Electoral Incentives to Combat Mosquito-Borne Illnesses: Experimental Evidence from Brazil *

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Abstract

Mosquito-borne illnesses present significant health challenges to the developing world. If citizens are informed about their government?s efforts to combat these diseases, will they reward incumbents who have performed well and punish those who have done poorly at this task? Electoral sanctioning requires that combatting disease be a sufficiently salient concern, which, in turn, is likely to depend upon subjective perceptions of the risks posed by particular illnesses. Epidemics typically prompt stronger risk perceptions than endemic diseases, but where both types circulate jointly, the more familiar endemic disease may determine public reactions. The salience of health threats also varies among individuals; those with a self-interest in prevention or a personal connection to the effects of mosquito-borne illnesses may react more strongly.

This study presents the results of a face-to-face survey experiment in Pernambuco, Brazil, informing subjects about their mayor?s use of federal funds to combat mosquito-borne illnesses such as dengue (an endemic disease) and Zika and chikungunya (both epidemics). We examine the effect of this information on intended vote for the mayor?s reelection. For the full sample, the treatment has no significant effect. However, we find a large and significant punishment effect among voters who know someone affected by microcephaly or the Zika virus. Drawing on survey and focus group evidence, we argue that most voters fail to act upon our treatment information because mosquito control is a low-salience concern primarily associated with endemic rather than epidemic diseases.

Our study constitutes the first experimental evidence as to whether informing citizens about government public health efforts affects voting behavior. Our results suggests that, where similar epidemic and endemic diseases circulate together, informational campaigns aiming to induce electoral accountability should also seek to boost the salience of the information by educating the public about the difference between familiar and newer threats.

Keywords: Latin America; Brazil; elections; accountability; epidemic disease

1 Introduction

Mosquito-borne illnesses present significant health challenges to the developing world. Vectors for diseases such as malaria, dengue, chikungunya, and Zika thrive in wet, tropical climates. Countries closer to the equator tend to be poorer, producing living conditions—pools of standing water, open windows and fans rather than air conditioning—that facilitate mosquito reproduction and infection of humans (Gallup and Sachs, 2001). Lower levels of education in society mean fewer medical personnel and public health workers available to fight disease (Frenk et al., 2010). State capacity tends to be more limited as well, complicating efforts to mount large-scale public education campaigns or carry out household-level mosquito control efforts (Burkle Jr., 2006).

An additional challenge in combatting mosquito-borne illnesses in the developing world is distinctly political: inducing elected officials to prioritize the public good of disease control in contexts where clientelism and corruption may be common. The difficulties are often compounded when multiple levels of government are involved. Making funds available to local authorities for the purpose of fighting disease can potentially improve eradication efforts, since municipal officials tend to have better knowledge of their communities and may be more trusted by the population. Yet their political incentives may lead them to focus scarce resources on other priorities, such as infrastructure investment, that carry better expected electoral returns.

In democracies, vertical accountability offers a potential solution to the political challenges of combating disease. If voters are informed about the extent and effectiveness of their government's efforts, they can potentially reward incumbents who have performed well at this task and punish those who have done poorly. Yet effective electoral sanctioning requires that combatting disease be a sufficiently salient concern to influence voting behavior. In turn, the salience of government efforts in this area are likely to depend upon individuals' subjective perception of the risks posed by particular illnesses.

In this paper, we examine the electoral effect of informing citizens about their local government's efforts at combatting mosquito-borne illnesses such Zika, dengue, and chikungunya. Our study

takes place in the state of Pernambuco, Brazil—the epicenter of the 2015–16 outbreak of congenital Zika syndrome, or the series of birth defects associated with the Zika virus. We conducted a face-to-face survey experiment in July 2016, informing the treatment group about the mayor's use of federal funds to hire public health workers for the purpose of controlling mosquito-borne illnesses. We examine the effect of this information on intended vote for the mayor's reelection, measured via a secret ballot simulation at the end of the survey.

For the full sample, information about the local government's record in combatting mosquito-borne illnesses has no significant effect on intention to vote for the mayor's reelection. Yet we do find a large and significant punishment effect among a subgroup for whom information about mosquito control should be particularly salient: those who personally know someone affected by microcephaly or the Zika virus. Drawing on our survey as well as focus groups, we argue that most voters fail to act upon our treatment information because they primarily associate mosquito control with dengue, an endemic disease that has existed in Brazil for decades and is much more prevalent than Zika. Inducing behavioral changes in response to endemic diseases is much more difficult than in the case of epidemics because people have a tendency to discounts risks that are familiar and well-understood. While international media coverage focused extensively on the Zika epidemic, both citizens and politicians in Pernambuco are much more concerned with the quality of basic health services, such as the staffing of local medical centers.

2 Principals, Agents, Citizens, and Health Services

As with many public goods, the delivery of government-provided health services involves a relationship among a principal in charge of the state, agents who act on the principal's behalf, and citizens who consume or are the targets of the services provided. Prior experimental studies of health service provision, primarily in the field of economics, have focused on the inherent principal-agent problem in this relationship. Assuming that poor health indicators or service delivery statistics are primarily attributable to a lack of effort on the part of frontline providers, these studies have exam-

ined whether different forms of recruitment attract better health workers or whether performance incentives and monitoring can improve service provision for a given set of employees (Ashraf, Bandiera and Jack, 2014; Ashraf, Bandiera and Lee, 2014, 2016; Banerjee, Duflo and Glennerster, 2008; Basinga et al., 2011; Callen et al., 2018; Deserranno, 2017; Dhaliwal and Hanna, 2017; Gertler and Vermeersch, 2012; Mignozzetti, 2018; Miller et al., 2012). Such studies implicitly or explicitly assume that principals desire better health service provision. In a review of the literature, Finan, Olken and Pande (2017, 492) argue that in the case of "frontline government service providers," including health workers, "the government and the citizen's incentives are aligned: both would like the agent... to provide more or better services."

Yet politicians may not always have an interest in reforms that improve health outcomes. Increasing the quality of agents' service delivery through monitoring, performance incentives, or new recruitment methods can reduce opportunities for corruption and undermine existing clientelistic practices involving the distribution of both health worker jobs and medical services (Avelino, Barberia and Biderman, 2014; Nichter, 2018; Sugiyama, 2012). Managing health programs may consume scarce resources that elected officials would prefer to spend in high-visibility areas with more potential for credit claiming, such as infrastructure investment. Even among politicians who prioritize health, there may be greater will to focus on emergency or specialty care than on public health and preventative services that contribute more to the overall well-being of the population.

Given that politicians' incentives may not be aligned with the goal of improved service delivery, several studies over the past decade have investigated the potential for social accountability: conveying information about government service delivery directly to citizens in the hopes that they will demand better performance from frontline providers (Fox, 2015; World Bank, 2016). Conclusions from this research program have been mixed; one study shows that efforts to facilitate citizen monitoring improve service delivery and health outcomes (Björkman and Svensson, 2009; Björkman Nyqvist, de Walque and Svensson, 2017), whereas other studies in the area of education have found null effects on citizen engagement, learning outcomes, and teacher effort (Banerjee et al., 2010; Lieberman, Posner and Tsai, 2014). A general conclusion is that the effective exercise

of social accountability is often inhibited by barriers to collective action, a low sense of efficacy, and a lack of knowledge of concrete steps that citizens can take to act upon information (Banerjee et al., 2010; Buntaine, Daniels and Devlin, 2018; Fox, 2015; Lieberman, Posner and Tsai, 2014).[1]

Yet direct citizen monitoring of agents is not the only way that information can potentially foster improved health outcomes. Rather than bypassing politicians with misaligned incentives, citizens can potentially change those incentives by conditioning their voting behavior on the quality of service provision (World Bank, 2016). While pressuring frontline providers for better service may require collective action, a strong sense of efficacy, and knowledge of how to participate in new ways, the simple, individual, and routine act of voting faces few barriers of this sort. Fox (2015) thus issues a call to scholars to "bring vertical accountability back in" to the study of social accountability in the developing world. Sanctioning good performers and punishing bad performers at the ballot box can, in theory, be a powerful tool for development.

As with the literature on social accountability, field experiments that provide information in an effort to induce electoral sanctioning have reached mixed conclusions. In India, Banerjee et al. (2011) found that information about service provision boosted the vote share of better performing and more qualified incumbents. In Mexico, Chong et al. (2015) show that information about corruption lowered support for incumbent parties but also for challengers. In a Brazilian mayoral election, De Figueiredo, Hidalgo and Kasahara (2011) show that informing about corruption charges reduced vote share only for the challenger, not for the incumbent. In Uganda, Humphreys and Weinstein (2012) argue that information dissemination has little effect on incumbent vote share at all. Most recently, six separate studies in Africa and Latin America, informing about aspects of performance from public goods provision to charges of malfeasance, show that information provision almost always has null effects on voting for the incumbent (Dunning et al., Forthcoming).

In an effort to explain null effects in the literature on information and accountability—both social and vertical—several studies have argued that information must be salient in order to affect individual behavior. Citizens weigh any number of competing criteria when they decide how to cast a single vote, and while they can potentially exercise social accountability in multiple policy areas

at once, time and resource constraints typically mean that they are forced to prioritize. Lieberman, Posner and Tsai (2014) suggest that the null effects of their education-related intervention might be partially attributable to the fact that parents prioritize health care and clean drinking water almost as much as education. Likewise, Dunning et al. (Forthcoming, 16) suggest that the null findings from the six Metaketa studies might be attributable to the information not being sufficiently salient to change voting behavior.

Yet empirical evidence that salience moderates the effect of information on electoral sanctioning is still relatively sparse. In one of the Metaketa studies, Adida et al. (2016) show that the effect of information about legislative performance on incumbents' vote share depends in part on whether it was accompanied by a "civics message" that drew connections between legislative performance and voter welfare, which they interpret as boosting the salience of the information. Yet in the meta-analysis of the six Metaketa studies, perceived salience is not a significant moderator of information effects Dunning et al. (Forthcoming, 426), perhaps because the common measure of salience across these studies is insufficiently precise. And while Lieberman, Posner and Tsai (2014) suggest that salience might matter, they do not test for it as a moderator.

3 Risk Perception, Salience, and Citizens' Health Behavior

The present study seeks to test whether information about government efforts to combat mosquito-borne illness prompt electoral sanctioning and whether the effect of this information varies according to its likely salience for particular individuals. Public perception of the risks posed by particular diseases is central to these questions of issue salience and likely changes in voting behavior.

While research in economics has focused on incentivizing health workers to provide better services, studies in the field of public health have looked centrally at how citizens respond to disease eradication campaigns. Combatting mosquito-borne illnesses is as much a social challenge as a medical problem because it relies heavily on stimulating the public to engage in protective and preventive behaviors. There are few vaccination options for illnesses such as dengue, chikungunya,

and Zika, and their most common host, the *Aedes aegypti* mosquito, is resistant to fumigation efforts because it typically lives indoors where airborne insecticides do not penetrate (Gubler, 1989). Hence, the most effective way to fight these diseases is to prevent their insect hosts from reproducing or infecting new individuals. Eradication efforts thus focus on inducing behavioral changes in individuals, such as eliminating standing water and using bed nets, insect repellant, and long sleeves.

The effectiveness of efforts to induce behavioral changes in response to health threats depends on individuals' perception of risks. While scientists usually quantify risks in terms of objective criteria such as death or infection rates, individuals' risk perceptions generally depend on subjective factors. There is a tendency to overestimate the risk of activities that have potentially catastrophic consequences or lie outside of individuals' direct control—for example, plane crashes, which are statistically much less common, but routinely more feared, than automobile accidents. Likewise, threats that are new, unobservable, or not well understood are routinely perceived as posing greater risks than threats that are familiar and comprehensible (Slovic, 1987).

Subjective risk perceptions have implications for efforts to combat disease. When a disease is new and not well understood, people have a tendency to overreact in terms of protective and preventive efforts. The public reaction to the Severe Acute Respiratory Syndrome (SARS) outbreak in 2003 was particular strong, with negative implications for economies throughout East Asia, well beyond what would be expected based on the severity of the disease itself (Smith, 2006). Media attention—a major factor in the SARS epidemic—has a tendency to exacerbate this strong response to new, poorly understood, or potentially catastrophic epidemics.

By contrast, when a disease is endemic in a particular population, reactions tend to be much more subdued, and it is harder to induce protective behavior (Few, 2012). In the 1960s, smallpox was endemic in Bihar, India, but "it did not cause panic primarily because explanations for the disease were incorporated into the culture." Meanwhile, outbreaks of the same disease in Africa routinely prompted villagers to flee their communities (Foege, 1988, 334). Several studies of dengue in the developing world have underscored the difficulties of stimulating a strong public

response or sustaining one after an epidemic subsides (Pérez-Guerra et al., 2009; Phuanukoonnon, Brough and Bryan, 2006; Setbon and Raude, 2011). In their study of dengue in Martinique, Setbon and Raude (2011, 6) conclude that "after a certain amount of time, when the threat becomes better understood and familiar, the fear triggered by the novelty of the threat is superseded by a process of normalisation, posing the question of how high-risk perception and protective behaviours can be maintained sustainably in endemic contexts."

Public health research has focused on the relationship between risk perception and disease-prevention behaviors, but similar expectations should apply to political behavior. All else equal, information regarding government performance in combatting a new, mysterious, potentially catastrophic and highly salient epidemic disease should have a greater effect on vote choice than information concerning one that is endemic, familiar, and well understood.

Apart from variations in salience associated with the risk perception of different diseases, the salience of information about mosquito control should be greater for those who have a personal connection to mosquito-borne illnesses or an individual self-interest in combatting them. In a study in Malawi, Dionne (2012, 2018) shows that individuals who are HIV positive or know someone who died of AIDS are more likely to support government HIV/AIDS programs over other spending priorities. In the first case, individuals stand to benefit from a private good, since the majority of spending is for treating the infected rather than for prevention. In the second instance, their risk perceptions of the same disease should be heightened since they have seen its devastating consequences firsthand.

4 Mosquito-Borne Illnesses and Risk Perceptions in Brazil

Given its tropical climate, mosquito-borne illnesses have plagued Brazil for centuries. The most common of these is dengue fever, which has existed in Brazil since the late 19th century. Dengue is a viral disease spread primarily by the *Aedes aegypti* mosquito. Symptoms include fever, headache, joint pain, swollen lymph nodes, and a skin rash; most patients recover fully within

a week. In a small percentage of cases, the disease develops into more dangerous and potentially life-threatening versions, including dengue hemorrhagic fever and dengue shock syndrome. The overall risk of death is very low—less than one in one thousand in recent years in Brazil.[2]

In recent years, two new diseases spread by the *Aedes aegypti* mosquito, Zika and chikungunya, have come to circulate in many of the same parts of Brazil historically affected by dengue. Both present very similar symptoms to those of dengue, and it is often difficult for physicians and health workers, much less the public, to tell them apart (Cardoso et al., 2015; Ioos et al., 2014; Moulin et al., 2016). Chikungunya was first detected in Brazil in 2010 and began to spread widely in 2015–2016. As with dengue, most patents recover from the flu-like symptoms quickly, though joint pain sometimes lasts for several months. Also similar to dengue, the death rate from chikungunya has been low—less than one in one thousand in Brazil in 2016.

The newest disease spread by *Aedes aegypti*, the Zika virus, was identified in northeastern Brazil in April 2015. While Zika's symptoms are similar to those of dengue and chikungunya, they are often milder, and the disease is frequently asymptomatic. The risk of death is even lower than with dengue and chikungunya—only 6 deaths out of 215,319 cases of the disease in Brazil in 2016. However, the Zika outbreak in northeastern Brazil was soon linked to a series of severe birth defects in children born to mothers infected with the disease during pregnancy. These birth defects—the most prominent of which is microcephaly, or a small cranium, due to impeded brain development *in utero*—are referred to as congenital Zika syndrome (Possas et al., 2017).

For reasons that are not yet understood, the state of Pernambuco in northeastern Brazil has registered an unusually high incidence of congenital Zika syndrome. Figure 1 plots the number of suspected cases per million residents in the states most affected by the epidemic. Congenital Zika syndrome was more than three times as common in Pernambuco as in neighboring Alagoas, the second-worst hit state. Zika itself was much more commonly diagnosed elsewhere in Brazil,[3] but since the main danger of the disease is the birth defects it can generate, Pernambuco is widely considered the epicenter.

Though Zika is the newest mosquito-borne illness to afflict Brazil, its incidence pales in com-

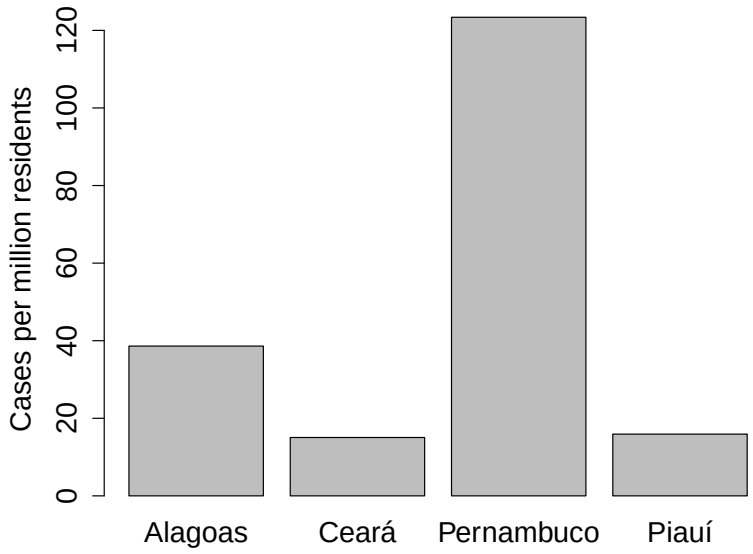

Figure 1: Suspected Cases of Congenital Zika Syndrome in 2015

NOTE: Totals shown for those states with more than 1 case per million residents. Figures do not include the last week of 2015. Source: *Boletim Epidemiológico* 47, 1 (2016): 3.

parison to that of dengue and chikungunya. Figure 2 plots the number of cases of each disease per million Pernambuco residents from 2010 though 2016. Dengue has been endemic in Pernambuco for at least two decades, and there have been major outbreaks in 2002 and 2015, along with more limited spikes in a number of years. Chikungunya began spreading widely in 2016, approaching the incidence of dengue in that year. In 2015, there were more than 96 times as many confirmed cases of dengue as suspected cases of congenital Zika syndrome. In 2016, the ratio was 60 to 1 for dengue and 45 to 1 for chikungunya.

As with endemic diseases elsewhere in the world, dengue should not be expected to generate a strong perceived risk among Pernambuco residents. The disease and its periodic outbreaks are a familiar feature of life in the region. Risk of death is low, the infection period is relatively short, and in the vast majority of cases, symptoms are no worse than those of the flu. Given this profile, studies of dengue in Brazil have reached similar conclusions as those from other countries with respect to subjective risk perception and preventive behavior. In the town of Santo Agostinho in Pernambuco, a study concluded that the public was well-informed about dengue but took insufficient measures

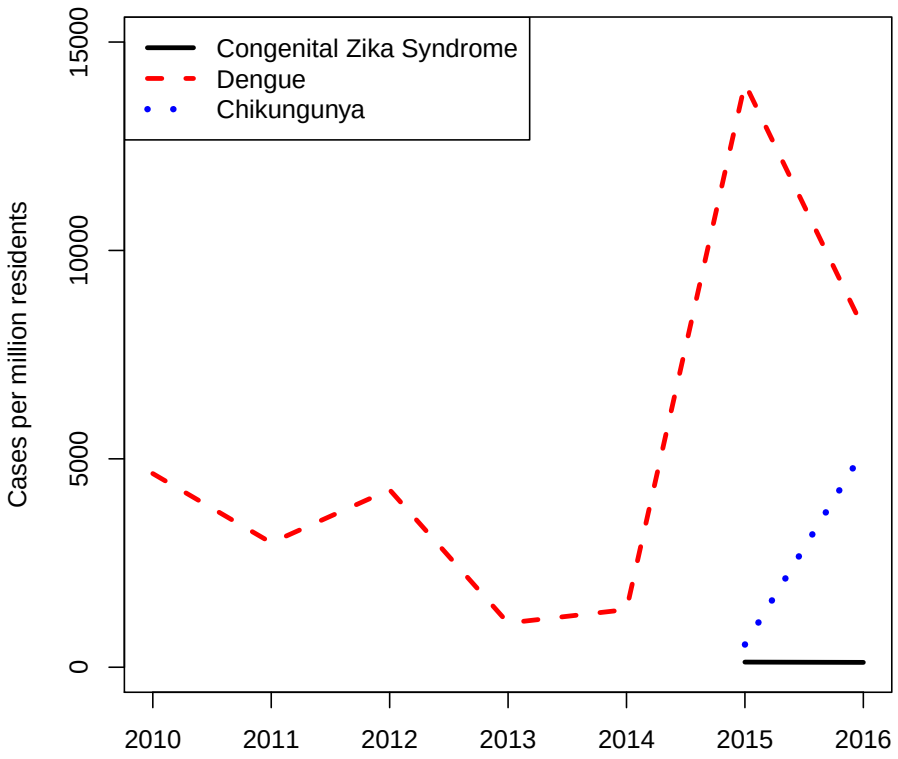

Figure 2: Mosquito-Borne Illnesses in Pernambuco, 2010–2016

NOTE: Disease data are from *Boletim Epidemiológico* 48, 3 (2017): 6 (chikungunya), http://portalsaude.saude.gov.br/index.php/situacao-epidemiologica-dados-dengue (dengue), and Informe Técnico 17 (2017), Secretaria de Saúde, Estado de Pernambuco (congenital Zika syndrome). Zika figures include those cases (a majority in each year) that were later ruled out as being Zika-related. Population data are from the Instituto Brasileiro de Geografia e Estatística (IBGE).

to protect themselves from infection (Santos, Cabral and Augusto, 2011). Another study in the southern state of Mato Grosso do Sul reached similar conclusions, emphasizing the difficulty of maintaining preventive behavior after outbreaks have subsided (Reis, Andrade and Cunha, 2013).

Considered on their own, both chikungunya and Zika might be expected to generated a stronger sense of risk and a more robust public reaction. These diseases are new to Brazil, and their spread in 2015–2016 can be characterized as an epidemic. Much is still unknown about both—especially Zika, its relationship to microcephaly, and why there has been such as unusual concentration of cases in northeastern Brazil. The prognosis for babies born with congenital Zika syndrome is also uncertain, though initial evidence suggests that the associated birth defects are devastating. In

general, the combination of newness, unfamiliarity, and, in the case of Zika, potentially severe consequences would predict a strong subjective sense of risk and a potential overreaction by the public.

However, given the similar symptoms and common insect host of the three diseases, it makes sense that the Brazilian public might confuse them with one another and, to the extent that they do draw distinctions, react to chikungunya and Zika through the lens of the much more familiar dengue. Relevant data are sparse, but one nationally-representative survey from late November 2015 lends support to this conjecture. Asked whether they had heard about the recent increase in microcephaly—the first case of which had only been reported a month before—80% of respondents said yes. But when asked what disease caused microcephaly, a nearly equal number mentioned dengue (28%) as chose Zika (29%), and a sizable share (13%) also mentioned chikungunya (Brazil, 2016).

Moreover, certain features of Zika might be expected to constrain the public response to this disease. The incidence of Zika and congenital Zika syndrome is still limited, even in the most heavily afflicted state. While Pernambuco residents may be familiar with Zika due to media exposure and public education campaigns, they are unlikely to have personal experience with the disease. Though the potential consequences for developing fetuses are severe, symptoms are generally mild for infected individuals themselves. Women that are not of childbearing age or couples using a reliable method of birth control might perceive relatively little risk from the disease.

Outside of infected countries, anecdotal evidence suggests that the risks of Zika were perceived to be severe. A number of Olympic athletes, including the top four seeds in the golf competition, pulled out of the Rio de Janeiro games in August 2016 out of concerns over Zika (Palazzo, 2016). In the international media, there was extensive coverage of Zika and its relationship with microcephaly, which likely both reflected and intensified public perceptions of risk. Panel a) of Figure 3 plots the number of New York Times stories on Zika and other mosquito-borne illnesses in Brazil from January 1, 2015 to April 1, 2017. At its peak, in February 2016, the New York Times ran 296 stories that mentioned Zika in Brazil, or more than 10 per day. Moreover, the focus on Zika far

outstripped attention to dengue and chikungunya.

Similar data from Brazilian newspapers suggest that Zika, while still salient, was relatively less of a concern than it was for the New York Times. Panels b) and c) of Figure 3 plot similar data for Folha de São Paulo, one of Brazil's newspapers of record, and Jornal do Comércio, the major daily in Pernambuco's state capital, Recife. Both show evidence of relatively greater concern with dengue than the New York Times, with peaks during mosquito season in 2015 as well as 2016. Moreover, while both newspapers covered Zika more heavily than the other diseases, the gap is much smaller.

While media of all sorts had natural incentives to focus on the more newsworthy Zika, data from Google searches conducted by users in Brazil as a whole and in the state of Pernambuco, in panels d) and e) of Figure 3, suggest that dengue was more prevalent on people's minds. At the height of the Zika outbreak in the first several months of 2016, dengue was still a more prominent search term than Zika.

In sum, while international media attention has focused squarely on the risks posed by the Zika epidemic—prompting extreme reactions in some cases, such as Olympic athletes pulling out of the Rio games—evidence suggests that Brazilians residents may view this disease differently, using the frame of reference of a familiar endemic disease, dengue, to evaluate the risk of the new and unknown Zika.

5 Research Design

To test whether voters in Pernambuco seek to hold elected officials accountable for their efforts in combatting mosquito-borne illnesses such as Zika, dengue, and chikungunya, we conducted a survey experiment on a sample drawn from 56 municipalities of Pernambuco. We limited the sampling frame to municipalities with first-term mayors who were eligible to run for reelection in October 2016; most went on to do so. The survey was fielded from July 1–21, 2016 and was conducted in partnership with the State Accounts Court of Pernambuco (Tribunal de Contas do

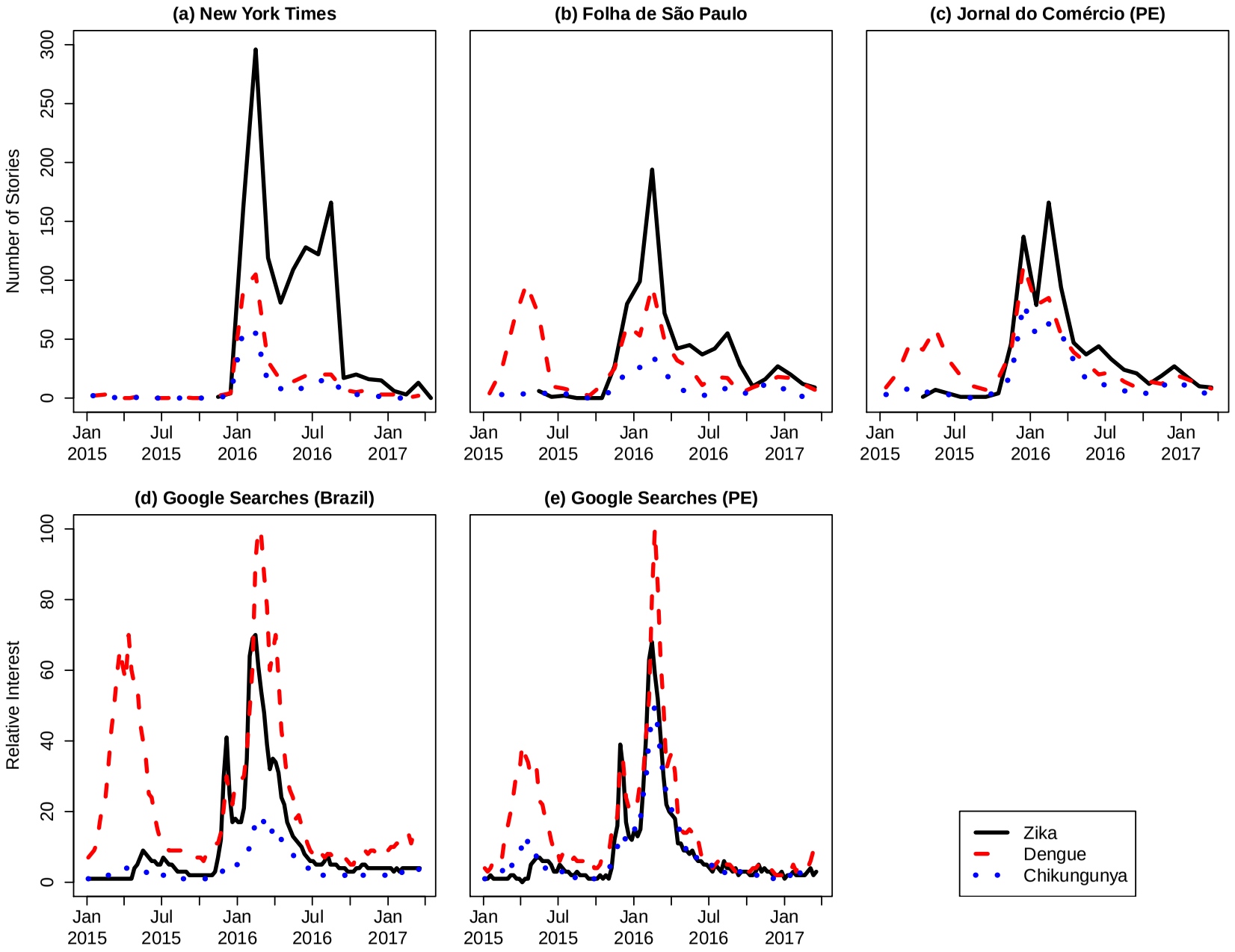

Figure 3: Attention to Brazilian Mosquito-Borne Illnesses

NOTE: For newspapers, results are based on searches for each disease name (along with "Brazil" for the New York Times) in the full text of all articles. For Google, results are based on searches for each disease name in Google Trends.

Estado de Pernambuco, TCE-PE), an agency charged with auditing municipal governments. In addition to information about mosquito control, we included two other informational treatments. At the census tract level, respondents were block-randomized with equal probability to one of these three treatment conditions or a pure control condition that received no information. The present paper analyzes only the subset of respondents in the control group or mosquito control treatment group (N = 1,004).

Given the overall political salience of healthcare in Pernambuco, it is plausible to expect that information about government efforts to combat mosquito-borne illness affects voting behavior. In our survey, we asked open-ended questions about the most serious problem facing the municipality and what problems respondents had sought help from a government official in order to resolve. Health topped both lists; it was named as the biggest problem by 35% of respondents, and 29% of those who had sought help from the government did so for a health-related concern. In a separate post-electoral survey in many of the same municipalities, we asked what issue candidates had most emphasized during the campaign. Health, mentioned by 46% of respondents, was again at the top of the list.

Our experimental treatment provided voters with information regarding the municipality's hiring of Anti-Endemic Disease Agents (*Agentes de Combate às Endemias*, ACE), specialized public health workers who visit homes for education and eradication purposes. Brazil's first efforts to combat mosquito-borne illnesses were organized by the federal government, but in 1999, this task was devolved to municipalities, in concert with broader efforts to decentralize the public health system and grant more control to local governments. Since 2008, the ACE have been incorporated into teams of health professionals associated with the Family Health Program (*Programa Saúde da Família*), Brazil's major primary care service, where they work alongside doctors and nurses who make house calls and attend to patients in their communities. The work of the ACE includes inspecting for standing water where mosquitos can breed and teaching citizens about disease prevention measures (Torres, 2009; Oliveira, Castro and Figueiredo, 2016).

While municipalities are responsible for hiring ACE, the Federal government provides funds

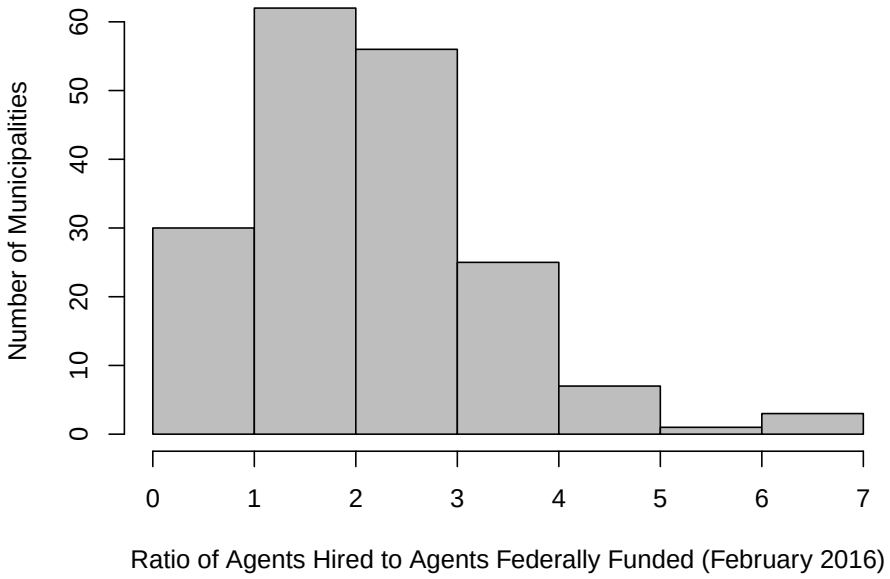

Figure 4: Hiring of Anti-Endemic Disease Agents in Pernambuco

in order to help them do so. Using a formula that takes into account the municipal population as well as epidemiological data, the Federal government determines a target number of ACE per municipality and subsidizes 95% of their standard salary. The remaining 5% of each agent's salary can be paid to the municipality as a "financial incentive for strengthening policies affecting the performance of the ACE." Hence, in effect, the entire salary of a set number of agents is covered by the Federal government. Municipalities have the option of using their own funds to hire additional agents, and some go well beyond what the Federal government subsidizes. However, a non-negligible number of municipalities hire fewer agents than are subsidized by the Federal government, possibly because they did not have the bureaucratic capacity or did not wish to expend the necessary resources to manage a full team of agents.

To convey information about municipal mosquito control in a fashion that would be understandable to Pernambuco residents, we informed them of how their municipality's performance compared to that of others in the state. We first calculated the ratio of ACE agents from each municipality in the national health worker registry to the maximum number that could be subsidized by the Federal government, using the most recent data available at the time (February 2016). As shown in Figure 4, there is substantial variation in this figure across the 185 municipalities of

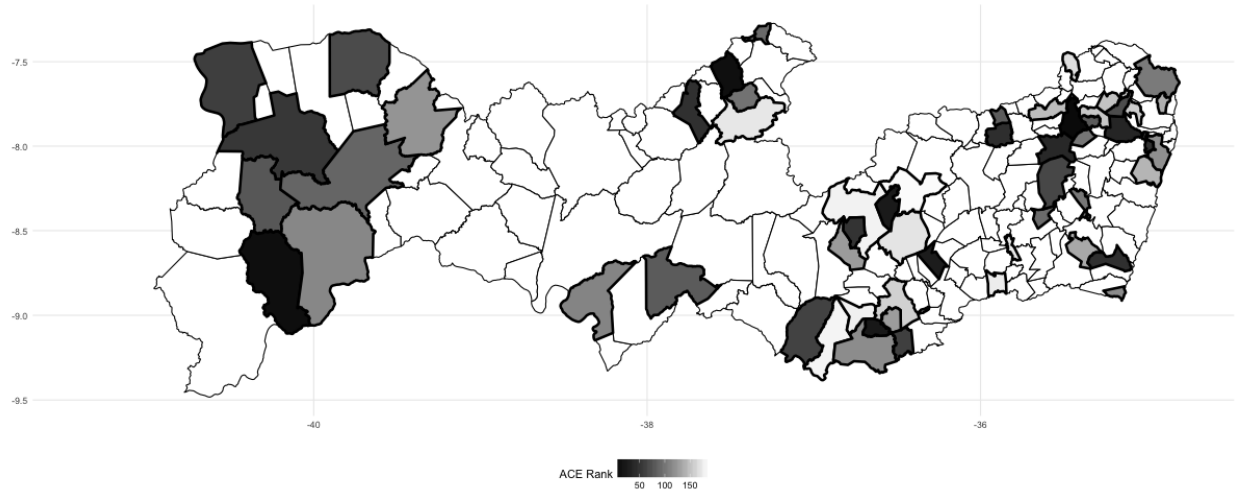

Figure 5: Map of Sampled Municipalities. Outlined municipalities are in the sample; darker shading indicates better performance.

Pernambuco. We then ranked all municipalities in the state according to their ratios, using the ranking as the metric to communicate to voters. Feedback from pretesting focus groups indicated that voters had only a weak understanding of ratios, but readily understood rankings, which are used in other contexts such as sports standings. Figure 5 presents a map of sampled municipalities in the state, shaded according to their ACE rank.

Treatment information was delivered to voters in the form of a flier handed out by enumerators during the survey; examples are contained in the Appendix. The front of the flier bears the logos of our partner institution, the TCE-PE, and it briefly explains that municipalities are responsible for hiring ACE to combat Zika, dengue, and chikungunya. The reverse side conveys municipality-specific details, including an infographic summarizing the ranking and the following text, which was also read out loud by the enumerator:

> In 2016, the Municipality of [MUNICIPALITY] was in position [X] in the statewide ranking of the Anti-Endemic Disease Agents. This means that [MUNICIPALITY] came out [BETTER / WORSE] than [Y]% of municipalities in Pernambuco in terms of hiring professionals to fight against Zika, dengue, and chikungunya.

While ratios could lend themselves to a number of interpretations—for example, a municipality

hiring seven times the federally-funded number of agents might be seen as wasting resources—the rankings and comparative metrics communicated to voters should send a clear and unambiguous signal of relative performance.

In addition to salience, source credibility is an important condition for information to affect voting behavior (Weitz-Shapiro and Winters, 2017). As shown in the Appendix, confidence in the TCE-PE, which was presented as the conveyor of information, was significantly higher than in the federal government, the justice system, or respondents' municipal governments.

Our experiment relies on the assumption that residents consider hiring ACE to be a good thing. To evaluate attitudes toward these agents, we asked a survey question about one of their most controversial activities—entering homes by force to look for mosquito breeding grounds when the owner or occupant cannot be located. Seventy-eight percent of respondents totally approved of this measure, and nine percent partially approved, while only twelve percent expressed partial or total disapproval. Presumably, support for the ACE's more common and less invasive activities, such as educating about mosquito prevention or entering homes with the occupant's permission, is even higher.

Our sample of municipalities includes both good and bad performers on the ACE rank metric; theoretical expectations of treatment effects depend upon the valence of the information. We split our sample and present separate estimates for positive information, defined as performing at or better than the statewide median, and negative information, defined as performing worse than the median. Our sample was stratified such that half of the respondents came from a municipality in each group, so this approach also maximizes statistical power.

A similar but slightly different approach—defining "good news" and "bad news" subjectively, as information that is better or worse than a respondent's priors (Dunning et al., Forthcoming)—works well for many types of information but is less ideal for our measure. First, the granularity of the ranking can lead to counterintuitive classifications—someone who guesses their municipality is ranked last (185th place) in the state and is told that it ranks next-to-last would be scored as receiving good news, when in reality their highly negative prior has essentially been confirmed.

Second, people are unlikely to have well-informed priors about a ranking that was constructed for this project and had never been communicated in the media. The correlation of true ACE rank and priors on this measure is –0.05, suggesting that priors are extremely noisy and conditioning on them would simply generate inefficiency.

Our outcome variable, measured immediately after the delivery of treatment information, asks whether the respondent would vote for the incumbent mayor if the municipal elections were held that week. To reduce social desirability bias and demand effects when measuring vote choice, and to give voters confidence in the secrecy of their responses, we used municipality-specific printed ballots, which respondents were asked to mark privately and deposit in an envelope carried by the enumerator. Ballots contained the mayor's name and photograph, both of which appear on the electronic voting confirmation screen in Brazil. Opposition candidates had not yet registered for the election, so we could not list other options by name, but we allowed respondents to check a box for "another candidate" (accompanied by a generic male silhouette) or "none/blank/null" as alternatives to voting for the mayor. Our *Vote* variable takes on a value of 1 if the respondent chose the incumbent and 0 otherwise, including nonresponse (4.7% of surveys) and the "none/blank/null" option (23.3%). An example ballot is contained in the Appendix.

We also sought to reduce Hawthorne effects, or researcher-induced changes in behavior, as much as possible. The survey firm we hired, Instituto de Pesquisas Sociais, Políticas e Econônimicas (IPESPE), has extensive experience conducting surveys about politics in Pernambuco. Enumerators were all residents of the state and varied in terms of age, sex, race, and apparent socioeconomic status. Surveys are quite common during campaign season in Brazil, so a visit from a researcher asking about politics is not necessarily an unusual experience. The low rate of nonresponse to the vote question implies that respondents were comfortable declaring their intentions in the form of a secret ballot question.

Given the research design—a survey experiment asking about intended vote, where the outcome is recorded immediately after delivery of treatment information—we stand a good chance of detecting any effects that exist in the real world. Respondents have no time to reflect upon the

information before stating a vote intention, but they also have no time to forget it, weigh it against other concerns, hear denials and counterattacks from targeted politicians, or experience any number of other features of a real election that might be expected to diminish the magnitude of effects. Intended vote measured months before the election is also less likely to be affected by vote buying than is behavior on election day. In general, accountability experiments that ask about intended or hypothetical vote have recorded larger and more significant effects than those that ask about real-world voting behavior (omitted self-citation).

Because ACE's mosquito control efforts target several diseases simultaneously, informing about local government's prioritization of this issue cannot exploit differences in the salience of dengue, chikungunya, and Zika. Rather than disease-level variation, we focus on individual-level variation in salience. We test for heterogeneous treatment effects among subgroups for whom information about mosquito control ought to be more salient, due to self-interest or a personal connection to the issue. First, we examine effects among those who have children under 9 months of age—such that the mother would have given birth in October 2015 or later, when news of Zika was beginning to circulate—or are planning to have a child in the near future. This group faces a much greater risk of negative effects from contracting Zika, so they have (or recently had) a stronger self-interest in mosquito control.[4] We also examine effects among those who know someone with a child affected by microcephaly or the Zika virus. As with those who know someone who died of AIDS (Dionne, 2012, 2018), this group has seen firsthand the devastating effects of Zika and should be more attuned to the risks that it presents.

To examine the overall impact of our treatment, we estimate the average treatment effect using the following equation:

$$Y_i = \beta_0 + \beta_1 \mathbf{T}_i + \sum_{k=1}^{K-1} \mu_k B_{ki} + \epsilon_i \tag{1}$$

Y_i is the outcome variable for individual i, $\mathbf{T_i}$ is the treatment indicator, B_{ki} is the kth block (or census tract) dummy, μ_k is the kth block effect, and ϵ_{im} is the disturbance term.[5]

In the Appendix, we show that results are robust to other estimating approaches, including interacting our treatment indicator with the raw ACE ranking rather than subsetting on municipalities above or below the statewide median and controlling for a standard set of covariates in our regression.

6 Results

The results of our analysis are summarized in Figure 6; numerical estimates are presented in the Appendix. Overall, we find that providing information about the municipal government's efforts to combat disease has no effect on intended vote for the incumbent mayor, regardless of whether the municipality had an above- or below-median score on our measure of performance. Our estimates are insignificant, and the point estimates are very close to zero. Among respondents who have a child under 9 months or are planning to have one in the next several years, we find similarly null results, despite this group's greater self-interest in disease prevention.

However, among respondents who know someone in the community with a child affected by microcephaly or Zika, we find that negative information about combatting mosquito-borne illnesses has a large, negative, and statistically significant effect on intended vote for the incumbent (–37.7 percentage points). For this group, as with the others, positive information about government performance has no significant effect on intended vote for the mayor.

We also examined whether the significant treatment effect among those with a personal connection to microcephaly is replicated more broadly in municipalities with a high incidence of congenital Zika syndrome, even among those who do not personally know someone affected by the disease. For example, local media coverage might highlight cases of microcephaly in a particular town, boosting the salience of the disease and perception of risk for all residents. To test this hypothesis, we obtained data from Brazil's Ministry of Health on the number of cases of congenital Zika syndrome in each municipality of Pernambuco from the start of the outbreak through July 1, 2016, when our survey went to the field. As shown in the Appendix, when we subset on

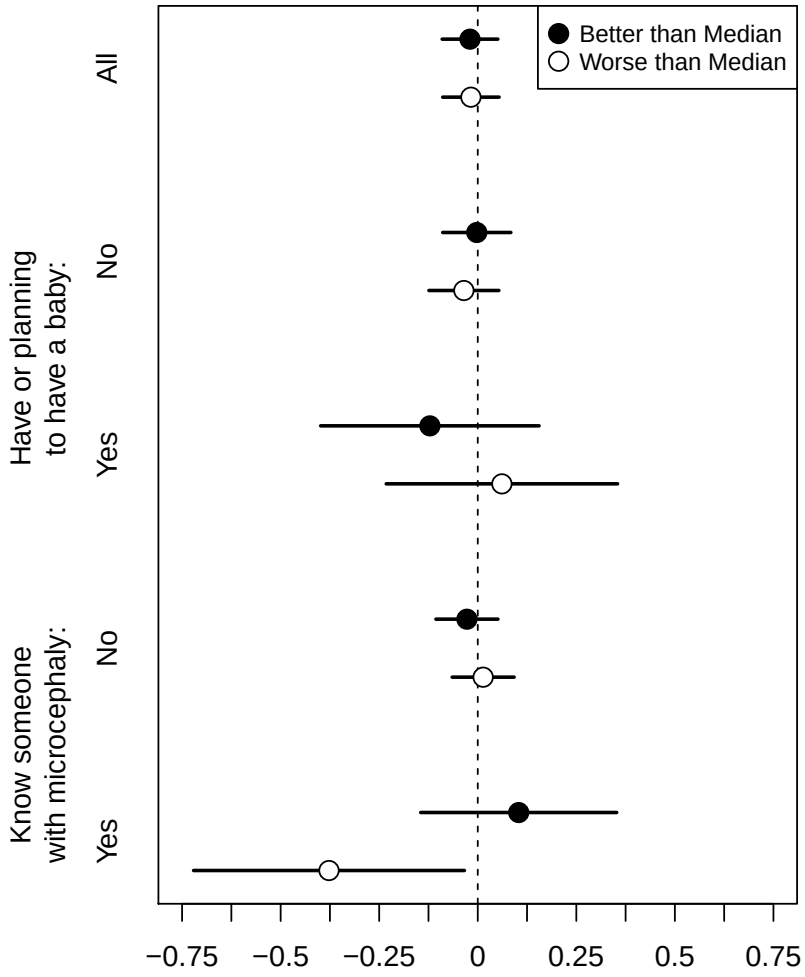

Figure 6: Average Treatment Effects on Intended Vote for Incumbent Mayor

NOTE: Dots give point estimates and lines give two-sided 95% confidence intervals.

poor performing municipalities and interact our treatment indicator with the logged incidence of congenital Zika syndrome, estimated conditional effects are in the expected direction but insignificant. These findings suggest that only a personal connection to microcephaly can prompt voters to sanction politicians for sub-par effort in combatting mosquito-borne illnesses.

7 Discussion

Why do the vast majority of voters fail to respond to information about government efforts to combat mosquito-borne illnesses? In this section, we argue that mosquito control is a low-salience concern for most Pernambuco residents, in part because they fail to associate it with Zika, the epidemic disease most likely to generate strong perceptions of risk. Rather, the familiar endemic situation of dengue provides a frame of reference for interpreting new mosquito-borne illnesses. In such a context, new threats do not cause panic for the vast majority of residents, even when the pattern of outbreak can be characterized as epidemic.

As discussed above, the quality of basic health care is a highly salient issue for voters and mayoral candidates in Pernambuco. Yet when voters speak of major problems with healthcare in their municipalities, the control of mosquito-borne illnesses does not arise. To gain a more in-depth, qualitative understanding of residents' concerns, we commissioned focus groups in three municipalities in central Pernambuco, two of which had been included in our survey and one of which had not.[6] When asked about major problems in their towns, participants in the focus groups often mentioned issues related to health care. Major complaints included a shortage of doctors and medications in local clinics and needing to travel outside of town for emergency care. However, the issue of mosquito control or combatting Zika, dengue, and chikungunya never arose spontaneously.

Evidence from candidates' campaign platforms also shows that, while basic health is a highly salient issue in municipal politics, fighting mosquito-borne illnesses is not. Candidates for executive office are required to file their campaign platforms with Brazil's electoral agency; we downloaded these platforms for all mayoral candidates in Pernambuco's 2016 elections and converted them to searchable text. The vast majority (80%) of 559 platforms mentioned the Family Health Program, Brazil's major primary care service, which is partially funded by the Federal government but managed by municipalities (Sugiyama, 2012).[7] By contrast, 14% of platforms mentioned dengue, and Zika and chikungunya appeared in only 5% each.[8]

Focus groups further underscored that voters have a relatively relaxed attitude about mosquito

control and that they associate the efforts of the ACE with diseases other than Zika. When asked about the "*Aedes aegypti* situation" in the municipality, participants mentioned dengue or chikungunya but never Zika.[9] People were familiar with the ACE and the municipality's role in combatting disease, and they were generally satisfied with these efforts—a stark contrast to the frequent complaints about basic health. The only real complaint that arose from these conversations was about a community member who had gone to the hospital with heart attack symptoms that were dismissed as chikungunya—highlighting both the sometimes blasé attitude toward mosquito-borne illnesses and the overarching concern with basic medical care, including emergency services.

In sum, the pattern of public attitudes about mosquito-borne illness in Pernambuco is much more consistent with an endemic disease situation, as with dengue, the most common disease spread by *Aedes aegypti*. Residents appear to filter the issue of mosquito control through a familiar lens, and they do not consider it a highly salient issue. Health services are of great importance to voters, but basic and emergency care, which they often find lacking, largely accounts for these concerns.

Indeed, given the high salience of primary care, some Pernambuco residents might even see a tradeoff between devoting resources to mosquito control versus basic medical services. Excelling in a low-salience area could be viewed as a net negative if it is seen as taking resources away from a high-salience area—a possible explanation for some of the negative (albeit insignificant) point estimates associated with better-than-median performance in Figure 6.

It is worth considering several alternative explanations for the primarily null effects of our experiment. First, residents might care about control of mosquito-borne illnesses but not believe that the disease-control measure about which we provide information—municipalities hiring ACE—actually makes a difference. While we do not have direct evidence of attitudes about the efficacy of the ACE's work, the strong levels of support for their most controversial activity, entering unoccupied houses by force to inspect for mosquito breeding grounds, implies that people think they are doing good work to prevent disease.

Second, even if people believed that hiring ACE matters for disease control and that their municipality should do better, they might have a negative view of the political opposition, such that

voting against the mayor is not seen as a solution. However, electoral results show that the opposition was comparatively popular: mayors were defeated in 62% of sampled municipalities where they ran for reelection. In addition, respondents were given the option to indicate a null or blank vote or abstention—each of which count as voting against the mayor in the present analysis—so it was possible to punish the incumbent without siding with the opposition. In the survey, 23.8% did so, nearly identical to the rate in the actual mayoral elections in Pernambuco (24.0%).

Moreover, salience is a better explanation than the alternatives for why we do find a significant punishment effect among respondents who know someone affected by microcephaly or the Zika virus. Given high overall levels of support for ACE entering unoccupied houses, those with a connection to microcephaly are not significantly more likely to support this measure, which might indicate their being more inclined to believe that these agents help control disease (4.55 vs. 4.43 on a 5-point scale; $p = 0.17$). Nor are they more sympathetic to the opposition—in fact, pretreatment, they give slightly higher evaluations to the mayor (3.57 vs. 3.40 on a 5-point scale; $p = 0.07$). However, given their personal connection to the devastating effects of Zika, they do have a strong reason to consider mosquito control more salient than the vast majority of respondents.

8 Conclusion

Providing citizens with information about government service delivery has the potential to improve development outcomes. When voters are better informed about their elected officials, they are in a position to sanction poor performers and reward good ones. Moreover, merely knowing that their actions are subject to greater transparency may prompt politicians and civil servants to clean up their act. In recognition of the importance of transparency for development, a 2016 World Bank report recommends providing information about government performance to citizens in ways that can change politicians' incentives and ultimately produce better policy (World Bank, 2016).

Brazil is an important case in which information about government performance clearly has the potential to generate positive effects for development through the mechanism of electoral account-

ability. Brazil's federal government has been a leader in transparency initiatives, in part because it has hoped to improve accountability and governance outcomes at the state and municipal level (Alves and Heller, 2013). The municipal-level data on mosquito control efforts that we use to construct our treatment information, made public by Brazil's Ministry of Health, is consistent with this effort to use transparency to improve the political conditions for development. Prior studies have shown that this effort can work. When random audits of municipal governments by Brazil's Comptroller General are released before mayoral elections, negative audit results decrease an incumbent's vote share, and positive results increase it (Ferraz and Finan, 2008).

However, our study highlights that simply making information about government performance available to citizens may be insufficient to induce electoral accountability if the vast majority of citizens do not consider the information to be politically salient. Health services are a huge concern in the municipal politics of Pernambuco—the major problem as judged by citizens, and the main issue that mayoral candidates talk about during campaigns. Yet attention focuses on aspects such as basic and emergency care rather than the prevention of mosquito-borne illnesses. In a context where prevailing diseases are endemic rather than epidemic, citizens may perceive that infection carries little risk. Moreover, blasé attitudes may carry over from endemic diseases like dengue to epidemics like chikungunya and Zika if they are easily confused with one another, thanks to similar symptoms and the same insect host.

Despite our overall null results, we also demonstrate a large and statistically significant punishment effect among residents who know someone affected by microcephaly or the Zika virus. Our study thus adds crucial empirical support to the common speculation that a lack of salience underlies null effects in information and accountability experiments. In other research emerging out of this broader project, we have obtained similar results. When informed of poor standardized test scores in the municipality, only parents of children enrolled in municipal schools, for whom information about educational performance ought to be most salient, vote against incumbent mayors (omitted self-citation). We also find that salience matters for real electoral choices where voters are forced to make trade-offs among competing priorities, but not in hypothetical vignettes where

they are free to consider treatment information in isolation from other concerns. Information about charges of mayoral malfeasance by an auditing agency—a low salience issue in municipal politics, compared to other, more tangible concerns—prompts a large punishment effect in the context of a vignette experiment but has null effects on vote for the incumbent in a real election (omitted self-citation).

Our findings have several implications for future research. First, providing information about government performance on an issue that is salient for a larger share of voters might prompt electoral accountability on a broad scale. Basic medical services in local health clinics, which personally affect many more residents than microcephaly or the Zika virus, are a strong candidate. Second, information about government performance on less salient issues might still be able to change voting behavior if combined with educational messages that boost the salience of this information (Adida et al., 2016). Informing about government mosquito control efforts could be accompanied by an additional message that distinguishes among the different diseases spread by mosquitos, gives concrete examples of local governments with good or bad performance in this area, and highlights the consequences for citizens' health. Future research could test whether an additional message of this sort succeeds in boosting the salience of mosquito control and the effect of information on voting behavior.

Notes

[1]In recognition of these barriers, scholars have begun to examine how providing information to citizens might advance public health by improving the consumption of health services rather than the quality supplied by frontline providers (Chicoine and Guzman, 2017).

[2]Calculated from data at http://portalarquivos.saude.gov.br/images/pdf/2017/fevereiro/10/obitos-ate-2016.pdf and http://portalarquivos.saude.gov.br/images/pdf/2017/fevereiro/10/Dengue-classica-ate-2016.pdf

[3]See, e.g., http://portalsaude.saude.gov.br/index.php/situacao-epidemiologica-dados-zika.

[4]In contrast to HIV/AIDS programs that disproportionately benefit the infected (Dionne, 2012, 2018), mosquito control focuses on prevention, so we do not expect that those who have already contracted dengue, chikungunya, or Zika would view this issue as more salient out of self-interest.

[5]As pointed out by Gerber and Green (2012, 117), a regression of this form is not consistent for the average treatment effect when treatment probabilities vary by block. To adjust for this issue, we weight each treatment (control) unit by the inverse of the probability of treatment (control).

[6]These focus groups were conducted by a professional facilitator from the same firm hired for the survey; one of us attended as an observer. Our discussion here draws upon our own notes as well as a report prepared by the survey firm.

[7]While ACE work in conjunction with Family Health doctors and nurses, the personnel associated with each program have different responsibilities and areas of expertise. Hence, control of mosquito-borne illnesses is not subsumed under the Family Health Program; it would be plausible for candidates concerned with both issue areas to mention them separately.

[8]For chikungunya, we account for the alternate spelling "chicungunha" as well as common misspellings.

[9]The species of the mosquito that transmits dengue, chikungunya, and Zika is frequently mentioned in Brazilian news reports and government communications, and participants were readily familiar with the term.

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