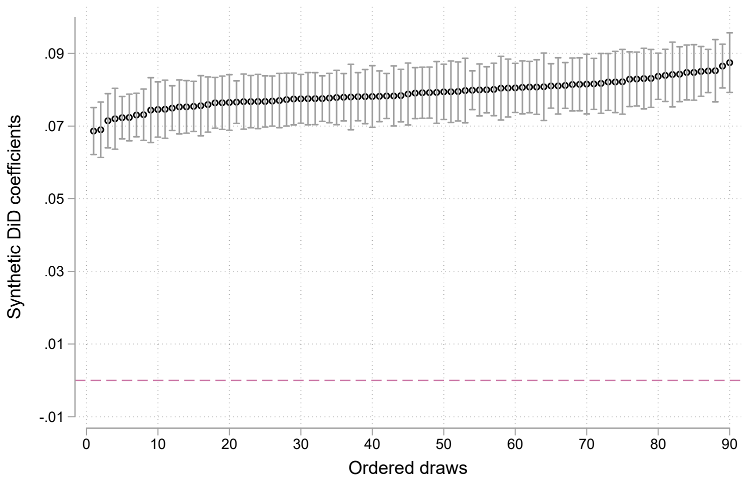
Table 5: DiD health care presence on 1st round vote shares

	(1)	(2)	(3)	(4)	(5)	(6)
ICU x 2022	-0.0053	-0.0105	-0.0044			
	(0.0001)	(0.0000)	(0.0001)			
ABA x 2022				-0.0046	-0.0094	-0.0041
				(0.0001)	(0.0001)	(0.0001)
age		0.0020	0.0018		0.0021	0.0018
		(0.0000)	(0.0000)		(0.0000)	(0.0000)
education		0.1208	0.1253		0.1335	0.1228
		(0.0016)	(0.0017)		(0.0017)	(0.0017)
education^2		-0.0094	-0.0091		-0.0105	-0.0088
		(0.0002)	(0.0002)		(0.0002)	(0.0002)
sex		-0.0860	-0.0855		-0.0875	-0.0854
		(0.0011)	(0.0012)		(0.0012)	(0.0011)
married		-0.0327	0.0077		-0.0321	0.0077
		(0.0017)	(0.0018)		(0.0017)	(0.0018)
Mun.×year FE	✓		✓	✓		✓
N	872,604	872,617	872,599	872,604	872,617	872,599

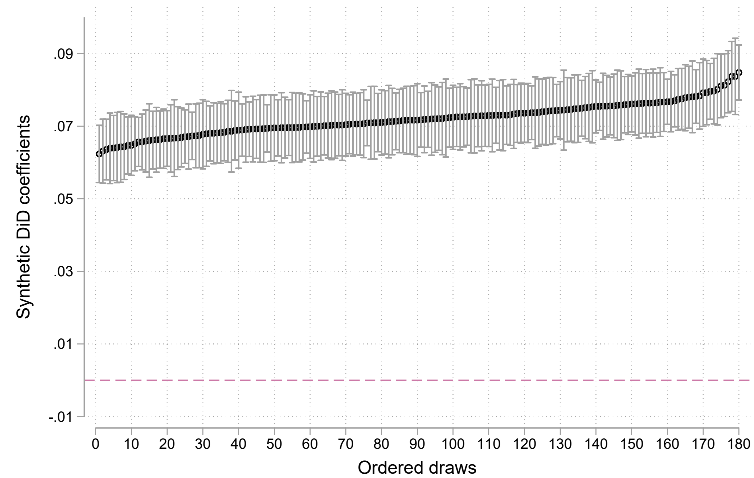
Standard errors in parentheses

Note: The outcome is Bolsonaro's vote share in the first rounds of elections. The treatment variable is health care access measured by ICU presence and any care unit respectively. All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).

E Different treatment cutoff for SDID



(a) Treatment = $\mathbf{1}(ICU > 2)$



(b) Treatment = $\mathbf{1}(ICU > 6)$

Note: The SDID model takes PT vote shares as outcomes and treatments are defined by the cut-off values as indicated. The models include demographic control variables on the electoral polling station level, age, gender, education, education^2, and marital status. Standard errors are clustered on the polling station level. We report 95% confidence intervals.

F Robustness

F.1 Sample split by meso-region

Table 6: DiD sample split by Northeast region

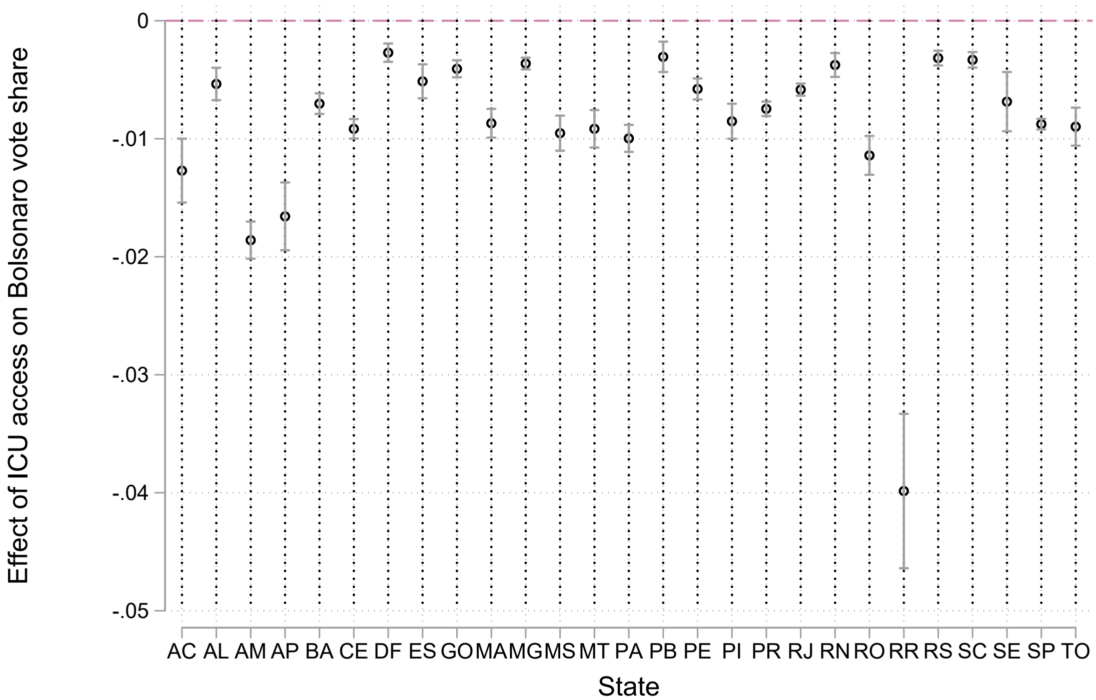
	(1)	(2)	(3)	(4)	(5)	(6)
			Non-Northeast region			
ICU x 2022	-0.0080	-0.0122	-0.0070			
	(0.0001)	(0.0001)	(0.0001)			
ABA x 2022				-0.0062	-0.0105	-0.0056
				(0.0001)	(0.0001)	(0.0001)
age		0.0025	0.0022		0.0026	0.0022
		(0.0000)	(0.0000)		(0.0000)	(0.0000)
education		0.1384	0.1354		0.1546	0.1337
		(0.0024)	(0.0025)		(0.0025)	(0.0025)
education^2		-0.0115	-0.0101		-0.0129	-0.0099
		(0.0003)	(0.0003)		(0.0003)	(0.0003)
sex		-0.0657	-0.0688		-0.0670	-0.0687
		(0.0014)	(0.0014)		(0.0014)	(0.0014)
married		-0.0509	0.0076		-0.0505	0.0073
		(0.0021)	(0.0021)		(0.0021)	(0.0021)
N	632,886	632,899	632,881	632,886	632,899	632,881
			Northeast region			
ICU x 2022	-0.0075	-0.0067	-0.0072			
	(0.0002)	(0.0001)	(0.0002)			
ABA x 2022				-0.0046	-0.0068	-0.0047
				(0.0001)	(0.0001)	(0.0001)
age		0.0015	0.0014		0.0015	0.0014
		(0.0001)	(0.0001)		(0.0001)	(0.0001)
education		0.0240	0.0488		0.0228	0.0456
		(0.0028)	(0.0028)		(0.0028)	(0.0028)
education^2		0.0030	0.0012		0.0033	0.0016
		(0.0004)	(0.0003)		(0.0004)	(0.0003)
sex		-0.0784	-0.0785		-0.0789	-0.0782
		(0.0021)	(0.0021)		(0.0021)	(0.0021)
married		-0.0195	0.0340		-0.0165	0.0342
		(0.0027)	(0.0029)		(0.0027)	(0.0029)
Mun.×year FE	✓		✓	✓		✓
N	239,718	239,718	239,718	239,718	239,718	239,718

Standard errors in parentheses

Note: The sample is restricted to observations from the Northeast meso-region or not. The outcome is Bolsonaro's vote share in the runoff election. The treatment variable is health care access measured by ICU presence and any care unit respectively. All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).

F.2 Sample split by state

Figure 10: Heterogeneous effects by state



Note: This figure reports coefficients from the DiD model with control variables and municipality-specific time trends. The outcome is Bolsonaro's vote shares in the runoff election. The treatment is ICU presence.

F.3 Sample split by death rate

Table 7: DiD by levels of death rate

Death-rate	1^{st} quartile	2^{nd} quartile	3^{rd} quartile	4^{th} quartile
ICU x 2022	-0.0063	-0.0055	-0.0083	-0.0067
	(0.0003)	(0.0002)	(0.0002)	(0.0002)
age	0.0017	0.0018	0.0025	0.0023
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
education	0.0709	0.1079	0.1524	0.1445
	(0.0036)	(0.0043)	(0.0047)	(0.0042)
education^2	-0.0022	-0.0066	-0.0115	-0.0108
	(0.0004)	(0.0005)	(0.0005)	(0.0004)
sex	-0.0697	-0.0746	-0.0751	-0.0714
	(0.0029)	(0.0024)	(0.0021)	(0.0021)
married	0.0306	0.0277	0.0067	0.0046
	(0.0041)	(0.0039)	(0.0031)	(0.0035)
N	218,070	217,065	219,149	218,315

Standard errors in parentheses

Note: For each column, the sample is restricted to observations within the respective quartile of municipality-level reported death rates. The outcome is Bolsonaro's vote share in the runoff election. The treatment variable is health care access measured by ICU presence and any care unit respectively. All regressions in this table control for year and unit fixed effects, and municipality-specific time trends. Standard errors are clustered at the treatment level (voting location).

F.4 Sample split by 2018 vote share

Table 8: DiD by 2018 vote share

2018 vote share	1^{st} quartile	2^{nd} quartile	3^{rd} quartile	4^{th} quartile
ICU x 2022	-0.0041	-0.0050	-0.0033	-0.0033
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
age	0.0011	0.0015	0.0010	0.0012
	(0.0001)	(0.0000)	(0.0000)	(0.0000)
education	0.0424	0.0836	0.0549	0.0442
	(0.0032)	(0.0040)	(0.0028)	(0.0026)
education^2	0.0007	-0.0049	-0.0035	-0.0026
	(0.0004)	(0.0004)	(0.0003)	(0.0003)
sex	-0.0605	-0.0660	-0.0376	-0.0333
	(0.0025)	(0.0023)	(0.0018)	(0.0016)
married	0.0354	-0.0020	-0.0130	0.0225
	(0.0037)	(0.0029)	(0.0022)	(0.0022)
N	217,446	217,300	217,491	217,668

Standard errors in parentheses

Note: For each column, the sample is restricted to observations within the respective quartile of 2018 Bolsonaro vote shares. The outcome is Bolsonaro's vote share in the runoff election. The treatment variable is health care access measured by ICU presence and any care unit respectively. All regressions in this table control for year and unit fixed effects, and municipality-specific time trends. Standard errors are clustered at the treatment level (voting location).

F.5 Sample split by number of registered voters

Table 9: DiD by number of registered voters in a polling station

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ICU x 2022	-0.0098	-0.0074	-0.0074	-0.0065	-0.0059	-0.0063	-0.0061	-0.0059	-0.0067	-0.0077
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
age	0.0021	0.0017	0.0015	0.0015	0.0015	0.0018	0.0020	0.0020	0.0024	0.0024
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
education	0.1124	0.0909	0.0986	0.1061	0.1238	0.1242	0.1163	0.1358	0.1563	0.1156
	(0.0086)	(0.0053)	(0.0058)	(0.0057)	(0.0050)	(0.0058)	(0.0063)	(0.0056)	(0.0064)	(0.0074)
education^2	-0.0065	-0.0042	-0.0058	-0.0065	-0.0087	-0.0091	-0.0088	-0.0110	-0.0126	-0.0082
	(0.0011)	(0.0006)	(0.0006)	(0.0006)	(0.0005)	(0.0006)	(0.0007)	(0.0006)	(0.0007)	(0.0008)
sex	-0.0754	-0.0696	-0.0613	-0.0538	-0.0606	-0.0640	-0.0581	-0.0699	-0.0707	-0.0852
	(0.0073)	(0.0044)	(0.0042)	(0.0038)	(0.0034)	(0.0033)	(0.0035)	(0.0035)	(0.0034)	(0.0035)
married	0.0847	0.0551	0.0333	0.0290	0.0355	0.0127	-0.0063	-0.0148	-0.0091	-0.0410
	(0.0117)	(0.0061)	(0.0062)	(0.0054)	(0.0048)	(0.0047)	(0.0052)	(0.0049)	(0.0043)	(0.0052)
N	84,936	84,644	84,916	87,022	84,908	87,318	86,870	80,704	89,764	88,727

Standard errors in parentheses

Note: For each column, the sample is restricted to observations within the respective decile of the number of registered voters in 2018. The outcome is Bolsonaro's vote share in the runoff election. The treatment variable is health care access measured by ICU presence and any care unit respectively. All regressions in this table control for year and unit fixed effects, and municipality-specific time trends. Standard errors are clustered at the treatment level (voting location).

F.6 Distance to closest ICU

Table 10: DiD with alternative treatment definitions: distance

	(1)	(2)	(3)	(4)	(5)	(6)
proximity × 2022	-0.0005	-0.0006	-0.0004			
	(0.0001)	(0.0000)	(0.0001)			
ICU in 50km × 2022				-0.0123	-0.0733	-0.0118
				(0.0008)	(0.0004)	(0.0008)
age		0.0028	0.0022		0.0028	0.0022
		(0.0000)	(0.0000)		(0.0000)	(0.0000)
education		0.1825	0.1281		0.1815	0.1293
		(0.0022)	(0.0019)		(0.0020)	(0.0019)
education^2		-0.0159	-0.0090		-0.0157	-0.0091
		(0.0002)	(0.0002)		(0.0002)	(0.0002)
sex		-0.0784	-0.0728		-0.0776	-0.0728
		(0.0012)	(0.0012)		(0.0012)	(0.0012)
married		-0.0575	0.0133		-0.0562	0.0133
		(0.0019)	(0.0018)		(0.0018)	(0.0018)
Mun.×year FE	✓		✓	✓		✓
N	872,604	872,617	872,599	872,604	872,617	872,599

Standard errors in parentheses

Note: The outcome is Bolsonaro's vote share in the runoff election. The treatment variable is the distance to the closest ICU in columns (1) - (3). In columns (4) - (6) the treatment is defined as a binary indicator for whether an ICU exists within 50km of the polling station. All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).

Table 11: DiD with alternative treatment definitions: distance

	(1)	(2)	(3)	(4)	(5)	(6)
ICU in 20km × 2022	-0.0223	-0.0687	-0.0210			
	(0.0007)	(0.0004)	(0.0007)			
ICU in 30km × 2022				-0.0167	-0.0717	-0.0162
				(0.0008)	(0.0004)	(0.0008)
age		0.0027	0.0022		0.0027	0.0022
		(0.0000)	(0.0000)		(0.0000)	(0.0000)
education		0.1591	0.1287		0.1651	0.1292
		(0.0020)	(0.0019)		(0.0020)	(0.0019)
education^2		-0.0134	-0.0091		-0.0140	-0.0091
		(0.0002)	(0.0002)		(0.0002)	(0.0002)
sex		-0.0765	-0.0728		-0.0766	-0.0728
		(0.0012)	(0.0012)		(0.0012)	(0.0012)
married		-0.0572	0.0132		-0.0545	0.0132
		(0.0018)	(0.0018)		(0.0018)	(0.0018)
Mun.×year FE	✓		✓	✓		✓
N	872,604	872,617	872,599	872,604	872,617	872,599

Standard errors in parentheses

Note: The outcome is Bolsonaro's vote share in the runoff election. In columns (1) - (3) the treatment is defined as a binary indicator for whether an ICU exists within 20km of the polling station. In columns (4) - (6) the treatment is defined as a binary indicator for whether an ICU exists within 30km of the polling station. All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).

F.7 Sample restriction on hospital size and proximity

Table 12: Sample restriction on hospital size and proximity

	(1)	(2)	(3)	(4)	(5)	(6)
ICU x 2022	-0.0075	-0.0122	-0.0066	-0.0064	-0.0066	-0.0079
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0003)
age		0.0026	0.0022	0.0022	0.0022	0.0027
		(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
education		0.1369	0.1261	0.1419	0.1459	0.1277
		(0.0020)	(0.0019)	(0.0030)	(0.0046)	(0.0086)
education^2		-0.0113	-0.0087	-0.0106	-0.0111	-0.0091
		(0.0002)	(0.0002)	(0.0003)	(0.0005)	(0.0009)
sex		-0.0755	-0.0734	-0.0764	-0.0781	-0.0839
		(0.0012)	(0.0012)	(0.0015)	(0.0021)	(0.0034)
married		-0.0649	0.0097	0.0043	0.0081	-0.0112
		(0.0018)	(0.0018)	(0.0024)	(0.0036)	(0.0050)
N	824,546	824,647	824,541	441,262	232,565	78,003

Standard errors in parentheses

Note: The outcome is Bolsonaro's vote share in the runoff election. The treatment is defined as the ICU index. The sample is restricted to observations with any care unit within a 20km distance for all columns. In columns (4) - (6) the sample is further restricted by the number of non-ICU care units within 20km. Column (4) considers only observations with more than 50 care units. Column (5) considers only observations with more than 100 care units. Column (6) considers only observations with more than 200 care units. than All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).

Table 13: Sample restriction on hospital size and proximity

	(1)	(2)	(3)	(4)	(5)	(6)
ICU in 20km $\times$ 2022	-0.0094	-0.0656	-0.0087	-0.0069	-0.0117	-0.0227
	(0.0008)	(0.0004)	(0.0007)	(0.0016)	(0.0035)	(0.0081)
age		0.0027	0.0022	0.0023	0.0023	0.0028
		(0.0000)	(0.0000)	(0.0000)	(0.0001)	(0.0001)
education		0.1621	0.1332	0.1512	0.1575	0.1430
		(0.0021)	(0.0020)	(0.0030)	(0.0047)	(0.0089)
education^2		-0.0136	-0.0095	-0.0115	-0.0122	-0.0106
		(0.0002)	(0.0002)	(0.0003)	(0.0005)	(0.0009)
sex		-0.0773	-0.0737	-0.0767	-0.0784	-0.0842
		(0.0012)	(0.0012)	(0.0015)	(0.0021)	(0.0034)
married		-0.0609	0.0089	0.0035	0.0073	-0.0121
		(0.0018)	(0.0018)	(0.0024)	(0.0036)	(0.0050)
Mun.$\times$year FE	✓		✓	✓	✓	✓
N	824,546	824,647	824,541	441,262	232,565	78,003
	Mean		Standard deviation		Min	Max
Non-ICU care units	83.8257		89.8908		0	1,014

Standard errors in parentheses

Note: The outcome is Bolsonaro's vote share in the runoff election. The treatment is defined as a binary indicator for whether an ICU exists within 20km of the polling station. The sample is restricted to observations with any care unit within a 20km distance for all columns. In columns (4) - (6) the sample is further restricted by the number of non-ICU care units within 20km. Column (4) considers only observations with more than 50 care units. Column (5) considers only observations with more than 100 care units. Column (6) considers only observations with more than 200 care units. than All regressions in this table control for year and unit fixed effects. Standard errors are clustered at the treatment level (voting location).