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ABSTRACT

An Ounce of Prevention for a Pound of Cure: Efficiency of Community-Based Healthcare*

We study the efficiency in health systems generated by community health teams, a common strategy in low- and middle-income countries for primary healthcare delivery. We exploit the rollout of a nation-wide expansion of coverage to this model in El Salvador. Using a panel dataset of municipalities spanning 2009-2018 from consultation and hospital records of almost 4 million episodes, we show that investing in community-based healthcare, which relied on less-specialized health workers, led to a more efficient allocation of care. Preventive care increased and curative care and hospitalizations from preventable conditions decreased, while coverage in curative care for previously unattended chronic diseases increased.

JEL Classification: I15, I18, H21, H51
Keywords: community-based healthcare, efficiency, access

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1 Introduction

The substantial growth in healthcare spending in recent decades has put efficiency of health systems in the spotlight (Hall and Jones, 2007; Garber and Skinner, 2008; Grigoli and Kapsoli, 2018; Christopoulos and Eleftheriou, 2020). In in low- and middle-income countries (LMICs) hospital care accounts for the highest percentage of government health care expenditure (around 60%) (Pinto et al., 2018). Indeed, a common feature of health systems in LMICs is the underuse of primary care, which results in undue reliance on hospital services to treat illnesses which could have been better prevented or managed through primary care (Medici and Lewis, 2019; Wagstaff et al., 2015). Preventive care can improve health outcomes (Soares, 2007; Cesur et al., 2017; Carrillo and Feres, 2019), but less is known about how it can improve efficiency, which is relevant for a thorough welfare assessment.

We study efficiency gains from a supply-side expansion of preventive care using a nation-wide reform in El Salvador that created Community Health Teams (CHTs). CHTs deployed throughout the nation are composed of physicians, nurses and community health workers and provide a portfolio of preventive health services through a combination of outpatient consultations at the primary level, home visits and community outreach activities.[1] The reform also improved the referral system across levels of care, which was inoperative before as it usually is in LMICs (English et al., 2004; Kruk and Freedman, 2008), while leaving unchanged the reporting system of visits and hospitalizations. Drawing on such at-scale reform bolsters the external validity of our study.

We first document the effects of the reform on the expansion and composition of healthcare workers and the supply of preventive care services. To study efficiency, we then estimate the effects of CHTs on the production of two types of services: curative consultations for conditions amenable to healthcare, and hospitalizations for conditions amenable to primary care. We differentiate care for communicable diseases (CDs), due to the salient burden in LMICs, and non-communicable diseases (NCDs), which are growing in importance. By increasing the use of primary care, CHTs can prevent CDs and increase the timely diagnosis of NCDs as well as improve their treatment, decreasing the likelihood of increasing complications, costly hospitalization, and worse health outcomes.

Our empirical strategy exploits the staggered roll-out of CHTs across municipalities between 2010 and 2013.[2] We construct a panel dataset of 254 municipalities that spans between years 2009 and 2018 by combining several sources of detailed, high-quality, and high-frequency microdata from administrative records and census. We use fine-grain consultation data from 4.2 million visits spanning 2009-2018 and 3.9 million hospital records spanning 2005-2018 to measure the number of preventive and curative

[1] CHTs have a long-dated trajectory as a supply-side alternative to provide primary care, showing a recent resurgence in LMICs (Organization et al., 2006; Singh and Sachs, 2013; Das et al., 2013; Kok et al., 2015; Perry et al., 2014; Angwenyi et al., 2018). CHTs have been effective in improving population health. See, for instance, Caldwell (1986), Arends-Kuenning (2001), Bhutta et al. (2010), Rocha and Soares (2010), Salehi-Isfahani et al. (2010), Barham (2012), Joshi and Schultz (2013), Bailey and Goodman-Bacon (2015), Boone et al. (2016), Lassi et al. (2016), Herrera-Almanza and Rosales-Rueda (2020), Bhalotra et al. (2019) and Kose et al. (2022).

[2] Municipalities are the lowest jurisdictional level in El Salvador. An average municipality had 22,000 inhabitants by the 2007 Census.

consultations and hospitalizations (split by type) per municipality-year.

We use the method proposed by Borusyak et al. (2021) to explore dynamics of treatment effects when policies are rolled out at different periods in different areas. Briefly, the method defines groups of municipalities according to the period that they were treated and estimates counterfactuals for each treated group using imputation procedures and relying on untreated units as donors at each point of time.

We show that the expansion of primary healthcare happened through a model focused on task-shifting, and resulted in a more efficient allocation of care.[3] While the main task of CHTs was to supply preventive healthcare, demand-side barriers such as knowledge about benefits, liquidity constraints (e.g. affordable transportation costs) and time-inconsistent preferences (e.g. not willing to sacrifice time today for benefits tomorrow) impose challenges to promoting its adoption in LMICs (Dupas, 2011). We find that CHTs increased preventive consultations by 36% with respect to initial levels. Treatment effects take approximately two years to show and peak at four years since CHTs are implemented. This finding is consistent with capital adjustment costs of installing new health services, which create an initial disruption in need of learning that can result in service delivery lags (Cooper and Haltiwanger, 2006; Celhay et al., 2019). As such, we overcome issues in short-term studies that severely underestimate potential effects of primary care expansion on healthcare efficiency.

The effect of CHTs on curative healthcare is *a priori* ambiguous. On the one hand, greater preventive care could translate into fewer curative consultations, saving resources as the latter tend to be more expensive (*efficiency* effect). On the other hand, we could see an increase in curative visits, particularly in the short run, if the stock of primary care in need is high (*coverage* effect) (Hennessy, 2008; Glazer and McGuire, 2012). We find evidence of both effects, as CHTs decreased curative consultations for CDs (8.5%), while it increased coverage for chronic diseases (18%). Since public clinics usually work under tight capacity constraints, the opportunity costs of using resources for otherwise preventable conditions are high. As such, there are two gains of efficiency from expanding preventive care: one where more preventive care shifts resources within a clinic towards cheaper activities (from curative to more preventive care), but also liberates resources from curative care for CDs towards curative care for NCDs, and so increases the capacity of health units to attend these cases.

Such improvements in case management at the primary level led to reductions in hospitalizations for conditions amenable to primary care after the creation of the CHTs (13.5%). These reductions were mostly driven by fewer cases of CDs requiring inpatient treatment. All these results are robust to several sensitivity checks.

While we lack data to test for causal effects on health outcomes, we find that the expansion of CHTs is associated with a reduction in mortality for causes that are sensible to the expansion of basic primary care, primarily due to preventable CDs. As mentioned above, there is a large and growing literature estimating positive effects of CHTs on health outcomes. Hence, we focus on understanding the mechanisms behind

[3] According to the World Health Organization, 'task-shifting' is a process of delegation whereby tasks are moved, where appropriate, to less-specialized health workers (Campbell and Scott, 2011).

these effects by studying efficiency in the supply of healthcare within a national health system.

Previous work in advanced economies has shown that expanding primary care improves overall health system's efficiency by reducing the use of emergency rooms or hospitalizations for avoidable NCDs (Dafny and Gruber, 2005; Kolstad and Kowalski, 2012; Miller, 2012; Alexander et al., 2019; Pinchbeck, 2019; Ding et al., 2021; Gruber et al., 2022). While these outcomes may be well suited for such contexts, in LMICs the margins of efficiency from preventing curative care of CDs are still large (Dupas, 2011; Kremer and Glennerster, 2011). These curative consultations usually take place in the same primary care facilities, but are more resource-intensive than preventive consultations (e.g., require medication and great medical-staff hours) and are unscheduled, which affects daily time-allocation of physicians within clinics (Hey and Patel, 1983; Courbage and Rey, 2006; Williams et al., 2006; Nuscheler and Roeder, 2016; Wang, 2018; Peter, 2021). In addition, hospitals or ER rooms in LMICs could be unreachable by a portion of the population since its infrastructure is located in urban centers (Thornton, 2008; Kremer and Glennerster, 2011; Adhvaryu and Nyshadham, 2015).

Studying how CHTs can shift resources within primary care units is important to understand efficiency gains in settings were primary care is the only option for most of the population. CHTs can affect the production of health services in primary care both through the volume and the composition of care, i.e. shifting resources from curative care for CDs to curative care for NCDs. Our findings provide much needed evidence for a general welfare assessment of the potential benefits of CHTs and so we contribute to a long-standing debate around health policy approaches centered on promoting competitive markets, creating quasi-markets or public provision of healthcare.

2 Community Health Teams in El Salvador

In El Salvador the network of public health care providers is available for all citizens. Individuals who are not employed in the formal sector or do not receive a contributory pension mainly obtain healthcare through this network. This vulnerable population are not enrolled in a particular insurance program, and often there is not an explicit package of treatments or diagnostic tests to which they are entitled to. The fact that there is no explicit insurance also implies that there is no registry of those entitled to use the public health care network, which in turn allows those with contributory coverage to also use the public health care network, resulting in double coverage. The health expenditure burden over the public health system increased over the years, and the system was highly inequitable as the rural and poorest areas had limited access to health personnel (Espinoza and Barten, 2008). By 2010, the country had 377 primary care units for a population close to 6 million inhabitants.

During the 2000s, primary healthcare in El Salvador was expanded by contracting Non-Governmental Organizations (NGOs) to provide a basic package of health services, focused mostly on maternal and child health services, predominantly curative rather than preventive services. However, care at the primary level was often inadequate and disjointed from higher levels of care (i.e. specialty consultations or

hospitals).

To address these issues, in 2010, El Salvador's Ministry of Health (MoH) reformed its public health system to expand coverage of integrated primary care services. The reform had a strong emphasis on the expansion of preventive care and the horizontal (i.e. across types of healthcare) and vertical (i.e. across levels of healthcare) integration of care.

The reform was centered on the creation of government funded and managed community health teams. These teams were designed to serve the primary care needs of the population within a pre-defined catchment area of approximately 3,000 individuals in rural areas and 9,000 individuals in urban areas. Each rural team was composed of seven members: a physician, a professional nurse, an auxiliary nurse, three community health workers (CHWs, one for every 200 families) and a multipurpose worker. Urban teams had the same composition but had a higher number of CHWs.[4] Guidelines contained job-descriptions for each member of the team and their role in providing the established services according to the risk profile of the population. Within the community health teams, physicians provided consultations with the aid of nurses. CHWs performed community outreach, educational activities, and home visits for follow-up or referral to services.

Community health teams were responsible for delivery of primary care services in a designated geographical catchment area. Teams had a clearly defined portfolio of approximately 300 primary healthcare services which included health education and promotion (e.g. age-appropriate nutrition, sexual and reproductive education), preventive care (e.g. infection prevention and control for seasonal respiratory infections), curative care (e.g. treatment for both CDs and NCDs such as diabetes mellitus and hypertension), and community-based rehabilitation. Horizontal integration occurred at community health teams since they provided both preventive and curative care for the population in their catchment area. Vertical integration also occurred as basic units were the entry point, and a referral system was put in place to link services between levels, including hospital services. The electronic reporting system of visits and hospitalizations in the public health system of El Salvador was well in place and functioning since before this reform, which remained unchanged throughout the period of study.

The government prioritized implementation of CHTs in the country's ninety-eight poorest municipalities. The government's goal was to fully implement the service delivery model in as many of these municipalities as quickly as possible. To this effect, the MoH inventoried the supply side capacity in each municipality in terms of health units, personnel and supplies required to implement the CHTs.

To provide these services, health teams conducted a census of their catchment areas to obtain health and demographic data used to generate a health-risk profile of families and individuals. This risk profile determined the services required by patients according to established guidelines (Ministerio de Salud de El Salvador, 2011). This census represented their kick-off task.

[4] Guidelines stated that one CHW will serve 300 families, hence urban teams had six CHWs, which take into consideration an average family size of 5.

By 2015 there were 747 healthcare units in El Salvador, each staffed by at least one CHTs. By that time, the MoH of El Salvador was the main provider of health services and community health teams helped to increase the coverage of health services. For example, in 2014, the MoH provided around 93% of postnatal care services in rural areas and close to 75% in urban areas (UNICEF, 2014).

3 Data

We construct a balanced panel data set of 254 municipalities by combining several sources of detailed, high-quality, high-frequency administrative microdata and census data.

Our main dependent variables are the number of preventive consultations, curative consultations for conditions amenable to healthcare, and hospitalizations for conditions amenable to *primary* care. We use health records provided by the Ministry of Health of El Salvador, covering all outpatient and inpatient services in the country from the earliest period available in electronic format. We merge these data with population forecasts to express the outcomes per inhabitants.[5]

To measure the outcomes of interest we rely on three main datasets:

- CHTs records: Data on primary healthcare units in operation and personnel (from 377 units in 2009 and 747 in 2015) is available at three points in time: two prior to the introduction of CHTs (2009 and 2010) and one after (2015).[6] The main outcomes we build are number of primary units and human resources by type. By 2009, the average municipality had 5.5 primary healthcare units and nine members of staff per 1,000 inhabitants.

- Health consultations data: Data on outpatient consultations from approximately 4.2 million visits to primary care units spanning 2009-2018 and containing information on the unit providing the service, the reason for the visit classified according to preventive and curative and the main diagnosis ICD-10 codes. The physician or nurse that performed the consultation reports the data to the central government level for digitalization, coding of ICD-10 codes, review and aggregation at the municipality level where the health unit is located.

  The main outcomes we build from this dataset are the number of preventive consultations and curative consultations for conditions amenable to healthcare in a municipality-year. We set the distinction between preventive and curative healthcare following (Alsan et al., 2019), who define the former as care recommended during a state of relatively good health to avoid future illness (e.g. screenings and immunizations), and the latter as needed during a state of illness to restore

[5] Population forecasts come from the 2007 Census and are estimated by the General Directory of Statistics and Census from El Salvador for the years 2005 up to 2025. We also use vital statistics data on the number of deaths per cause (following the ICD-10 code). This data is available for every municipality yearly between 2011 and 2018. The main outcome we build for the analysis in Appendix Table G9 is mortality rates per 1,000 inhabitants for each municipality and year.

[6] We cannot assign personnel to periods in between to specific municipalities in the data provided by the Ministry of Health. This is because in the transition of the Health Reform (2009-2014) personnel were allocated to the region they worked on in the data and not the specific primary unit.

health. While preventive consultations are scheduled, curative consultations are mostly walk-in patients. In our setting, some preventive consultations are routinely made by CHWs at home or as part of outreach activities implemented by health units. By 2009, an average municipality had 508 preventive consultations per 1,000 inhabitants per year.

We identify curative consultations for *conditions amenable to healthcare* following Kruk et al. (2018)'s classification. These are diseases and conditions that can lead to death if untreated, and are avoidable through access to quality healthcare in LMICs.[7] By 2009, an average municipality had per year 1,103 curative consultations amenable to healthcare per 1,000 inhabitants, more than double the number of preventive consultations.

- Hospital discharge data: Data on hospitalizations from approximately 3.9 million hospital discharge records spanning 2005 to 2018. We identify hospitalizations for *conditions amenable to primary care* as the intersection between Kruk et al. (2018)'s list of conditions that can lead to death if untreated and Rodriguez Abrego (2012)'s list of ambulatory care sensitive conditions. The latter are conditions for which effective primary health-care and case management can help prevent inpatient episodes. As such, they are often used in the literature as a measure of the efficiency of primary care (Dafny and Gruber, 2005; Kolstad and Kowalski, 2012; Rosano et al., 2013). Anemia, for instance, is an ambulatory care sensitive condition, but rarely leads to death in LMICs, so it is not included in this outcome.See Appendix G10 for the full list of ambulatory-care sensitive conditions, including the ICD-10 codes, and its intersection with the list of conditions amenable to healthcare. Before the introduction of CHTs, an average municipality had per year 7.4 hospitalizations for conditions amenable to *primary* healthcare per 1,000 inhabitants.

We further classify curative consultations for conditions amenable to healthcare and hospitalizations for conditions amenable to primary care into communicable and non-communicable. Before 2010, NCDs made up only 23% of the curative consultations amenable to healthcare, while later on they increase to 35% in treated municipalities (see Appendix Table G2, columns (1) and (2)). The most common reason for curative visits were common cold from the CDs (22%) and primary hypertension from the NCDs (11%) (see Appendix Table G1, columns (1) and (2)). CDs made up more than half the hospitalizations amenable to primary care and this share dropped slightly after the reform (see Appendix Table G2, columns (3) and (4)). The most common reasons for hospitalizations were gastroenteritis and colitis (26%) from the CDs and type 2 diabetes mellitus (12%) from the NCDs (see Appendix Table G1, columns (3) and (4)).

Finally, we compute an indicator capturing when each municipality started implementing CHTs. We use administrative records of the intervention status of municipalities. We set the year of creation as the year in which municipalities enrolled 5% of their population into the CHTs system using population forecasts based on the 2007 Population Census. We conduct sensitivity checks by setting the year of treatment as

[7] See Appendix G10 for the full list of diseases and conditions amenable to healthcare, including the ICD-10 codes.

the one in which a municipality enrolled 10%, 15% and 20% of their population (see Table G6 in the Appendix) and the results remain robust.

The proxy for enrolment in CHTs that we use is family records collected by these units in their area of influence to obtain health and demographic data, which they used to generate a health-risk profile of families and individuals. This family census was their first task and hence accurately captures the creation of CHTs in a given municipality.

4 Empirical Strategy

The Ministry of Health of Salvador implemented CHTs in 183 municipalities out of a total of 254 in the nation (71 never treated). The implementation across municipalities was staggered, with a rapid expansion of coverage between 2010 and 2013. Out of the treated municipalities, CHTs were implemented in 2010 (T2010) in 41%, in 2011 (T2011) in 52%, in 2012 (T2012) in 4% and in 2013 (T2013) in 3%. The map in Figure 1 illustrates how the roll-out of the community health teams took place by highlighting the calendar year in which municipalities started being treated.

We use an event-study strategy relying on the variation created by the roll-out of the CHTs across municipalities and over time. The 'static' event-study or difference-in-differences (DiD) strategy implemented with two-way fixed effects regressions is denoted by:

$$Y_{jt} = \beta D_{jt} + \phi_j + \lambda_t + \nu_{jt} \tag{1}$$

where Y_{jt} is the outcome of interest in municipality j and calendar year t, and ϕ_j and λ_t are the municipality and calendar year fixed effects respectively (two-way fixed effects). D_{jt} is a binary treatment indicator that takes values equal to one for treated municipalities, after the creation of CHTs, and zero otherwise. We cluster standard errors at the municipal level to deal with serial correlation in the panel data structure.

The fully dynamic specification takes the form:

$$Y_{jt} = \sum_{h=-a}^{b} \tau_h 1[K_{jt} = h] + \phi_j + \lambda_t + \mu_{jt}, \tag{2}$$

where the set of $1[K_{jt} = h]$ are the lead and lag treatment indicator variables tracking the number of years $K_{jt} = t - E_j$ since the year of the CHTs creation for the municipality, E_j, $a \geq 0$ and b ≥ 0 are the numbers of included leads and lags of the event indicator, respectively, and μ_{jt} is the error term. b is chosen such that all possible lags in the sample are covered. This specification also includes yearly pre-trends coefficients, i.e. $a = 3$. Absent pre-trends, the coefficients on the lags are interpreted as the dynamic path of causal effects: at $h = 0, ..., b$ years after the creation of CHTs.

Initial municipal characteristics and the initial level of healthcare services are not predictors of the treatment status of a municipality (see Table 1). There is a small imbalance in the number of hospitalizations due to communicable diseases amenable to primary care across treated and control municipalities (Column (1)). Treated municipalities had 0.001 additional hospitalizations due to these causes, a small magnitude considering that the average initial level is 4.028.

Furthermore, a Cox hazard model reveals that the timing of the creation of CHTs was unrelated to initial demographic characteristics of the municipality's population, the initial availability of inputs for primary healthcare production, as well as the initial level of healthcare services (Column (2)). Although the MoH implemented CHTs giving priority to poorer municipalities (as discussed in Section 2), the actual start of CHTs activities (e.g. enrolling families in their catchment area) was at the same time slower in poorer municipalities. Hence, the net effect of poverty on the timing of the start of CHTs' activities in null. Any imbalance would have been, however, not problematic for the identification strategy as parallel trends in outcomes may still hold once we include municipal fixed effects. Indeed, we fail to reject them with pre-trend tests.

As it has been well documented by now, these traditional DiD (two-way fixed effects) regressions to analyze the effects of interventions with a staggered roll-out do not identify the average treatment effect on the treated; or identify it under very strong assumptions such as homogeneity across groups treated in different points in time ('treatment cohorts', see De Chaisemartin and d'Haultfoeuille (2020); Goodman-Bacon (2021); Sun and Abraham (2021); Callaway and Sant'Anna (2021); Athey and Imbens (2022)).

To address concerns of the composition of treatment cohorts driving treatment effects (and pre-trends), we use the imputation estimator proposed by Borusyak et al. (2021) which is robust to treatment effect heterogeneity.[8] Briefly, Borusyak et al. (2021)'s method defines groups of municipalities according to the period that they were treated and estimates counterfactual outcomes for each treated group. Potential control outcomes $Y_{jt}(0)$ are derived from municipalities that were never treated (28% of total municipalities), and those that were treated later on in each year. The counterfactuals are estimated using imputation procedures at each point of time, which are robust and efficient under heteroskedasticity.

An advantage of this nonparametric event study is that it allows to visually assess the pattern of treatment effects relative to the creation of CHTs. In our main results we test for up to three-year pre-trends, but we also test for up to six-year pre-trends using data at the half-year level and exploiting the availability of hospital records from 2005. These robustness checks are presented and discussed in Section 5.6.

When calculating group-specific average treatment effects by time, we end up with many treatment effect parameters in a "fully dynamic" specification. For ease of interpretation, we take the mean over all point estimates using a linear combination, as suggested by Cunningham (2021).

[8] Borusyak et al. (2021)'s estimator addresses issues raised by alternative estimators and yields the greatest efficiency.

5 The Effects of Community Health Teams

5.1 Changes in Inputs for Primary Healthcare

We start by evaluating how the reform in El Salvador affected the availability of inputs for the production of primary healthcare in municipalities. Using three rounds of data, 2009, 2010 and 2015, we estimate a static DiD model using Equation 1.

The reform improved access to primary care services by increasing the number of primary care units and human resources, in particular nurses and administrative support. Table 2, Panel A, shows that on average primary care units increased by 0.07 units per 1,000 inhabitants in treated municipalities after the creation of CHTs, equivalent to a 3.7% increase from the 2009 mean of never-treated municipalities. Furthermore, the total number of human resources in municipalities increased by 0.21 per 1,000 inhabitants on average (14.6%). This overall increase is mostly driven by an increase in the number of nurses and administrative support (0.07 per 1,000 inhabitants, 26% and and 24% respectively compared to the 2009 mean of never-treated municipalities). There are no statistically significant changes in the number of doctors or CHWs associated with the CHTs creation.

Panel B shows how the reform expanded primary-care services provided by larger multi-disciplinary teams, rather than relying on physicians alone. The composition of human resources changed, with an increase by 1.5 and 1.6 percentage points (ppts) in nurses and administrative support, respectively, and a decrease by 2 ppts in CHWs out of the total human resources for primary healthcare, on average.

The reform expanded the inputs used in the production of primary healthcare and changed the composition of healthcare workers. The findings suggest that CHTs were based on a model that focused on less-specialized health workers and support personnel, which could help lower costs.

To test for pre-trends before the introduction of CHTs, we conduct a placebo test using data from the years 2009 and 2010. We drop municipalities treated in 2010 (T2010) and we estimate a static DiD with an indicator variables that equals to one in 2010 for municipalities treated after 2010. Before the creation of CHTs, we find no significant difference in inputs for primary healthcare production, neither in counts nor in shares, across later-treated (after 2010) and never-treated municipalities (see Appendix Table G3). Furthermore, we replicate the estimations in Table 2 for the sample of municipalities included in the placebo test, and we find that the results remain robust and even slightly higher in magnitude (see Appendix Table G4. This alleviates concerns that the placebo test captures a different composition of municipalities (as we exclude 41% of the treated municipalities) that may not be driving the main results.

5.2 Expansion of Preventive Care

We next evaluate the effect of CHTs on the production of preventive healthcare. Before delving into the analysis, we test for the presence of pre-trends. Figure 2, Panel A, shows that the pre-trend coefficients

are close to zero and are not statistically significant within conventional levels. Table 3 showing the linear combination of all the coefficients estimated for the years prior to the creation of the CHTs confirms that there is a statistically insignificant effect in the pre-treatment years (column (1)).

The creation of CHTs dramatically increased preventive healthcare in municipalities. The effect takes one year to show, it jumps from 37 to 170 additional consultations per 1,000 inhabitants in t+2 and peaks in t+5 at 277 consultations per 1,000 inhabitants. The effect remains high even eight years after the creation.

Table 4 summarizes the dynamic effects in a single coefficient capturing the average treatment effect for every year after the creation of the CHTs, based on Equation 2. Column (1) Panel A shows that, on average, the creation of CHTs increased preventive consultations by 188 per 1,000 inhabitants per municipality and year. This effect is equivalent to a 36% increase in preventive consultations over the pre-treatment mean, and it is significant at the 1% level.

5.3 Efficiency and Coverage Gains in Curative Care

The absence of statistically significant pre-trends in Figure 2, Panel B, and Figure 3, Panels A and B, bolsters our confidence to interpret the imputation estimations as causal effects of the arrival of CHTs on curative care. We confirm this in Table 3 (column (2)), where the average effect in years prior to the creation of CHTs is insignificant and goes in the opposite direction to the estimated post-treatment effect.

We estimate no significant effects on curative consultations amenable to healthcare (see Figure 2, Panel B). The average dynamic effect for up to eight years after the creation of CHTs is a statistically insignificant drop (see Table 4, Panel A, column 2).[9]

We next explore if this null effect is a result of greater coverage offsetting efficiency gains. For this, we distinguish curative consultations that are due to CDs or NCDs amenable to healthcare. There was lower coverage of chronic diseases prior to the creation of the CHTs (855 CD vs. 248 NCD curative consultations per 1,000 inhabitants) and it is arguably more resource-intensive to identify and follow-up on chronic conditions, like diabetes and asthma (Williams et al., 2006; Wang, 2018).

Panels A and B in Figure 3 reveal that indeed the average effect on curative consultations hides meaningful heterogeneity depending on the type of disease. While the creation of CHTs decreased curative consultations for CDs, it increased curative care for NCDs.

In the year CHTs were created, curative consultations for CDs dropped by 36 consultations per 1,000 inhabitants. The magnitude of this negative effect increased to 79 consultations in the fourth year and to 91 consultations after eight years (Figure 3, Panel A). On average, the creation of CHTs decreased curative consultations due to CDs by 73 per 1,000 inhabitants in a municipality-year, equivalent to a 8.5% drop with respect to the pre-treatment mean (Table 4, column (2)).

[9] Figure G9 Panel A in the Appendix shows also a statistically insignificant effect on *total* curative consultations.

At the same time, curative consultations due to NCDs increased immediately by 14 per 1,000 inhabitants, by 35 consultations in the fourth year and to 101 consultations after eight years (Figure 3, Panel B). The creation of CHTs increased curative consultations due to NCDs, on average, by 44.5 per 1,000 inhabitants (18%; Table 4, column (2)).

The absolute gain in efficiency appears greater in magnitude than the gain in coverage, though the overall (negative) net effect is not statistically significant.

5.4 Efficiency Gains in Hospitalizations

Did the expansion of community-based healthcare translate into efficiency gains in the system? To answer this question, we focus on hospitalizations due to conditions amenable to primary care. These are conditions for which effective primary care and case management can help prevent inpatient episodes, and for which poor healthcare quality can result in death.

Figure 2 Panel C confirms the absence of significant pre-trend estimates. Column (3) in Table 3 also confirms that the average effects on amenable hospitalizations were statistically insignificant before the creation of CHTs. Because we have data on hospitalizations since 2005, we also present estimates for up to six-year pre-trends in Section 5.6.

The creation of CHTs decreased hospitalizations amenable to primary care. The effect is an immediate drop by 0.72 hospitalizations per 1,000 inhabitants, which peaks three years later at -0.9 and again eight years later at -1.5 hospitalizations.

The average dynamic effect after the creation of the CHTs is presented in Table 4 (Panel A, column 3) –a drop equivalent to 10% with respect to the pre-treatment mean and statistically significant at the 1% level.[10] This effect reflects the net effect of greater efficiency and coverage in ambulatory curative care. Admissions might have increased as people were screened and referred more frequently for previously unattended health conditions. Yet, extreme cases were avoided through better case management at the primary level.

We evaluate efficiency as done for curative care. Figure 3, Panels C and D, reveal that while the CHTs decreased consistently hospitalizations for CDs, there is only an immediate drop on hospitalizations for NCDs (and only eight years later). In the year CHTs were created, amenable hospitalizations for CDs dropped by 0.4 per 1,000 inhabitants and for NCDs they dropped by 0.32 per 1,000 inhabitants. The magnitude of the negative effect on hospitalizations due to CDs increased to 0.7 hospitalizations in the fourth year and to 0.87 hospitalizations after eight years (Panel C). The average dynamic effect is equivalent to a drop by 13.4% in hospitalizations by CDs with respect to the pre-treatment mean, an effect statistically significant at the 1% level.

[10]Figure G9, Panel B, in the Appendix shows a similar effect on all hospitalizations due to all ambulatory care sensitive conditions, without restricting them to those that can lead to death if untreated. The effect is slightly greater in magnitude, meaning that our main estimates are a lower bound effect on hospitalizations amenable to primary care.

Although negative, the average effect on hospitalizations for NCDs is not statistically significant at conventional levels (see Table 4, column 3). Consistent with the large increase in curative care for NCDs, more of these cases seem to have been resolved through outpatient rather than inpatient care over time.

As a placebo test, we additionally estimate the dynamic effect of the launch of CHTs on hospitalizations caused by external factors, such as injury, poisoning, accidents, assaults and self-harm. Community healthcare should not affect admissions by these unforeseen conditions that require specialized care. In line, we find no statistically significant effect on hospitalizations by external causes (see Figure 2 Panel D).

5.5 Amenable Mortality

Finally, we expect CHTs to have improved health given the increase in preventive care and the coverage gains in curative care. We use data on mortality rates available between 2011 and 2018 and estimate a static DiD model following Equation 1.

Consistent with our previous results, Table G9 in the Appendix shows that mortality caused by CDs amenable to healthcare decreased by 11 deaths per 1,000 inhabitants after the creation of CHTs (Panel A). The point estimate is equivalent to a drop of 25% with respect to the 2011 mean of never-treated municipalities and statistically significant at the 5% level. The estimated association with mortality caused by NCDs amenable to healthcare and with mortality not amenable to healthcare is also negative, but not statistically significant. These latter results are encouraging as CHTs are expected to decrease mortality caused by diseases amenable to the quality of primary healthcare, and that are easy to prevent.

As only 7% of the treated municipalities implemented CHTs after 2011, we are unable to take advantage of the staggered treatment roll-out and test for pre-trends in mortality rates. Hence, we interpret the resulting coefficients with caution. As additional evidence, we compare amenable mortality rates between later-treated (after 2011) and never-treated municipalities in 2011, dropping T2010 and T2011 municipalities. In 2011, before being treated, we find no significant difference in mortality rates across later-treated and never-treated municipalities (Panel B). Additionally, we estimate a DiD static model dropping T2010 and T2011 municipalities in the sample, and we find that the results remain robust. Mortality caused by CDs amenable to healthcare decreased by 12 deaths per 1,000 inhabitants after the creation of CHTs, while there is no significant effect on mortality rates caused by NCDs and diseases and complications that are not amenable to primary care (Panel C).

5.6 Additional tests

All our estimated effects on preventive and curative consultations and hospitalizations are robust to sensitivity checks in which we set the year of treatment as the one in which a CHTs enrolled 10%, 15% and 20% of the municipality's population (see Table G6 in the Appendix). Throughout the different

specifications, the estimates effects remain highly significant. The magnitude of coefficients, if anything, increases slightly when the creation year is set when a higher percentage of the population was enrolled, suggesting that our main estimates are conservative.

We additionally estimate the static DiD effects following Equation 1. We show in Table in the Appendix that the results remain robust. The magnitude of the coefficients of the effects on preventive and curative visits are slightly lower in magnitude than when using the imputation method of Borusyak et al. (2021). This could be due to downward bias induced by the heterogeneity across treated cohorts (based on timing of creation), and because the effects seem to increase over time when looking at dynamic effects.

Furthermore, we compare the results obtained with the imputation estimator of Borusyak et al. (2021) to the alternative estimators of De Chaisemartin and d'Haultfoeuille (2020) (DCHF), Sun and Abraham (2021) (SA), and Callaway and Sant'Anna (2021) (CS) that are also robust to treatment cohort heterogeneity (see Figures G1, G2 and G3 in the Appendix). The results validate the main findings based on the imputation estimator, as the point estimates are very similar. These estimations alleviate concerns that the estimated effects are driven by differences in the composition of treatment cohorts. We can also observe in-sample efficiency gains from the imputation estimator (comparing the lengths of the confidence intervals) in the post-reform period, particularly in the longer-run.

Due to the availability of more rounds of hospitalization records before the creation of CHTs (from 2005 onwards), we are able to test for more pre-trends in these outcomes. Figures G4 and G5 in the Appendix show that there are no significant pre-trends when estimating up to six-year pre-trends and when using the alternative estimators of DCHF, SA and CS. For amenable hospitalizations by NCDs, DCHF, SA and CS all yield insignificant pre-trend coefficients. The imputation estimator yields significant coefficients for this outcome, but in the opposite direction of the post-treatment effects. All estimators yield a significant drop in amenable hospitalizations by NCDs in the year of the creation of CHTs.

To study further the pre-patterns, we also exploit the availability of healthcare utilization data at semi-annual level. The positive side of using semi-annual data is that we get more variation on the roll-out of the CHTs and we can test for longer pre-trends. 41% of treated districts were treated in the first half of 2011, 43% in the second half, 9% in the first half of 2012 and 1.6% in the second half, 2.7% in the first half of 2013 and 1.6% in the second half (Figure G6 in the Appendix shows the hazard plots for the event "Creation of CHTs" comparing half-yearly and yearly data). The negative side of using this finer timing is that the data is more noisy, mostly for rare events like hospitalizations. Figures G7 and G8 in the Appendix replicate Figures 2 and 3, respectively, using half-year data. We are able to rule out up to six-year pre-trends for all outcomes. We only find a significant effect in t–2 and t–5 for curative consultations due to CDs (in the opposite direction of the post-treatment effect) and a significant drop in t–1 for amenable hospitalizations caused by CDs, but the average effect of the pre-intervention period is insignificant. This is confirmed in Table G7 showing no significant average pre-trend coefficient for any outcome when using the semi-annual data. The average dynamic post-treatment effects remain robust (see Table G8 in the Appendix).

5.7 Discussion

In this section, we discuss the cost-effectiveness of introducing CHTs, for which we undertake some back-of-the-envelope calculations. We focus on monetizing hospitalization gains because the overall effect on curative care is zero, as coverage and efficiency gains offset each other. We use data on hospitalization costs from the MoH of El Salvador and reports from the CHTs implementation.

We first calculate how much an average municipality saved from the reduction in hospitalizations for cases amenable to primary healthcare per year. Using the coefficient of the effect on these hospitalizations of -0.80 per 1,000 inhabitants and per year per municipality (Table 4, Panel A, column 3), and considering the cost per hospitalization of USD 772.70, we estimate a saving per year and municipality equivalent to USD 615,841.90.[11]

Next we identify how costly are CHTs for an average municipality per year. The cost of running a CHT per year is USD 45,654.47. Considering that there are on average 1.4 primary units per municipality (see Table 2), the total cost is USD 63,916.26 per year and municipality.

This calculation suggests that the introduction of CHTs in Salvador was highly cost-effective. Per USD 1 invested in CHTs, El Salvador saved USD 10 in hospitalizations for conditions avoidable through primary care. This calculation is of course a lower bound, as we are not monetizing gains in total hospitalizations (the effect is -1.1 hospitalizations as shown in Figure G9 in the Appendix), curative care and the health status of the population (as suggested by Table G9 in the Appendix).

6 Conclusions

We analyze how the expansion of preventive healthcare enables a more efficient allocation of care by using the creation of community health teams in El Salvador. Access to preventive care can improve efficiency by reducing utilization of more expensive services as it usually consists in routine care, such as medical check-ups, immunization, screening, and health counseling.

We show that CHTs affect the production of curative care within the health system in three ways. First, more preventive care reduces curative visits related to preventable CDs (e.g., diarrhea, respiratory infections). Secondly, this effect releases resources to provide curative care for other types of condition (i.e. NCDs). Lastly, clinics decrease production of inpatient services for conditions that are amenable to primary care. In settings were clinics work under tight capacity constraints, these effects can be large. Our results show that each preventive visit generated by the reform translated into a reduction of 0.39 curative visits for CDs and 0.24 additional curative visits for NCDs once we adjust the production of health services by population size. Furthermore, a back-of-the-envelope calculation suggests that for every USD 1 invested in CHTs, El Salvador saved USD 10 in hospitalization expenditures for conditions

[11] The estimate of cost per hospitalization in El Salvador is obtained from (Ministry of Health of El Salvador, 2015).

avoidable through primary care.

We contribute to the debate on models of health provision by showing that publicly provided preventive health can be generate high returns. The literature on community-based healthcare interventions is inconclusive as to their effectiveness (Singh and Sachs, 2013; Das et al., 2013; Gilmore and McAuliffe, 2013; Adhvaryu and Nyshadham, 2015). We show that an intervention at scale can be effective at improving access to primary care and decreasing the incidence of critical episodes and preventable deaths.

In addition, while experimental studies provide evidence on the principles underlying the efficacy of demand and supply side interventions for improving health outcomes (Kremer and Miguel, 2007; Madajewicz et al., 2007; Ahuja et al., 2010; Dupas et al., 2014), there is little evidence on the effectiveness of large-scale interventions delivered by national governments on health outcomes in poor-resource settings (Dupas, 2011).

Improving the quality of healthcare is a global challenge that is particularly salient in the poorest and hardest to reach areas in low and middle-income countries. Achieving Sustainable Development Goal (SDGs) of "good health and wellbeing at all ages" by 2030, requires interventions that are effective at scale. Multidisciplinary community health teams have emerged as one of the most effective strategies to address human resources for health shortages, but little is known about their effectiveness once provided nationwide. In this study we provide evidence that these strategies can have large positive consequences for efficiency and population health.

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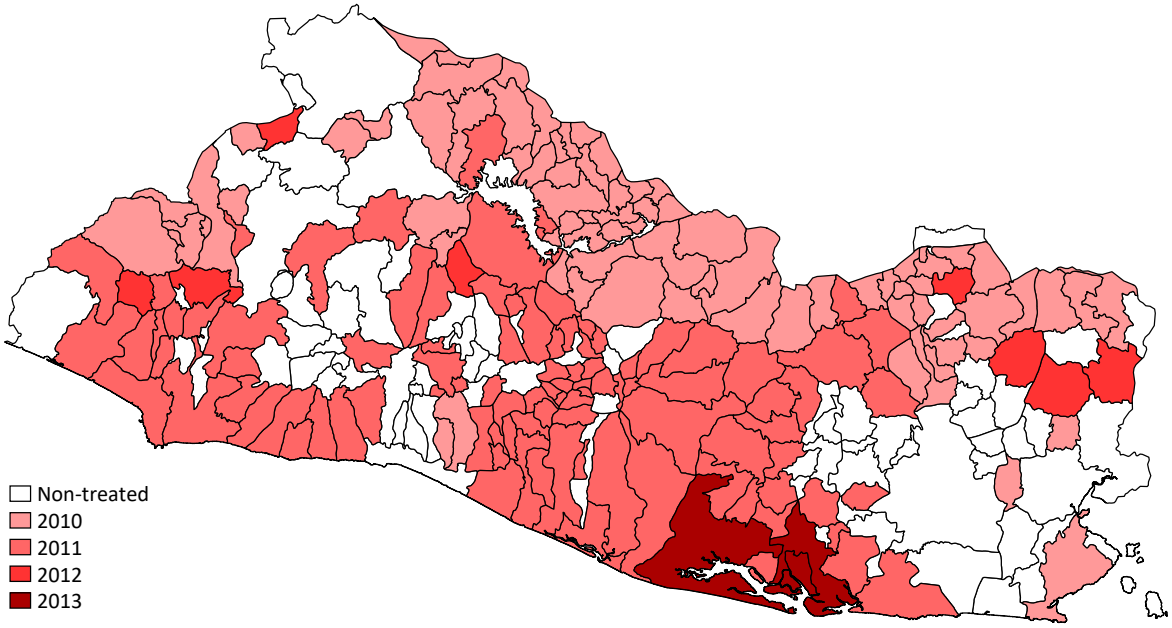
Figure 1: Spatial Distribution of CHTs' creation in El Salvador



Notes: This map shows the date in which community health teams were created, proxied by the year in which municipalities enrolled at least 5% of its population.

Table 1: Treatment status and timing to start CHTs

	Status OLS (1)	**Timing** Cox hazard model (2)
Demographic characteristics		
% Rural population	0.121	0.510
	(0.182)	(0.550)
Total population (ln)	-0.101	-0.365
	(0.081)	(0.242)
% Pop in poverty	0.806	-2.348
	(0.827)	(2.851)
% Pop in extreme poverty	0.385	5.677
	(1.097)	(3.916)
Inputs for primary healthcare production		
Primary units	-0.421	-0.386
	(0.305)	(0.870)
Total HR	0.059	-0.244
	(0.116)	(0.302)
Doctors	0.208	0.499
	(0.137)	(0.467)
Nurses	-0.099	0.512
	(0.141)	(0.474)
CHWs	0.137	-0.145
	(0.146)	(0.390)
Admin	-0.010	-0.014
	(0.211)	(0.584)
Outcomes		
Preventive consultations	0.000	0.000
	(0.000)	(0.000)
Curative consultations CDs	-0.000	0.000
	(0.000)	(0.000)
Curative consultations NCDs	0.000	-0.000
	(0.000)	(0.000)
Hospitalizations CDs	0.001**	-0.003
	(0.001)	(0.002)
Hospitalizations NCDs	-0.001	0.003
	(0.001)	(0.003)
Observations	250	184

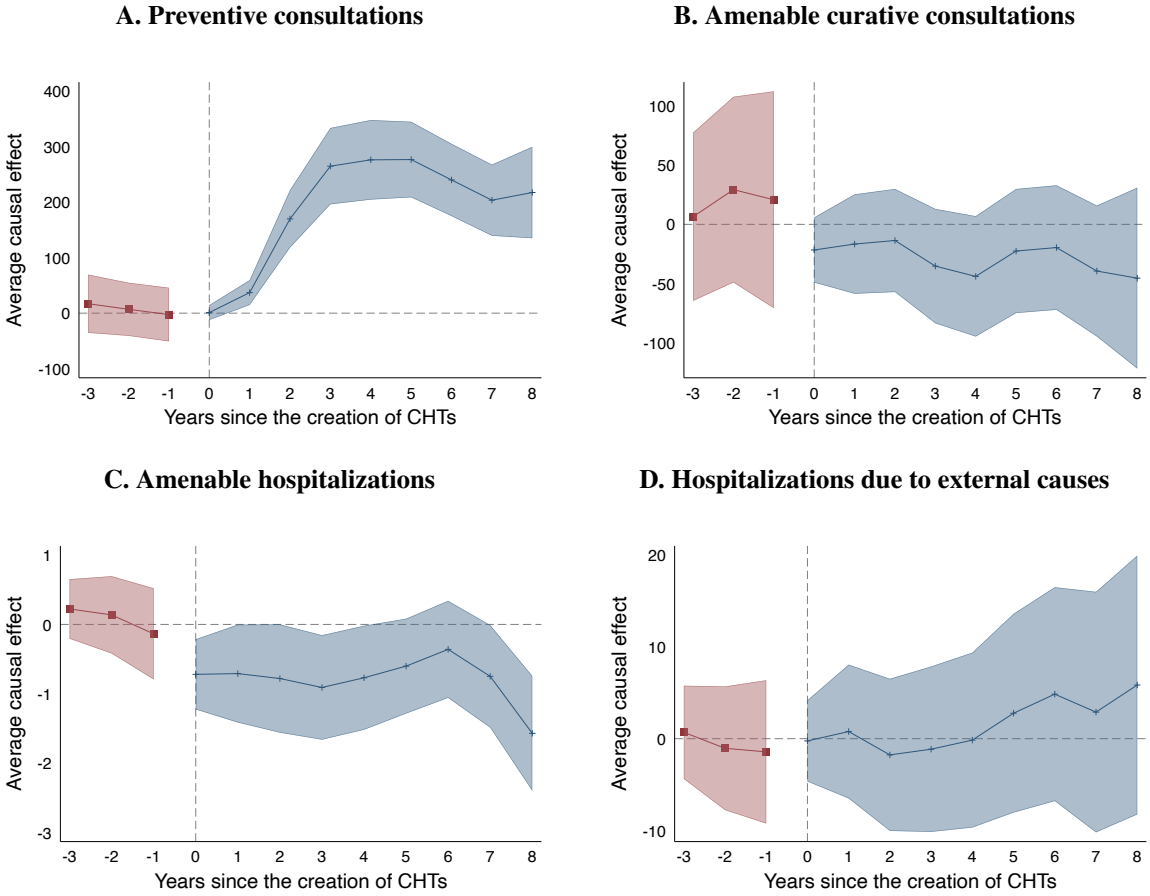
Note. Demographic characteristics are from the 2007 census, inputs for primary healthcare production are from 2009, and outcomes are the average of half-year observations in 2009 for consultations and 2005-2009 for hospitalizations. Column (1) shows coefficients of an OLS regression of being treated over initial characteristics. Column (2) shows coefficients of a Cox regression of timing until the start of CHTs. Standard errors are reported in parentheses. Statistical significance denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 2: Inputs for Primary Healthcare Production

	(1) Primary units	(2) Total	(3) Doctors	(4) Nurses	(5) CHWs	(6) Admin
Panel A: Count						
CHTs creation	0.064	0.209	0.027	0.074	0.046	0.068
	(0.009)	(0.078)	(0.021)	(0.022)	(0.030)	(0.022)
	[0.000]	[0.008]	[0.203]	[0.001]	[0.129]	[0.002]
2009 control mean	1.758	1.434	0.185	0.287	0.399	0.282
Panel B: Share						
CHTs creation			0.002	0.015	-0.020	0.016
			(0.006)	(0.005)	(0.007)	(0.005)
			[0.718]	[0.004]	[0.007]	[0.001]
2009 control mean			0.135	0.203	0.262	0.193
Muni-year	729	729	729	729	729	729
Municipality	250	250	250	250	250	250

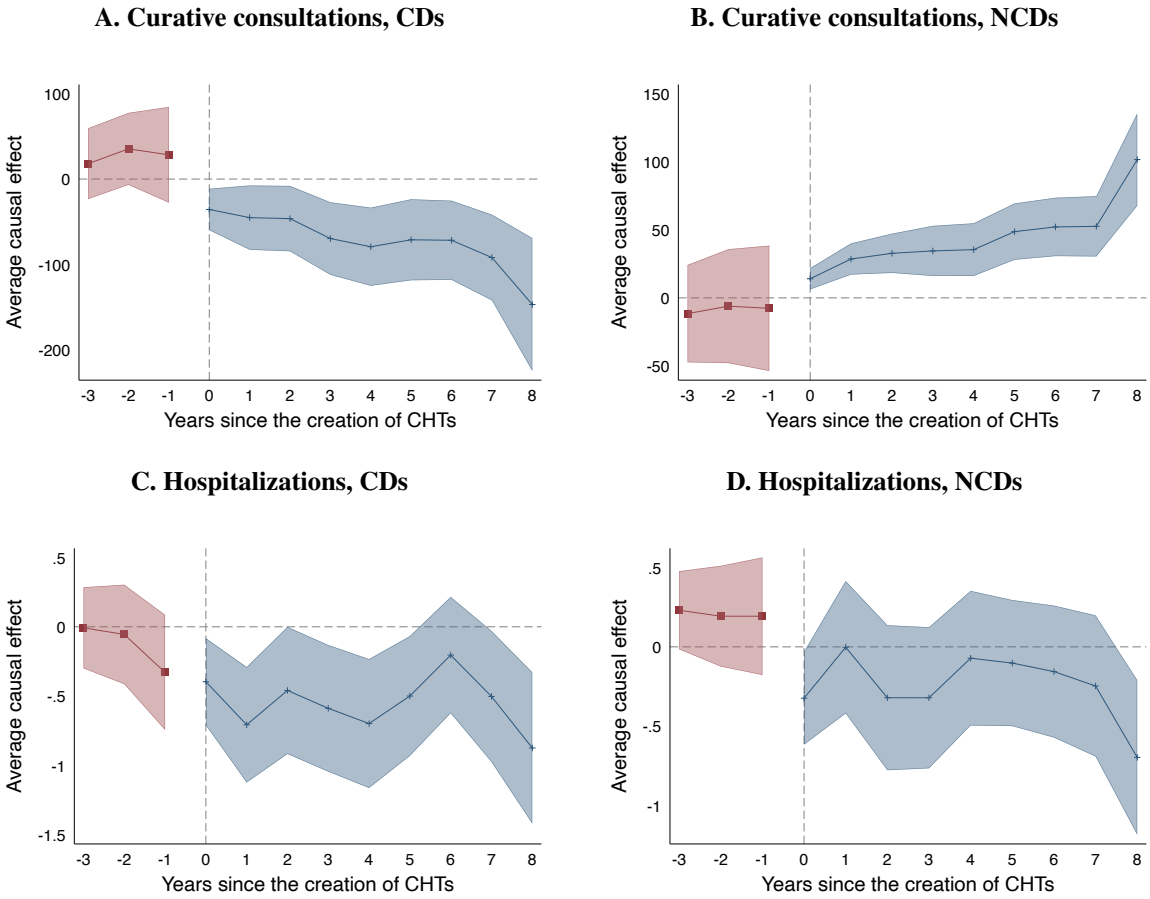
Notes: Estimated coefficients from an linear regressions of the dependent variable on a binary treatment indicator that takes values equal to one for treated municipalities, after the creation of CHTs (i.e. enrolled at least 5% of its population), and zero otherwise, following Equation 1. Dependent variables by column: (1) *Primary units*: number of primary care units per 1,000 inhabitants; (2) *Total*: number of total human resources in primary care units, per 1,000 inhabitants; (3) *Doctors*: number of doctors in primary care units per 1,000 inhabitants in Panel A and share of doctors out of total HR in Panel B; (4) *Nurses*: number of nurses in primary care units per 1,000 inhabitants in Panel A and share of nurses out of total HR in Panel B; (5) *CHWs*: number of community health workers in primary care units per 1,000 inhabitants in Panel A and share of CHWs out of total HR in Panel B; (6) *Admin*: number of administrative support in primary care units per 1,000 inhabitants in Panel A and share of support out of total HR in Panel B. We include municipality and year fixed effects in all estimations. Only three time periods are included in the data: 2009, 2010 and 2015. Outcome values are missing for four municipalities included in the main analysis. Standard errors clustered by municipality in parentheses and p-values in brackets.

Figure 2: Consultations and Hospitalizations



Notes: Coefficients from the fully dynamic specification following Equation 2 and estimated using the imputation estimator developed by Borusyak et al. (2021). The y-axis shows the average treatment effects and the x-axis the year relative to the creation of the CHTs. Dependent variables by panel: (A) *Preventive consultations*: total consultations for preventive care; (B) *Amenable curative consultations*: total curative consultations due to conditions amenable to healthcare; (C) *Amenable hospitalizations*: total hospital discharges due to a condition amenable to primary care as the main diagnosis; and (D) *Hospitalizations due to external causes*: total hospital discharges due to accidents and circumstances as the cause of environmental events and circumstances as the cause of injury, poisoning and other adverse effects. All outcomes are measured per 1,000 inhabitants. Confidence intervals at the 95% level.

Figure 3: Curative Consultations and Hospitalizations by Disease Type



Notes: Coefficients from the fully dynamic specification following Equation 2 and estimated using the imputation estimator developed by Borusyak et al. (2021). The y-axis shows the average treatment effects and the x-axis the year relative to the creation of the CHTs. Dependent variables by panel: (A) *Curative consultations, CDs*: total consultations for curative care due to a communicable disease amenable to healthcare; (B) *Curative consultations, NCDs*: total consultations for curative care due to a non-communicable disease amenable to healthcare; (C) *Hospitalizations, CDs*: total hospital discharges due to a communicable disease amenable to primary care; (D) *Hospitalizations, NCDs*: total hospital discharges due to a non-communicable disease amenable to primary care. All outcomes are measured per 1,000 inhabitants. Confidence intervals at the 95% level.

Table 3: Pre-treatment Effects on Consultations and Hospitalizations

	(1) Preventive consultations	(2) Curative consultations amenable to healthcare	(3) Hospitalizations amenable to primary care
Panel A: Total			
CHTs creation	7.168	18.798	0.075
	(23.918)	(34.897)	(0.242)
	[0.764]	[0.590]	[0.756]
Pre-treatment mean	508.027	1103.591	7.405
Panel B. Communicable diseases			
CHTs creation		27.254	-0.131
		(19.165)	(0.152)
		[0.155]	[0.390]
Pre-treatment mean		855.161	4.028
Panel C. Non-communicable diseases			
CHTs creation		-8.455	0.206
		(18.180)	(0.141)
		[0.642]	[0.145]
Pre-treatment mean		248.430	3.377
Muni-year		2540	3556
Municipality		254	254

Notes: Estimates correspond to a linear combination of the pre-trend coefficients estimates in Figures 2 and 3 for each corresponding outcome following Equation 2 and using Borusyak et al. (2021)'s methodology. Dependent variables as presented in Table 4, all measured per 1,000 inhabitants.

Table 4: Consultations and Hospitalizations, Total and by Type

	(1) Preventive consultations	(2) Curative consultations amenable to healthcare	(3) Hospitalizations amenable to primary care
Panel A: Total			
CHTs creation	187.560	-28.602	-0.797
	(24.747)	(22.897)	(0.307)
	[0.000]	[0.212]	[0.010]
Pre-treatment mean	508.027	1103.591	7.405
Panel B. Communicable diseases			
CHTs creation		-73.059	-0.547
		(21.276)	(0.179)
		[0.001]	[0.002]
Pre-treatment mean		855.161	4.028
Panel C. Non-communicable diseases			
CHTs creation		44.457	-0.249
		(8.559)	(0.169)
		[0.000]	[0.141]
Pre-treatment mean		248.430	3.377
Muni-year		2540	3556
Municipality		254	254

Notes: Estimates correspond to a linear combination of the average treatment effects estimates in Figures 2 and 3 for each corresponding outcome following Equation 2 and using Borusyak et al. (2021)'s imputation estimator. Dependent variables by panel and column: (A.1) *Preventive consultations*: total consultations for preventive care; (A.2) *Curative consultations*: total curative consultations for conditions amenable to healthcare; and (A.3) *Hospitalizations*: total hospital discharges with a condition amenable to primary care as the main diagnosis; (B.2) *Curative consultations, communicable*: total consultations for curative care due to a communicable disease amenable to healthcare; (B.3) *Hospitalizations, communicable*: total hospital discharges due to a communicable disease amenable to primary care; (C.2) *Curative consultations, non-communicable*: total consultations for curative care due to a non-communicable disease amenable to healthcare; (C.3) *Hospitalizations, non-communicable*: total hospital discharges due to a non-communicable disease amenable to primary care. All outcomes are measured per 1,000 inhabitants. Standard errors clustered by municipality in parentheses and p-values in brackets.

7 Appendix

Table G1: Descriptive Statistics by Type of Disease (most common ICD-10 codes)

		Curative consultations		Hospitalizations	
		(1)	(2)	(3)	(4)
ICD-10	**Description**	**Pre-treatment mean**	**%**	**Pre-treatment mean**	**%**
Communicable diseases					
A04	Other bacterial intestinal infections			0.13	1.82
A06	Amoebiasis	19.64	1.92	0.24	3.32
A08	Viral and other specified intestinal infections			0.20	2.67
A09	Other gastroenteritis and colitis of infectious and unspecified origin	48.80	4.76	1.91	26.01
B35	Dermatophytosis	22.67	2.21		
B82	Unspecified intestinal parasitism	43.47	4.24		
J00	Acute nasopharyngitis [common cold]	233.78	22.82	0.08	1.14
J02	Acute pharyngitis	133.40	13.02		
J06	Acute upper respiratory infections of multiple and unspecified sites	143.68	14.03	0.10	1.36
J15	Bacterial pneumonia, not elsewhere classified			0.18	2.40
J18	Pneumonia, organism unspecified	14.57	1.42	0.07	0.93
J20	Acute bronchitis	24.75	2.42	0.33	4.44
J21	Acute bronchiolitis			0.32	4.35
J30	Vasomotor and allergic rhinitis	18.69	1.82		
Non-communicable diseases					
E11	Type 2 diabetes mellitus	24.62	2.40	0.90	12.18
E14	Unspecified diabetes mellitus	18.02	1.76	0.15	2.01
G40	Epilepsy	11.55	1.13	0.30	4.05
I10	Essential (primary) hypertension	121.14	11.83	0.49	6.65
I11	Hypertensive heart disease			0.06	0.87
I15	Secondary hypertension	4.33	0.42		
I64	Stroke, not specified as haemorrhage or infarction			0.09	1.24
I67	Other cerebrovascular diseases			0.12	1.60
J40	Bronchitis, not specified as acute or chronic	5.58	0.54		
J44	Other chronic obstructive pulmonary disease	3.60	0.35	0.36	4.86
J45	Asthma	18.32	1.79	0.63	8.54
J46	Status asthmaticus			0.07	0.90
K40	Inguinal hernia	2.96	0.29		
K80	Cholelithiasis	2.90	0.28		

Note: Columns (1) and (3) report the municipality average by the ten most common ICD-10 codes in the pre-treatment period across municipalities. Columns (1) and (3) show the mean for each condition and (2) and (4) show the mean as a percentage of the overall mean for each outcome.

Table G2: Descriptive Statistics by Type of Disease

	All		Treated	
	(1) Pre-treatment	(2) Post-treatment	(3) Pre-treatment	(4) Post-treatment
Total curative consultations	1932.88	1790.8	2074.34	1945.02
Curative consultations amenable to health-care	1024.71	844.16	1103.59	916.14
- Communicable diseases %	.77	.65	.78	.65
- Non-communicable diseases %	.23	.35	.22	.35
Total hospitalizations	10.92	12.93	11.03	12.8
Hospitalizations amenable to primary care	7.32	8.64	7.41	8.58
- Communicable diseases %	.53	.48	.54	.49
- Non-communicable diseases %	.47	.52	.46	.51

Note: Post treatment period is 2010-2018.

Table G3: Placebo for Inputs for Primary Healthcare Production, Excluding T2010

	(1) Primary units	(2) Total	(3) Doctors	(4) Nurses	(5) CHWs	(6) Admin
Panel A: Count						
CHTs creation	0.000	-0.006	-0.003	-0.001	-0.003	-0.000
	(0.001)	(0.020)	(0.004)	(0.003)	(0.005)	(0.003)
	[0.949]	[0.748]	[0.426]	[0.747]	[0.582]	[0.965]
2009 control mean	1.758	1.434	0.185	0.287	0.399	0.282
Panel B: Share						
CHTs creation			-0.000	0.000	-0.001	0.000
			(0.000)	(0.000)	(0.001)	(0.000)
			[0.319]	[0.353]	[0.319]	[0.319]
2009 control mean			0.135	0.203	0.262	0.193
Muni-year	329	329	329	329	329	329
Municipality	165	165	165	165	165	165

Notes: Same notes as Table 2. Coefficients correspond to estimates of the effect of "CHTs creation' using equation (1). "CHTs creation" is an indicator variable that equals to one in 2010 for municipalities treated after 2010 as a placebo test. Analysis excludes the cohort of municipalities treated in 2010 (T2010). Sample includes the years 2009 and 2010.

Table G4: Inputs for Primary Healthcare Production, Excluding T2010

	(1) Primary units	(2) Total	(3) Doctors	(4) Nurses	(5) CHWs	(6) Admin
Panel A: Count						
CHTs creation	0.140	0.581	0.043	0.179	0.186	0.173
	(0.015)	(0.141)	(0.040)	(0.039)	(0.047)	(0.039)
	[0.000]	[0.000]	[0.287]	[0.000]	[0.000]	[0.000]
2009 control mean	1.758	1.434	0.185	0.287	0.399	0.282
Panel B: Share						
CHTs creation			-0.002	0.025	-0.027	0.031
			(0.011)	(0.010)	(0.014)	(0.010)
			[0.849]	[0.009]	[0.049]	[0.001]
2009 control mean			0.135	0.203	0.262	0.193
Muni-year	494	494	494	494	494	494
Municipality	165	165	165	165	165	165

Notes: Same Notes as Table 2. Analysis excludes the cohort of municipalities treated in 2010 (T2010). Sample includes the years 2009, 2010 and 2015.

Table G5: Static DiD - Consultations and Hospitalizations, Total and by Type

	(1) Preventive consultations	(2) Curative	(3) ACSC Hospitalizations
Panel A: Total			
CHTs creation	72.273	-25.020	-0.747
	(21.882)	(17.899)	(0.279)
	[0.001]	[0.163]	[0.008]
Mean (pre-start)	543.683	778.064	7.885
Panel B. Communicable diseases			
CHTs creation	72.273	-31.355	-0.486
	(21.882)	(14.644)	(0.165)
	[0.001]	[0.033]	[0.004]
Mean (pre-start)	543.683	551.083	3.987
Panel C. Non-communicable diseases			
CHTs creation	72.273	6.336	-0.261
	(21.882)	(7.271)	(0.152)
	[0.001]	[0.384]	[0.088]
Mean (pre-start)	543.683	226.981	3.898
Observations	2540	2540	3556
Municipalities	254	254	254

Notes: Same notes as Table 4. Coefficients correspond to estimates of the effect of "CHTs creation' using equation (1). "CHTs creation" is an indicator variable that equals to one from the first year in which CHTs start operations in a municipality.

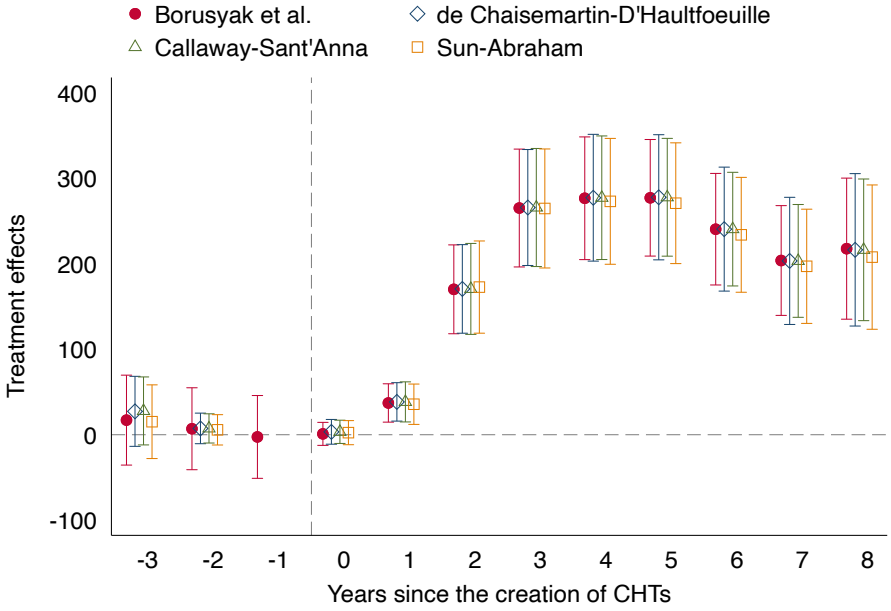
Table G6: Sensitivity Analysis by Year of CHTS creation

	(1) Preventive consultations	(2) Curative consultations amenable to healthcare	(3) Hospitalizations amenable to primary care
Panel A: Total			
CHTs creation 5%	187.560	-28.602	-0.797
	(24.747)	(22.897)	(0.307)
	[0.000]	[0.212]	[0.010]
Pre-treatment mean 5%	508.027	1103.591	7.405
Municipalities treated 5%	186	186	186
CHTs creation 10%	199.963	-28.108	-0.654
	(24.783)	(22.768)	(0.300)
	[0.000]	[0.217]	[0.029]
Pre-treatment mean 10%	512.954	1108.112	7.354
Municipalities treated 10%	180	180	180
CHTs creation 15%	216.138	-31.777	-0.583
	(24.602)	(22.545)	(0.291)
	[0.000]	[0.159]	[0.046]
Pre-treatment mean 15%	520.016	1120.244	7.260
Municipalities treated 15%	172	172	172
CHTs creation 20%	230.593	-31.948	-0.553
	(24.561)	(22.931)	(0.278)
	[0.000]	[0.164]	[0.046]
Pre-treatment mean 20%	527.817	1137.374	7.332
Municipalities treated 20%	163	163	163
Panel B. Communicable diseases			
CHTs creation 5%		-73.059	-0.547
		(21.276)	(0.179)
		[0.001]	[0.002]
Pre-treatment mean 5%		855.161	4.028
Municipalities treated 5%		186	186
CHTs creation 10%		-74.578	-0.473
		(21.324)	(0.175)
		[0.000]	[0.007]
Pre-treatment mean 10%		859.704	4.024
Municipalities treated 10%		180	180
CHTs creation 15%		-78.404	-0.465
		(21.237)	(0.170)
		[0.000]	[0.006]
Pre-treatment mean 15%		870.217	3.983
Municipalities treated 15%		172	172
CHTs creation 20%		-80.559	-0.457
		(21.659)	(0.164)
		[0.000]	[0.005]
Pre-treatment mean 20%		883.946	4.029
Municipalities treated 20%		163	163
Panel C. Non-communicable diseases			
CHTs creation 5%		44.457	-0.249
		(8.559)	(0.169)
		[0.000]	[0.141]
Pre-treatment mean 5%		248.430	3.377
Municipalities treated 5%		186	186
CHTs creation 10%		46.470	-0.181
		(8.415)	(0.166)
		[0.000]	[0.274]
Pre-treatment mean 10%		248.408	3.331
Municipalities treated 10%		180	180
CHTs creation 15%		46.627	-0.118
		(8.356)	(0.161)
		[0.000]	[0.464]
Pre-treatment mean 15%		250.026	3.277
Municipalities treated 15%		172	172
CHTs creation 20%		48.611	-0.096
		(8.378)	(0.154)
		[0.000]	[0.533]
Pre-treatment mean 20%		253.428	3.304
Municipalities treated 20%		163	163

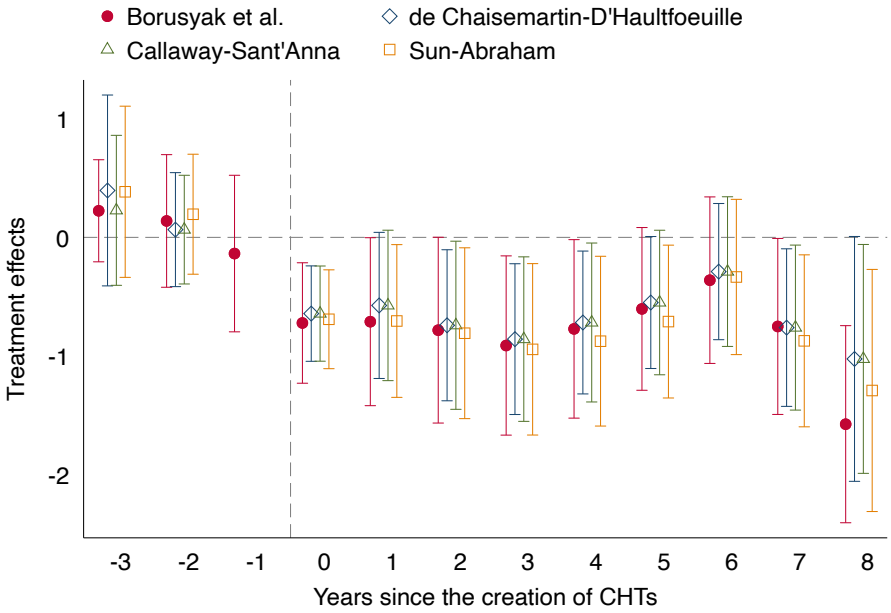
Notes: Same notes as Table 4. In each specification, the year of the creation of CHTs varies depending on the percentage of the municipality's population that health teams enrolled.

Figure G1: Consultations and Hospitalizations, Alternative TWFE Estimators

A. Preventive consultations



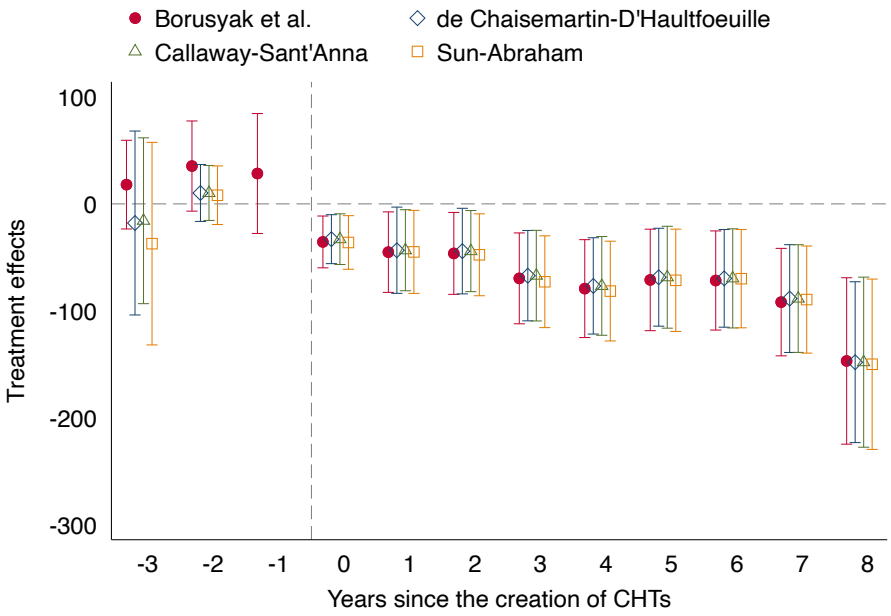
C. Amenable hospitalizations



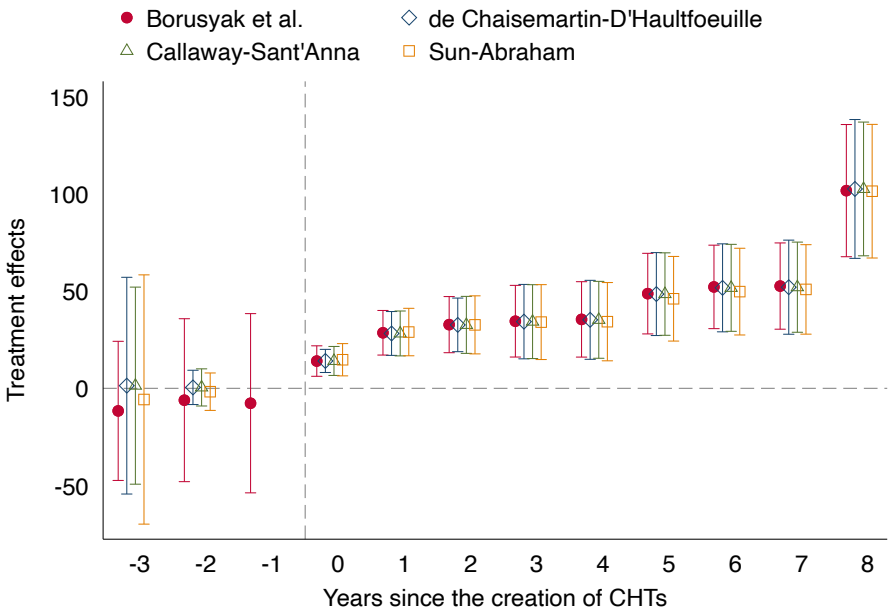
Notes: Same notes as Figure 2. In addition to the imputation estimator of Borusyak et al. (2021), we use three robust estimators: De Chaisemartin and d'Haultfoeuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021).

Figure G2: Curative Consultations by Disease Type, Alternative TWFE Estimators

A. Curative consultations, CDs



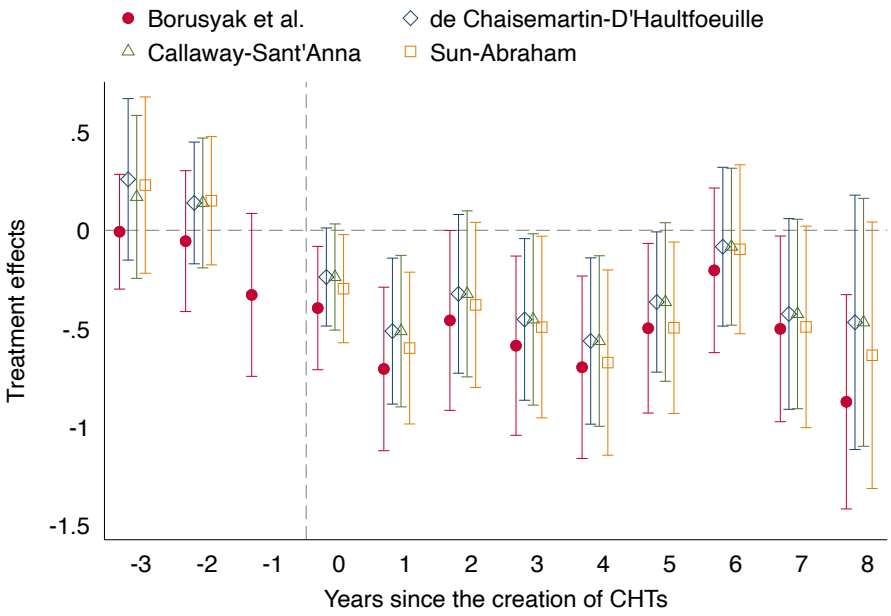
B. Curative consultations, NCDs



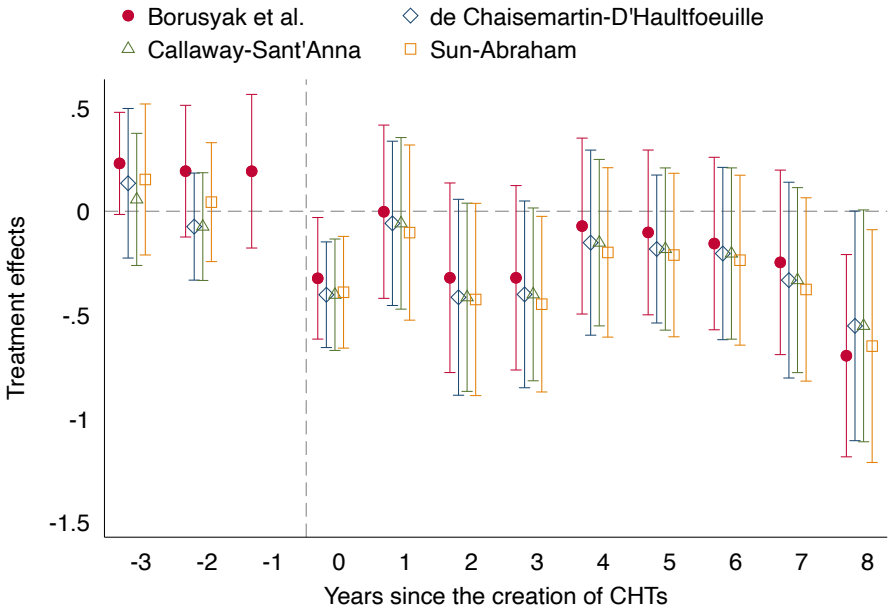
Notes: Same notes as Figure 3. In addition to the imputation estimator of Borusyak et al. (2021), we use three robust estimators: De Chaisemartin and d'Haultfoeuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021).

Figure G3: Hospitalizations by Disease Type, Alternative TWFE Estimators

C. Hospitalizations, CDs

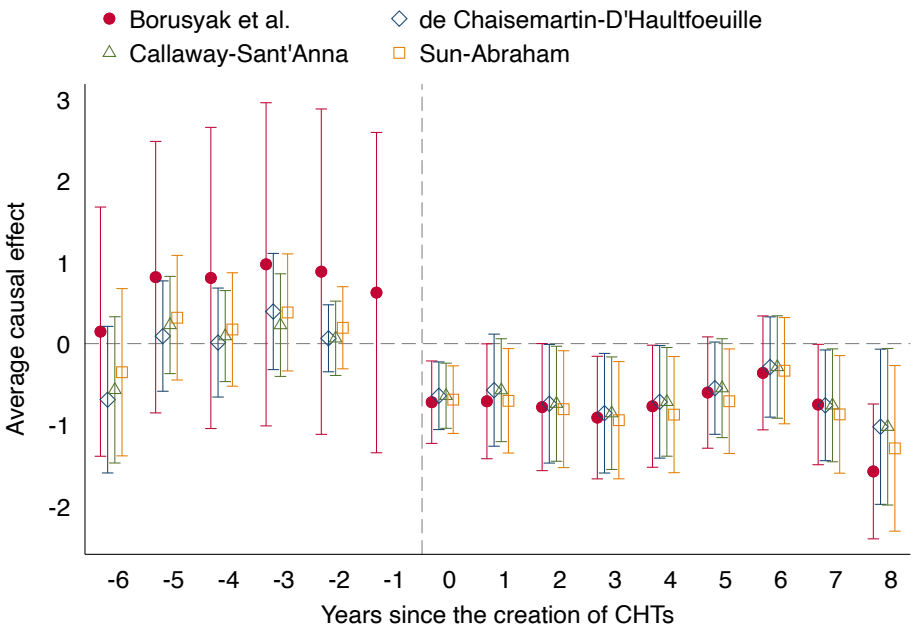


D. Hospitalizations, NCDs



Notes: Same notes as Figure 3. In addition to the imputation estimator of Borusyak et al. (2021), we use three robust estimators: De Chaisemartin and d'Haultfoeuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021).

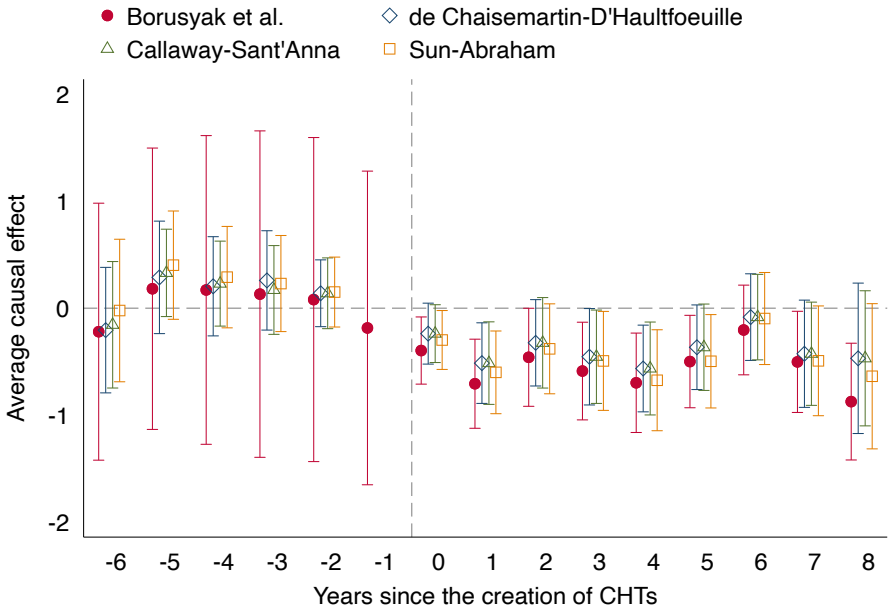
Figure G4: Amenable Hospitalizations, Alternative TWFE Estimators, 6-Year Pre-Trends



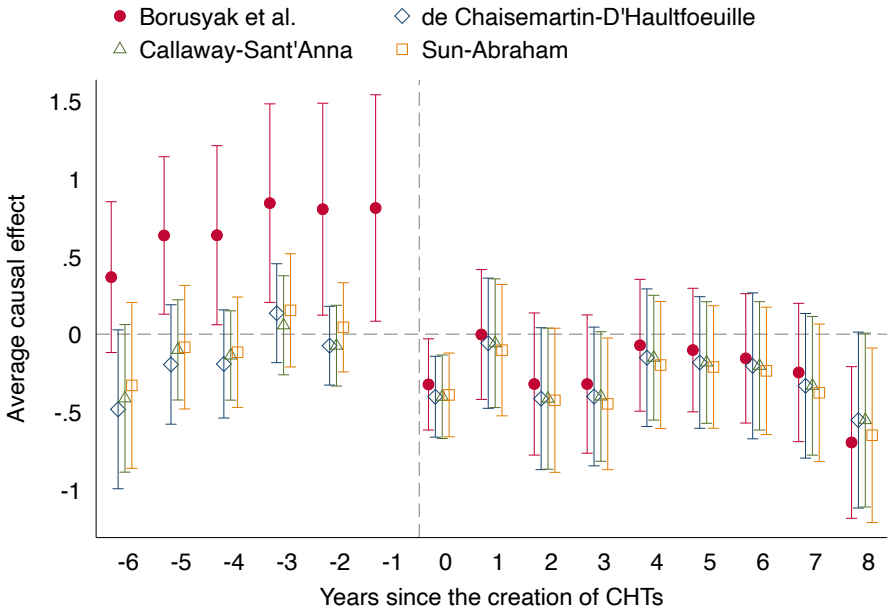
Notes: Same notes as Figure G1.

Figure G5: Hospitalizations by Disease Type, Alternative TWFE Estimators, 6-Year Pre-Trends

C. Hospitalizations, CDs



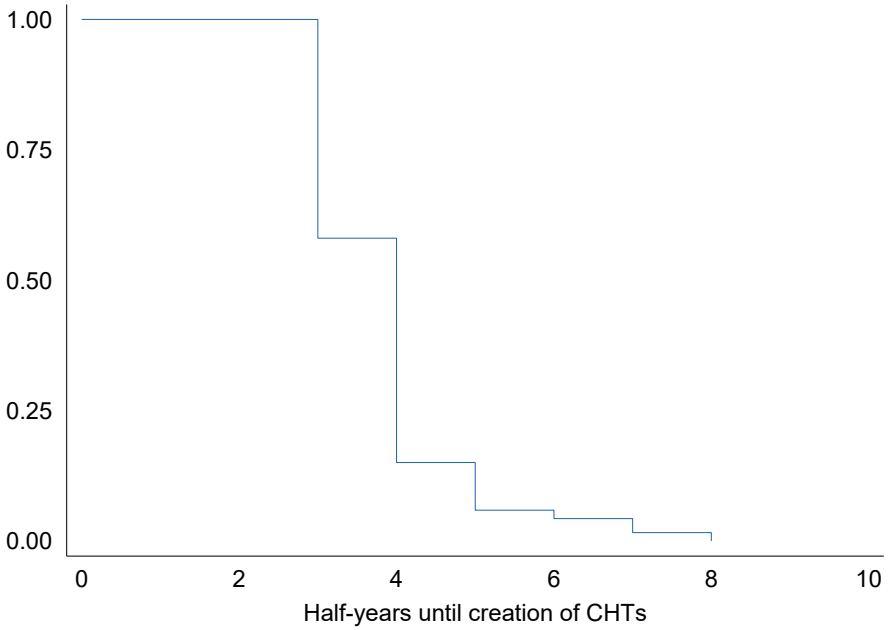
D. Hospitalizations, NCDs



Notes: Same notes as Figure G3.

Figure G6: Hazard plot: Creation of CHTs

A. Half-yearly data



B. Yearly data

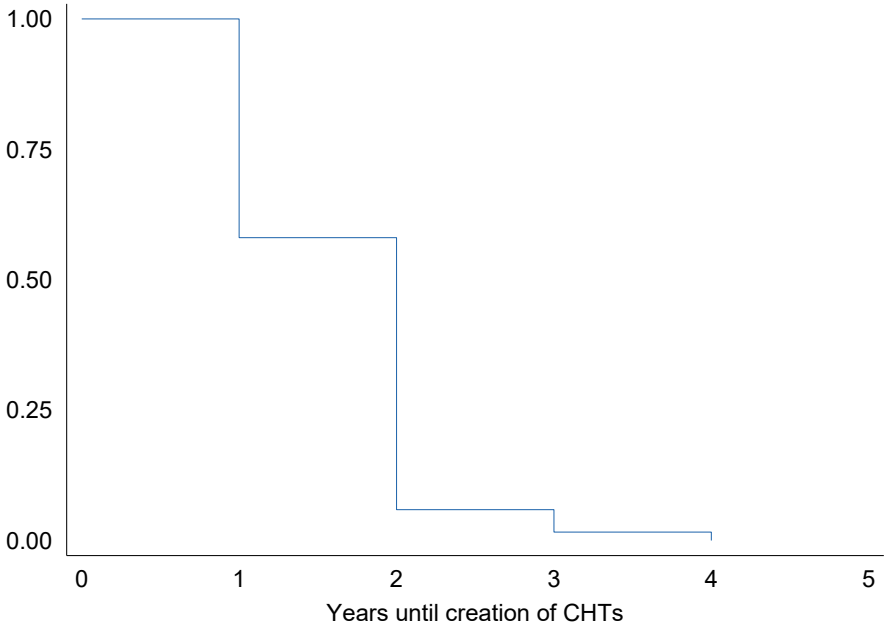
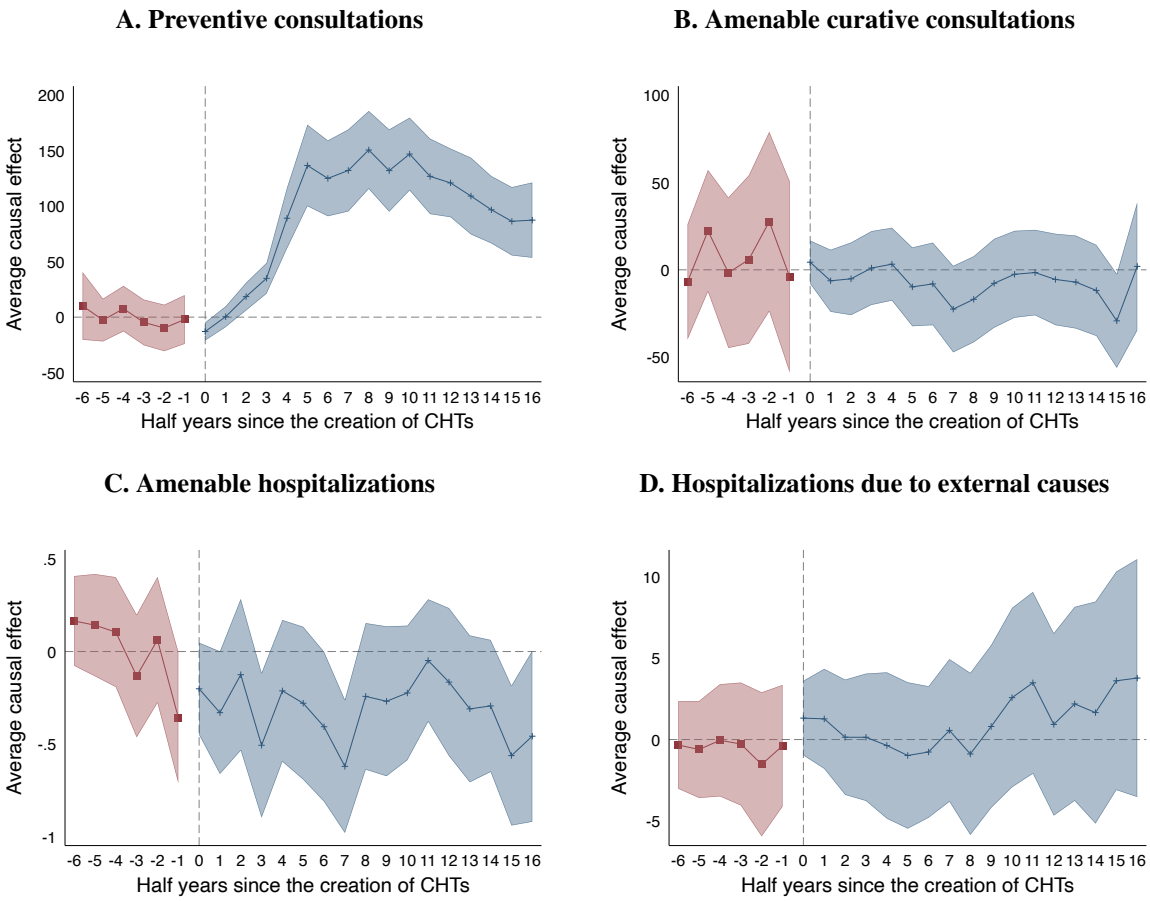
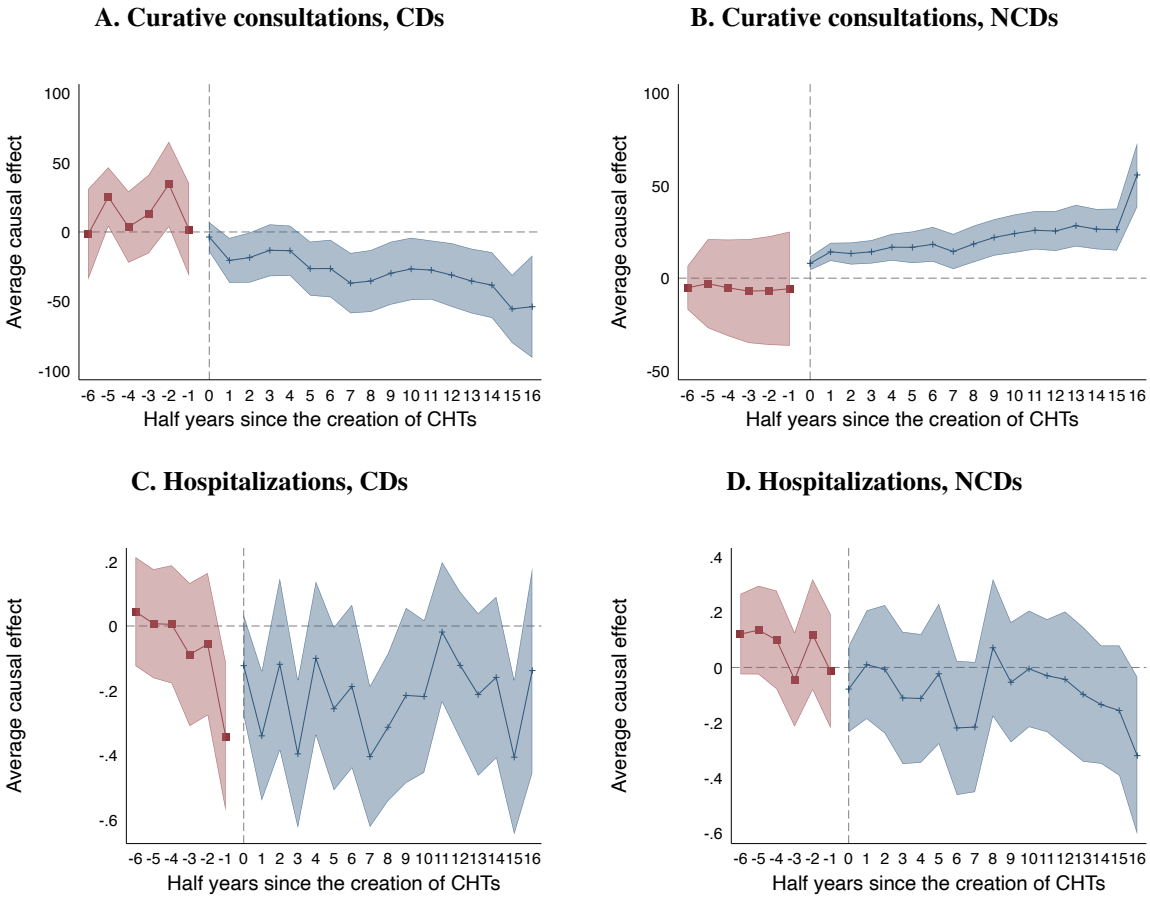


Figure G7: Consultations and Hospitalizations, Half-Year Data



Notes: Same notes as Figure 2. Data at the half-year level.

Figure G8: Curative Consultations and Hospitalizations by Disease Type, Half-Year Data



Notes: Same notes as Figure 3. Data at the half-year level.

Table G7: Pre-treatment Effects on Consultations and Hospitalizations, Half-Year Data

	(1) Preventive consultations	(2) Curative consultations amenable to healthcare	(3) Hospitalizations amenable to primary care
Panel A: Total			
CHTs creation	-0.239	7.193	-0.002
	(9.768)	(18.408)	(0.123)
	[0.981]	[0.696]	[0.985]
Pre-treatment mean	254.013	551.795	3.703
Panel B. Communicable diseases			
CHTs creation		12.657	-0.072
		(10.969)	(0.077)
		[0.249]	[0.352]
Pre-treatment mean		427.580	2.014
Panel C. Non-communicable diseases			
CHTs creation		-5.463	0.069
		(12.231)	(0.071)
		[0.655]	[0.326]
Pre-treatment mean		124.215	1.688
Muni-year		5080	7112
Municipality		254	254

Notes: Same Notes as Table 3. Data at the half-year level.

Table G8: Consultations and Hospitalizations, Total and by Type, Half-Year Data

	(1) Preventive consultations	(2) Curative consultations amenable to healthcare	(3) Hospitalizations amenable to primary care
Panel A: Total			
CHTs creation	93.063	-7.264	-0.309
	(11.990)	(10.766)	(0.151)
	[0.000]	[0.500]	[0.041]
Pre-treatment mean	254.013	551.795	3.703
Panel B. Communicable diseases			
CHTs creation		-28.976	-0.220
		(9.787)	(0.088)
		[0.003]	[0.012]
Pre-treatment mean		427.580	2.014
Panel C. Non-communicable diseases			
CHTs creation		21.713	-0.090
		(4.132)	(0.084)
		[0.000]	[0.284]
Pre-treatment mean		124.215	1.688
Muni-year		5080	7112
Municipality		254	254

Notes: Same Notes as Table 4. Data at the half-year level.

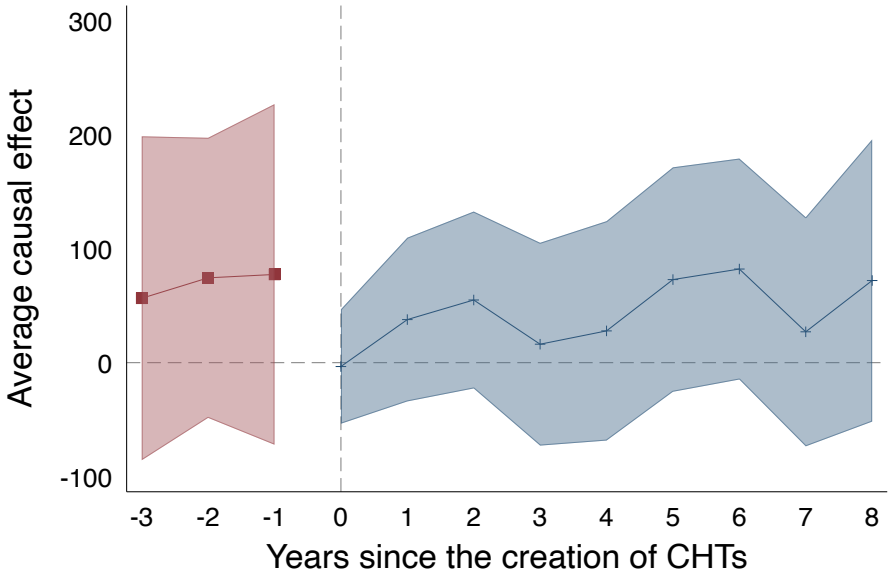
Table G9: Effects on Mortality Rates

	(1)	(2)	(3)
	Amenable MR		**Non-amenable MR**
	Communicable	Non-communicable	Total
Panel A: Static effect			
CHTs creation	-10.681	-16.766	-5.347
	(5.066)	(19.879)	(22.987)
	[0.036]	[0.400]	[0.816]
Municipality-year	2032	2032	2032
Municipality	254	254	254
Panel B: Placebo excluding T2010 and T2011			
Treated municipalities	1.159	3.165	23.333
	(9.012)	(23.715)	(33.491)
	[0.898]	[0.894]	[0.488]
Municipalities	79	79	79
Panel C: Static effect excluding T2010 and T2011			
CHTs creation	-11.731	-14.977	-4.059
	(5.292)	(20.591)	(24.307)
	[0.030]	[0.469]	[0.868]
2011 control mean	42.329	123.370	331.027
Municipality-year	632	632	632
Municipality	79	79	79

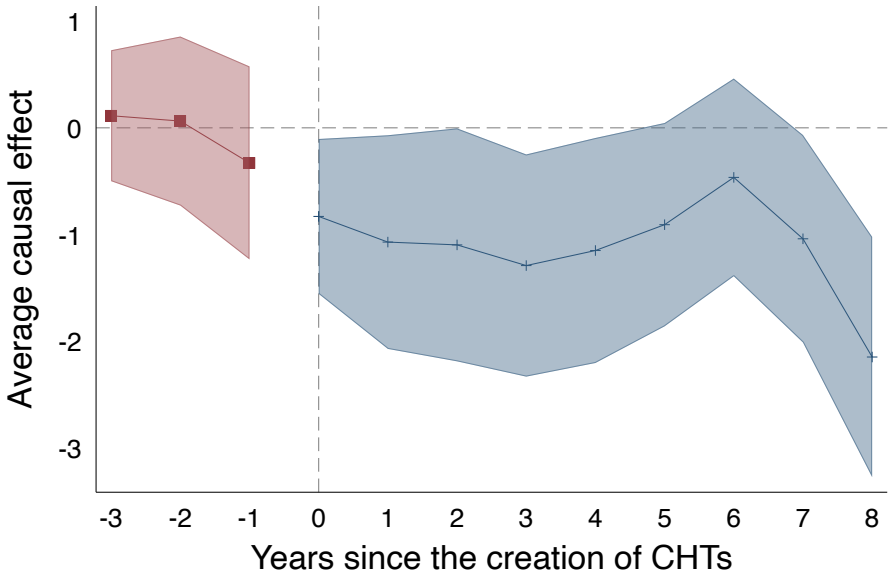
Note: This table reports the results of the effect estimated from an linear regressions of the dependent variable on a binary treatment indicator that takes values equal to one for treated municipalities, after the creation of CHTs (i.e. enrolled at least 5% of its population), and zero otherwise, following Equation 1. Dependent variables by column: (1) *Communicable*: amenable mortality rate caused by communicable diseases; (2) *Non-communicable*: amenable mortality rate caused by non-communicable diseases; (3) *No AMR*: mortality rate by diseases not amenable to healthcare. Amenable mortality are deaths avoidable through access to quality healthcare, which we classify following the definition by Kruk et al. (2018). All outcomes are measured per 1,000 inhabitants. Panel data of mortality rates is available yearly between 2011 and 2018. Panels A and C present coefficients of a static difference-in-difference estimation following Equation 1. Panel B presents coefficients of a cross-sectional OLS estimation of being treated later (after 2011) as opposed to never treated using 2011 data. Panels B and C drop from the sample of analysis municipalities that were treated before or in 2011 (T2010 and T2011). We include municipality and year fixed effects in all estimations in Panel A and C. Standard errors clustered by municipality in parenthesis and p-values in brackets.

Figure G9: Effects Total Curative Consultations and Hospitalizations

A. Total Curative Visits



B. Total ACSC Hospitalizations



Notes: Coefficients from the fully dynamic specification following Equation 2 and estimated using the imputation estimator developed by Borusyak et al. (2021). The y-axis shows the average treatment effects and the x-axis the year relative to the creation of the CHTs. Dependent variables by panel: (A) *Curative consultations*: total consultations for curative care; and (B) *Hospitalizations*: total hospital discharges due to ambulatory care sensitive conditions (ACSC), without restricting them to those that can lead to death if untreated. All outcomes are measured per 1,000 inhabitants. Confidence intervals at the 95% level.

Table G10: ICD-10 Codes for Curative Consultations and Hospitalizations

ICD-10	Description	Amenable to Healthcare		Ambulatory Care Sensitive Conditions
		Communicable	Non-communicable	
A00	Cholera	x		x
A01	Typhoid and paratyphoid fevers	x		x
A02	Other salmonella infections	x		x
A03	Shigellosis	x		x
A04	Other bacterial intestinal infections	x		x
A05	Other bacterial foodborne intoxications, not elsewhere classified	x		x
A06	Amoebiasis	x		x
A07	Other protozoal intestinal diseases	x		x
A08	Viral and other specified intestinal infections	x		x
A09	Other gastroenteritis and colitis of infectious and unspecified origin	x		x
A15	Respiratory tuberculosis, bacteriologically and histologically confirmed	x		x
A16	Respiratory tuberculosis, not confirmed bacteriologically or histologically	x		x
A17	Tuberculosis of nervous system	x		x
A18	Tuberculosis of other organs	x		x
A19	Miliary tuberculosis	x		
A20	Plague	x		
A21	Tularaemia	x		
A22	Anthrax	x		
A23	Brucellosis	x		
A24	Glanders and melioidosis	x		
A25	Rat-bite fevers	x		
A26	Erysipeloid	x		
A27	Leptospirosis	x		
A28	Other zoonotic bacterial diseases, not elsewhere classified	x		
A30	Leprosy [Hansen disease]	x		
A31	Infection due to other mycobacteria	x		
A32	Listeriosis	x		
A33	Tetanus neonatorum	x		x
A34	Obstetrical tetanus	x		
A35	Other tetanus	x		x
A36	Diphtheria	x		x
A37	Whooping cough	x		x
A38	Scarlet fever	x		
A39	Meningococcal infection	x		
A40	Streptococcal sepsis	x		
A41	Other sepsis	x		
A42	Actinomycosis	x		
A43	Nocardiosis	x		
A44	Bartonellosis	x		
A46	Erysipelas	x		x
A48	Other bacterial diseases, not elsewhere classified	x		
A49	Bacterial infection of unspecified site	x		
A50	Congenital syphilis	x		x
A51	Early syphilis	x		x
A52	Late syphilis	x		x

Continued on next page

Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
A53	Other and unspecified syphilis	x		x
A54	Gonococcal infection	x		
A55	Chlamydial lymphogranuloma (venereum)	x		
A56	Other sexually transmitted chlamydial diseases	x		
A57	Chancroid	x		
A58	Granuloma inguinale	x		
A59	Trichomoniasis	x		
A60	Anogenital herpesviral [herpes simplex] infection	x		
A63	Other predominantly sexually transmitted diseases, not elsewhere classified	x		
A64	Unspecified sexually transmitted disease	x		
A65	Nonvenereal syphilis	x		
A66	Yaws	x		
A67	Pinta [carate]	x		
A68	Relapsing fevers	x		
A69	Other spirochaetal infections	x		
A70	Chlamydia psittaci infection	x		
A71	Trachoma	x		
A74	Other diseases caused by chlamydiae	x		
A75	Typhus fever	x		
A80	Acute poliomyelitis	x		
A81	Atypical virus infections of central nervous system	x		
A82	Rabies	x		
A83	Mosquito-borne viral encephalitis	x		
A84	Tick-borne viral encephalitis	x		
A85	Other viral encephalitis, not elsewhere classified	x		
A86	Unspecified viral encephalitis	x		
A87	Viral meningitis	x		
A88	Other viral infections of central nervous system, not elsewhere classified	x		
A89	Unspecified viral infection of central nervous system	x		
A90	Dengue fever [classical dengue]	x		
A91	Dengue haemorrhagic fever	x		
A92	Other mosquito-borne viral fevers	x		
A93	Other arthropod-borne viral fevers, not elsewhere classified	x		
A94	Unspecified arthropod-borne viral fever	x		
A96	Arenaviral haemorrhagic fever	x		
A98	Other viral haemorrhagic fevers, not elsewhere classified	x		
A99	Unspecified viral haemorrhagic fever	x		
B00	Herpesviral [herpes simplex] infections	x		
B01	Varicella [chickenpox]	x		
B02	Zoster [herpes zoster]	x		
B03	Smallpox	x		
B04	Monkeypox	x		
B05	Measles	x		
B06	Rubella [German measles]	x		x
B07	Viral warts	x		
B08	Other viral infections characterized by skin and mucous membrane lesions, not elsewhere classified	x		
B09	Unspecified viral infection characterized by skin and mucous membrane lesions	x		

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Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
B15	Acute hepatitis A	x		
B16	Acute hepatitis B	x		x
B17	Other acute viral hepatitis	x		
B18	Chronic viral hepatitis	x		
B19	Unspecified viral hepatitis	x		
B20	Human immunodeficiency virus [HIV] disease resulting in infectious and parasitic diseases	x		
B21	Human immunodeficiency virus [HIV] disease resulting in malignant neoplasms	x		
B22	Human immunodeficiency virus [HIV] disease resulting in other specified diseases	x		
B23	Human immunodeficiency virus [HIV] disease resulting in other conditions	x		
B24	Unspecified human immunodeficiency virus [HIV] disease	x		
B25	Cytomegaloviral disease	x		
B26	Mumps	x		x
B27	Infectious mononucleosis	x		
B30	Viral conjunctivitis	x		
B33	Other viral diseases, not elsewhere classified	x		
B34	Viral infection of unspecified site	x		
B35	Dermatophytosis	x		
B36	Other superficial mycoses	x		
B37	Candidiasis	x		
B38	Coccidioidomycosis	x		
B39	Histoplasmosis	x		
B40	Blastomycosis	x		
B41	Paracoccidioidomycosis	x		
B42	Sporotrichosis	x		
B43	Chromomycosis and phaeomycotic abscess	x		
B44	Aspergillosis	x		
B45	Cryptococcosis	x		
B46	Zygomycosis	x		
B47	Mycetoma	x		
B48	Other mycoses, not elsewhere classified	x		
B49	Unspecified mycosis	x		
B50	Plasmodium falciparum malaria	x		x
B51	Plasmodium vivax malaria	x		x
B52	Plasmodium malariae malaria	x		x
B53	Other parasitologically confirmed malaria	x		
B54	Unspecified malaria	x		x
B55	Leishmaniasis	x		
B56	African trypanosomiasis	x		
B57	Chagas disease	x		
B58	Toxoplasmosis	x		
B59	Pneumocystosis	x		
B60	Other protozoal diseases, not elsewhere classified	x		
B64	Unspecified protozoal disease	x		
B65	Schistosomiasis [bilharziasis]	x		
B66	Other fluke infections	x		
B67	Echinococcosis	x		
B68	Taeniasis	x		

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Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
B69	Cysticercosis	x		
B70	Diphyllobothriasis and sparganosis	x		
B71	Other cestode infections	x		
B72	Dracunculiasis	x		
B73	Onchocerciasis	x		
B74	Filariasis	x		
B75	Trichinellosis	x		
B76	Hookworm diseases	x		
B77	Ascariasis	x		x
B78	Strongyloidiasis	x		
B79	Trichuriasis	x		
B80	Enterobiasis	x		
B81	Other intestinal helminthiases, not elsewhere classified	x		
B82	Unspecified intestinal parasitism	x		
B83	Other helminthiases	x		
B85	Pediculosis and phthiriasis	x		
B86	Scabies	x		
B87	Myiasis	x		
B88	Other infestations	x		
B89	Unspecified parasitic disease	x		
B90	Sequelae of tuberculosis	x		
B91	Sequelae of poliomyelitis	x		
B92	Sequelae of leprosy	x		
B94	Sequelae of other and unspecified infectious and parasitic diseases	x		
B95	Streptococcus and staphylococcus as the cause of diseases classified to other chapters	x		
B96	Other specified bacterial agents as the cause of diseases classified to other chapters	x		
B97	Viral agents as the cause of diseases classified to other chapters	x		
B98	Other specified infectious agents as the cause of diseases classified to other chapters	x		
B99	Other and unspecified infectious diseases	x		
C18	Malignant neoplasm of colon		x	
C43	Malignant melanoma of skin		x	
C44	Other malignant neoplasms of skin		x	
C50	Malignant neoplasm of breast		x	
C53	Malignant neoplasm of cervix uteri		x	
C55	Malignant neoplasm of uterus, part unspecified		x	
C62	Malignant neoplasm of testis		x	
C73	Malignant neoplasm of thyroid gland		x	
C81	Hodgkin lymphoma		x	
C95	Leukaemia of unspecified cell type		x	
D50	Iron deficiency anaemia			x
E10	Type 1 diabetes mellitus		x	x
E11	Type 2 diabetes mellitus		x	x
E12	Malnutrition-related diabetes mellitus		x	x
E13	Other specified diabetes mellitus		x	x
E14	Unspecified diabetes mellitus		x	x
E40	Kwashiorkor			x
E41	Nutritional marasmus			x
E42	Marasmic kwashiorkor			x

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Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
E43	Unspecified severe protein-energy malnutrition			x
E44	Protein-energy malnutrition of moderate and mild degree			x
E45	Retarded development following protein-energy malnutrition			x
E46	Unspecified protein-energy malnutrition			x
E50	Vitamin A deficiency			x
E51	Thiamine deficiency			x
E52	Niacin deficiency [pellagra]			x
E53	Deficiency of other B group vitamins			x
E54	Ascorbic acid deficiency			x
E55	Vitamin D deficiency			x
E56	Other vitamin deficiencies			x
E58	Dietary calcium deficiency			x
E61	Deficiency of other nutrient elements			x
E63	Other nutritional deficiencies			x
E64	Sequelae of malnutrition and other nutritional deficiencies			x
E86	Volume depletion			x
G00	Bacterial meningitis, not elsewhere classified			x
G40	Epilepsy		x	x
G41	Status epilepticus			x
G45	Transient cerebral ischaemic attacks and related syndromes			x
G46	Vascular syndromes of brain in cerebrovascular diseases			x
H66	Suppurative and unspecified otitis media			x
I00	Rheumatic fever without mention of heart involvement			x
I01	Rheumatic fever with heart involvement			x
I02	Rheumatic chorea			x
I05	Rheumatic mitral valve diseases		x	
I06	Rheumatic aortic valve diseases		x	
I07	Rheumatic tricuspid valve diseases		x	
I08	Multiple valve diseases		x	
I09	Other rheumatic heart diseases		x	
I10	Essential (primary) hypertension		x	x
I11	Hypertensive heart disease		x	x
I12	Hypertensive renal disease		x	
I13	Hypertensive heart and renal disease		x	
I15	Secondary hypertension		x	
I20	Angina pectoris		x	x
I21	Acute myocardial infarction		x	
I22	Subsequent myocardial infarction		x	
I23	Certain current complications following acute myocardial infarction		x	
I24	Other acute ischaemic heart diseases		x	
I25	Chronic ischaemic heart disease		x	
I50	Heart failure			x
I60	Subarachnoid haemorrhage		x	
I61	Intracerebral haemorrhage		x	
I62	Other nontraumatic intracranial haemorrhage		x	
I63	Cerebral infarction		x	x
I64	Stroke, not specified as haemorrhage or infarction		x	x
I65	Occlusion and stenosis of precerebral arteries, not resulting in cerebral infarction		x	x

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Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
I66	Occlusion and stenosis of cerebral arteries, not resulting in cerebral infarction		x	x
I67	Other cerebrovascular diseases		x	x
I68	Cerebrovascular disorders in diseases classified elsewhere		x	
I69	Sequelae of cerebrovascular disease		x	x
J00	Acute nasopharyngitis [common cold]	x		x
J01	Acute sinusitis	x		x
J02	Acute pharyngitis	x		x
J03	Acute tonsillitis	x		x
J04	Acute laryngitis and tracheitis	x		
J05	Acute obstructive laryngitis [croup] and epiglottitis	x		
J06	Acute upper respiratory infections of multiple and unspecified sites	x		x
J09	Influenza due to certain identified influenza virus	x		
J10	Influenza due to other identified influenza virus	x		
J11	Influenza, virus not identified	x		
J12	Viral pneumonia, not elsewhere classified	x		
J13	Pneumonia due to Streptococcus pneumoniae	x		x
J14	Pneumonia due to Haemophilus influenzae	x		
J15	Bacterial pneumonia, not elsewhere classified	x		x
J16	Pneumonia due to other infectious organisms, not elsewhere classified	x		
J17	Pneumonia in diseases classified elsewhere	x		
J18	Pneumonia, organism unspecified	x		x
J20	Acute bronchitis	x		x
J21	Acute bronchiolitis	x		x
J22	Unspecified acute lower respiratory infection	x		
J30	Vasomotor and allergic rhinitis	x		
J31	Chronic rhinitis, nasopharyngitis and pharyngitis	x		x
J32	Chronic sinusitis	x		
J33	Nasal polyp	x		
J34	Other disorders of nose and nasal sinuses	x		
J35	Chronic diseases of tonsils and adenoids	x		
J36	Peritonsillar abscess	x		
J37	Chronic laryngitis and laryngotracheitis	x		
J38	Diseases of vocal cords and larynx, not elsewhere classified	x		
J39	Other diseases of upper respiratory tract	x		
J40	Bronchitis, not specified as acute or chronic		x	x
J41	Simple and mucopurulent chronic bronchitis		x	x
J42	Unspecified chronic bronchitis		x	x
J43	Emphysema		x	x
J44	Other chronic obstructive pulmonary disease		x	x
J45	Asthma		x	x
J46	Status asthmaticus		x	x
J47	Bronchiectasis		x	x
J81	Pulmonary oedema			x
K25	Gastric ulcer			x
K26	Duodenal ulcer			x
K27	Peptic ulcer, site unspecified		x	x
K28	Gastrojejunal ulcer			x
K35	Acute appendicitis		x	
K36	Other appendicitis		x	

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Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
K37	Unspecified appendicitis		x	
K38	Other diseases of appendix		x	
K40	Inguinal hernia		x	
K41	Femoral hernia		x	
K42	Umbilical hernia		x	
K43	Ventral hernia		x	
K44	Diaphragmatic hernia		x	
K45	Other abdominal hernia		x	
K46	Unspecified abdominal hernia		x	
K50	Crohn disease [regional enteritis]		x	
K51	Ulcerative colitis		x	
K52	Other noninfective gastroenteritis and colitis		x	
K56	Paralytic ileus and intestinal obstruction without hernia		x	
K80	Cholelithiasis		x	
K81	Cholecystitis		x	
K82	Other diseases of gallbladder		x	
K83	Other diseases of biliary tract		x	
K85	Acute pancreatitis		x	
K86	Other diseases of pancreas		x	
K87	Disorders of gallbladder, biliary tract and pancreas in diseases classified elsewhere		x	
K92	Other diseases of digestive system			x
L01	Impetigo			x
L02	Cutaneous abscess, furuncle and carbuncle			x
L03	Cellulitis			x
L04	Acute lymphadenitis			x
L08	Other local infections of skin and subcutaneous tissue			x
N10	Acute tubulo-interstitial nephritis			x
N11	Chronic tubulo-interstitial nephritis			x
N12	Tubulo-interstitial nephritis, not specified as acute or chronic			x
N18	Chronic kidney disease		x	
N30	Cystitis			x
N34	Urethritis and urethral syndrome			x
N39	Other disorders of urinary system			x
N70	Salpingitis and oophoritis			x
N71	Inflammatory disease of uterus, except cervix			x
N72	Inflammatory disease of cervix uteri			x
N73	Other female pelvic inflammatory diseases			x
N75	Diseases of Bartholin gland			x
N76	Other inflammation of vagina and vulva			x
O23	Infections of genitourinary tract in pregnancy			x
P35	Congenital viral diseases			x
Q20	Congenital malformations of cardiac chambers and connections		x	
Q21	Congenital malformations of cardiac septa		x	
Q22	Congenital malformations of pulmonary and tricuspid valves		x	
Q23	Congenital malformations of aortic and mitral valves		x	
Q24	Other congenital malformations of heart		x	
Q25	Congenital malformations of great arteries		x	
Q26	Congenital malformations of great veins		x	
Q27	Other congenital malformations of peripheral vascular system		x	
Q28	Other congenital malformations of circulatory system		x	

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Table G10 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
Z72	Problems related to lifestyle		x	
Z73	Problems related to life-management difficulty		x	
Z74	Problems related to care-provider dependency		x	
Z75	Problems related to medical facilities and other health care		x	
Z76	Persons encountering health services in other circumstances		x	
Z80	Family history of malignant neoplasm		x	
Z81	Family history of mental and behavioural disorders		x	
Z82	Family history of certain disabilities and chronic diseases leading to disablement		x	
Z83	Family history of other specific disorders		x	
Z84	Family history of other conditions		x	
Z85	Personal history of malignant neoplasm		x	
Z86	Personal history of certain other diseases		x	
Z87	Personal history of other diseases and conditions		x	
Z88	Personal history of allergy to drugs, medicaments and biological substances		x	
Z89	Acquired absence of limb		x	
Z90	Acquired absence of organs, not elsewhere classified		x	
Z91	Personal history of risk-factors, not elsewhere classified		x	
Z92	Personal history of medical treatment		x	
Z93	Artificial opening status		x	
Z94	Transplanted organ and tissue status		x	
Z95	Presence of cardiac and vascular implants and grafts		x	
Z96	Presence of other functional implants		x	
Z97	Presence of other devices		x	
Z98	Other postsurgical states		x	
Z99	Dependence on enabling machines and devices, not elsewhere classified		x	