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An ounce of prevention for a pound of cure: Basic health care and efficiency in health systems *

Antonella Bancalari, Pedro Bernal, Pablo Celhay, Sebastian Martinez and Maria Deni Sánchez

Abstract

We examine the efficiency gains in health systems generated after the national roll out of basic healthcare in El Salvador between 2010 and 2013. Using data from over 120 million consultations and five million hospitalizations, we demonstrate that the expansion of community health teams, comprising less-specialized health workers, increases preventive care and decreases curative care and preventable hospitalizations. We also estimate coverage improvements for previously unattended chronic conditions amenable to effective primary care. These results suggest that decentralization of tasks to less-specialized health workers improves efficiency, maintaining quality of care.

JEL: I15, I18, H21, H51.

Keywords: community-based healthcare, efficiency, coverage.

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1 Introduction

The substantial growth in healthcare spending in recent decades has brought the efficiency of health systems into the spotlight (Hall and Jones, 2007; Garber and Skinner, 2008; Christopoulos and Eleftheriou, 2020). A notable source of inefficiency is the underutilization of primary care, leading to an overreliance on hospital services for illnesses that could be more effectively prevented or managed through primary care (Dafny and Gruber, 2005; Garber and Skinner, 2008; Alexander et al., 2019; Pinchbeck, 2019). In low- and middle-income countries (LMICs), hospital care accounts for approximately 60% of government healthcare expenditure (Pinto et al., 2018). In developed countries, wasteful spending in health has become a significant source of inefficiency (OECD, 2017). To this end, the reorganization and/or expansion of basic healthcare coverage as an alternative have garnered significant interest (Einav and Finkelstein, 2023).

We study efficiency gains from a supply-side expansion of basic healthcare through a nationwide reform in El Salvador, which established Community Health Teams (CHTs). These teams, comprising physicians, nurses, and community health workers, offer a range of preventive health services, including outpatient consultations, home visits, and community outreach activities. While it is well understood that community-based healthcare can improve health outcomes, less is known about how it can improve efficiency in healthcare provision in low-income contexts.

We first document the effects of the reform on the available inputs for healthcare delivery (i.e., health units and 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: (i) curative consultations for conditions that can be effectively managed, treated, or prevented through primary care, referred to as amenable curative consultations; and (ii) hospitalizations for conditions that can be effectively managed, treated, or prevented through primary healthcare and, if not properly addressed, could lead to unnecessary hospitalizations or complications, referred to as preventable hospitalizations.

A key and novel aspect of our study involves categorizing outpatient care production into preventive and curative components. In our context, most outpatient care is provided in a primary care setting, with roughly 95% of preventive consultations and 80% of curative consultations happening at this level. As CHTs complement traditional primary care unit services with home visits and community outreach, understanding how the production of outpatient care services changes with the promotion of CHTs provides a more comprehensive assessment of the economic value of basic care coverage. Our dataset enables this analysis, marking our study as one of the pioneers in exploring heterogeneity in the production of outpatient care based on the type of care provided.

Additionally, we can precisely differentiate between curative care for communicable diseases

(CDs) and non-communicable diseases (NCDs) in outpatient visits by utilizing ICD-10 diagnosis codes. This precision is valuable as basic healthcare has the potential to prevent CDs and expedite the timely diagnosis and treatment of NCDs, thereby reducing the likelihood of complications, costly hospitalizations, and adverse health outcomes.

We employ an event-study strategy exploiting the staggered roll-out of the CHT system across municipalities between 2010 and 2013.[1] We use a panel dataset of 254 municipalities, combining various sources of detailed, high-quality administrative records and census data. We construct this dataset aggregating over 120 million individual consultation records that took place between 2009 and 2018, and almost five million inpatient hospital records spanning 2005–2018, allowing us to measure preventive and curative consultations and hospitalizations per 1,000 inhabitants for each municipality and year. The duration of our data enables us to analyze dynamics for a period of up to 5 years following the implementation of the reform.

We use the method proposed by Borusyak et al. (2024) 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 not-yet treated and never-treated units as controls at each point of time.

Our findings show that CHTs improve efficiency in health systems through a task-shifting model, wherein certain tasks are appropriately delegated to skilled yet less-specialized health workers, such as nurses instead of doctors.[2] CHTs not only expanded preventive care but also reduced amenable curative consultations for CDs, while enhancing management for NCDs, ultimately decreasing preventable hospitalizations.

Specifically, we find that CHTs increased preventive consultations by 36.9% compared to initial levels. The greater supply of preventive healthcare services and outreach efforts were sufficient to overcome demand-side barriers characteristic of LMICs (Dupas, 2011).

The effect of CHTs on curative healthcare is *a priori* ambiguous. On one hand, increased preventive care could lead to fewer amenable curative consultations, thereby saving resources, as the latter tend to be more expensive (*efficiency effect*). On the other hand, there could be an increase in curative visits, especially in the short term, if there is a high demand for healthcare for unattended conditions (*coverage effect*) (Hennessy, 2008; Glazer and McGuire, 2012). Our data allows to disentangle both effects by dividing curative outpatient consultations according to type. We find that CHTs decreased amenable curative consultations for CDs by 8.5%, while increasing coverage for amenable curative consultations for NCDs by 17.9%, compared to initial levels.

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

[2] This is in line with the World Health Organization's definition of 'task-shifting' (Campbell and Scott, 2011).

Such improvements in case management within primary care units led to a 10.8% reduction in preventable hospitalizations following the creation of the CHTs. These reductions were primarily driven by a 13.6% drop in preventable hospitalizations for diagnosis related to CDs requiring inpatient treatment, compared to initial levels.

We provide evidence that the rollout of the CHT system across municipalities is uncorrelated with potential confounding factors that would invalidate our empirical strategy to identify treatment effects. Although the Ministry of Health prioritized implementing CHTs in poorer municipalities, the actual start of their activities depended on the speed at which teams registered the population, which could have been slower in targeted poorer municipalities. We demonstrate that the results remain robust when controlling for initial municipal poverty by year fixed effects and also present evidence supporting the parallel trends assumption. Furthermore, we show that the results withstand several sensitivity checks and the use of alternative two-way fixed effects estimators.

Finally, while we lack data to study causal effects on health outcomes, we find that the expansion of the CHT system is associated with a reduction in the mortality rate for CDs that can be effectively managed, treated, or prevented through outpatient care, referred to amenable mortality.

We contribute to three main literature streams. First, this paper contributes to studies on the effectiveness of basic healthcare provided through a model of community health. This model, with its longstanding history as a supply-side alternative for delivering primary care, has recently seen a resurgence in LMICs (see, for example, Angwenyi et al. (2018), Kok et al. (2015), Mor et al. (2023)). While much of the existing literature focuses on estimating health effects, our study aims to understand the mechanisms behind these effects by examining efficiency in healthcare delivery within a national health system.

One of the pioneering works in this domain is by Goldman and Grossman (1988), who demonstrated that community health centers in the USA are associated with a reduction in infant mortality rates.[3] Since then, a substantial body of literature, focusing primarily on maternal and child health, has emerged. For instance, Kose et al. (2022) in the USA, Das et al. (2013) reviewed studies in Asia and Africa, Brazil's Family Health Program studied by Macinko et al. (2006), Aquino et al. (2009), Rocha and Soares (2010), and Herrera-Almanza and Rosales-Rueda (2023) in Madagascar, to name a few. Several other studies have examined how community-based healthcare improves reproductive healthcare. For instance, Arends-Kuenning (2001), Barham (2012) and Joshi and Schultz (2013) in Bangladesh, Salehi-Isfahani et al. (2010) in Iran, and Herrera-Almanza and Rosales-Rueda (2020) in Madagascar.

Our study contributes to this literature stream by providing evidence that one mechanism for

[3] Further insights into the history and evolution of community health programs can be found in Singh and Sachs (2013) and Perry et al. (2014).

the success of CHTs as an alternative in organizing primary healthcare is a task-shifting model. In this model, certain tasks are delegated to skilled yet less-specialized health workers without compromising quality. Our evidence is relevant not only to LMICs, which have been implementing such primary care models, but also to developed countries contemplating strategies to address operational waste in healthcare spending, aiming to ensure patients receive similar benefits of care while utilizing fewer expensive resources (Bentley et al., 2008; OECD, 2017; Shrank et al., 2019).

Second, our study complements the literature stream on health system efficiency. Previous work, primarily from advanced economies, has shown that expanding primary care improves overall health system efficiency by reducing emergency room use and hospitalizations for avoidable NCDs (e.g., Dafny and Gruber, 2005; Kolstad and Kowalski, 2012; Miller, 2012; Dolton and Pathania, 2016; Whittaker et al., 2016; Alexander et al., 2019; Pinchbeck, 2019; Ding et al., 2021; Gruber et al., 2022). Notably, in Brazil, Macinko et al. (2010) found that a major expansion of primary care decreased unnecessary hospitalizations, and Bhalotra et al. (2020) observed that urgent care centers reduced hospital outpatient procedures and admissions, and that this is associated with improved hospital performance, indicated by a decline in inpatient mortality.

While efficiency gains from avoiding emergency hospitalizations are well-suited for high-income and upper-middle-income countries, in lower-income contexts, the efficiency margins within the production of primary care services remain large. Hospitals or emergency rooms in LMICs are inaccessible to a portion of the population, as their infrastructure is often located in urban centers (Thornton, 2008; Kremer and Glennerster, 2011; Adhvaryu and Nyshadham, 2015). In lower-income settings like ours, both preventive and outpatient curative care predominantly occur at the primary care level and share limited resources. Curative care is typically more resource-intensive than preventive consultations, requiring medication and significant medical staff hours. Moreover, curative consultations are usually unscheduled, disrupting physicians' daily schedules in health units (Hey and Patel, 1983; Courbage and Rey, 2006; Williams et al., 2006; Nuscheler and Roeder, 2016; Wang, 2018; Peter, 2021). Health centers often operate under tight capacity constraints, making the opportunity costs of using resources for otherwise preventable conditions significant.

We contribute to this literature by focusing on efficiency gains in a low-income context, examining how CHTs can shift resources within outpatient healthcare that mainly takes place at the primary level. A significant advantage of our data is that it enables us to analyze the utilization of care for conditions that are amenable to effective primary care. By separately focusing on care for CDs, which are easily preventable, and NCDs, which are more resource-intensive, we identify two types of gains from the CHT system: one where more preventive care shifts resources towards less expensive curative care (*efficiency effect*), and another that reallocates resources from curative care for CDs to curative care for NCDs, thereby increasing the capacity of health units to handle these cases (*coverage effect*).

More broadly, this study contributes to the growing body of literature on health system restructuring and universal health coverage in LMICs. For instance, Bhalotra et al. (2019) explores Brazil's shift to universal health coverage, emphasizing improved primary care access and lower mortality. Studies in the US (Bailey and Goodman-Bacon, 2015) and Costa Rica (Mora-García et al., 2024) link increased primary care access to reduced long-term mortality. Another set of studies investigate the introduction of subsidized health insurance. In Peru, Bernal et al. (2017) finds positive effects on care utilization, Miller et al. (2013) in Colombia observes reduced financial risk and increased use of preventive services, and Conti and Ginja (2023) finds that Mexico's Seguro Popular lowered infant mortality in poor municipalities. Recently, Einav and Finkelstein (2023) advocate for expanding universal coverage for basic healthcare in the USA. However, there is limited understanding of how these nationwide policies impact the efficiency of health systems across interconnected levels of care.

We contribute to this literature by evaluating how a nationwide health system reform that increased coverage of community-based healthcare can promote efficiency. By studying effects for different types of care and diseases, we provide insights into the interplay between coverage and efficiency gains in outpatient care, as well as efficiency gains in preventable hospitalizations. Ultimately, this leads to efficiency gains in the overall system, where conditions are effectively managed, treated, or prevented through outpatient care at the primary level, thus avoiding unnecessary hospitalizations or complications.

The paper is organized as follows. Section 2 presents details about the reform that created the CHTs, and section 3 about the data and measurements. Section 4 presents the empirical strategy, section 5 shows the results and our cost effectiveness analysis and section 6 concludes.

2 Community Health Teams in El Salvador

In El Salvador the network of public health care providers is available for all citizens. 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 only 377 primary care units for a population close to six million inhabitants. 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 centered on the creation of government-funded and managed Community Health Teams (CHTs). Each rural CHT consisted of seven members: a physician, a professional nurse, an auxiliary nurse, three community health workers (CHWs, one for every 200 families), and a multipurpose or support worker. Urban teams had the same composition but included a higher number of CHWs. Guidelines provided job descriptions for each team member and their role in delivering services according to the population's risk profile. Within the CHTs, physicians provided consultations with the aid of nurses, while CHWs performed community outreach, educational activities, and home visits for follow-up or referral to services.

These teams were designed to serve the primary care needs of the municipal population within a pre-defined catchment area of approximately 3,000 individuals in rural areas and 9,000 individuals in urban areas. Guidelines stated that one CHW would serve 300 families; hence, urban teams had six CHWs, considering an average family size of five. Teams worked in primary health units, with each unit operating exclusively within the borders of a single corresponding municipality, ensuring that no CHTs or health units spanned across multiple municipalities. By 2015 there were 747 healthcare units El Salvador, and in treated municipalities, each health unit was staffed by at least one CHTs.

CHTs were responsible for the delivery of primary care services, with a strong emphasis on preventive care. Teams had a clearly defined portfolio of approximately 300 primary healthcare services, including 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), and community-based rehabilitation.

The reform emphasized both horizontal (i.e., across types of healthcare) and vertical (i.e., across levels of healthcare) integration of care. Horizontal integration occurred within CHTs as they provided both preventive and curative care. Vertical integration was also achieved, as basic units were the entry point, and a referral system was established to link services between levels, including hospital services. The electronic reporting system for visits and hospitalizations in El Salvador's public health system was already well-established and functioning before this reform and remained unchanged throughout the study period.

The government prioritized the implementation of CHTs in the country's poorest municipalities, aiming 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.

However, CHTs only began their activities after conducting a census of their catchment areas to obtain health and demographic data, which was 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 was accompanied by initial outreach efforts by CHWs to provide preventive home consultations and refer to follow-up consultations with a physician or professional nurse in the health unit when health risks were observed.

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 outpatient care, and preventable hospitalizations. 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.

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

- CHTs records: Data on primary healthcare units in operation and healthcare personnel is available at three points in time: two prior to the introduction of CHTs (2009 and 2010) and one after (2015).[4] The main outcomes we build are number of primary units and healthcare human resources in municipalities by type. By 2009, an average municipality had 1.5 primary healthcare units and a total of two members of staff per 1,000 inhabitants.

- Consultations data: Data on outpatient consultations from 120.3 million consultations taking place between 2009 and 2018, which contains information on the unit providing the service, the reason for the visit and the main diagnosis. The physician or nurse that performed the consultation reports the data to the central government for digitalization and coding of ICD-10 codes. We aggregate this dataset at the municipality level where the health centre is located.

  Preventive consultation refers to care recommended during a state of relatively good health to avoid future illness, such as screenings and immunizations. In contrast, curative consultation is care required during a state of illness to restore health. Preventive consultations conducted by CHWs during home visits, such as those that were part of the kick-off outreach activities to register individuals in the CHT system, are not captured in this dataset. Most of the outpatient care is provided in a primary care setting, with roughly 95% of preventive consultations and 80% of curative consultations happening at this level.

  The main outcomes we build from this dataset are the number of *preventive consultations* and *amenable curative consultations* in a municipality-year. The latter includes conditions

[4] 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.

that can be effectively managed, treated, or prevented in a primary care setting, potentially avoiding the need for specialized or tertiary care, following Kruk et al. (2018)'s classification tailored to LMICs.[5] In 2009, only 20% of the total consultations were preventive and all the remaining were for curative purposes. By 2009, an average municipality had 1,933 curative consultations per 1,000 inhabitants, more than four times the number of preventive consultations (466 per 1,000 inhabitants). Out of the curative consultations, 53% fall under the classification 'amenable curative consultations' (see Table A3).

- Hospital discharge data: Data on hospitalizations from approximately 4.8 million hospital discharge records spanning 2005– 2018 and containing information on the main diagnosis. All public hospitals report these data to the central government level for digitalization and coding of ICD-10 codes. We aggregate the data at the municipality level where the hospital is located.

  The main outcome we build from this dataset is *preventable hospitalizations*, set as hospitalizations for conditions that: (i) can be effectively managed, treated, or prevented in a primary care or outpatient setting; and, (ii) if not appropriately addressed, could lead to unnecessary hospitalizations or complications. To achieve this, we use conditions at the intersection of Kruk et al. (2018)'s list of conditions amenable to effective primary care (same as with amenable curative consultations), and Rodriguez Abrego (2012)'s list of ambulatory care sensitive conditions (ACSC).[6] We validate this definition of preventable hospitalizations by using asoutcomes the hospitalizations considering only Kruk et al. (2018)'s list of conditions amenable to effective primary care, the same classification used for amenable curative consultations, as well as when using only Rodriguez Abrego (2012)'s list of ambulatory-care sensitive conditions. In Section 5.5 we discuss how the results remain consistent across the use of these alternative classifications.

  While ACSCs specifically focus on conditions that, if not managed properly and timely through outpatient care, could lead to hospitalization, conditions amenable to primary care have a broader scope and include conditions that can be effectively managed in a primary care setting, potentially avoiding the need for any specialized care. Most of the ACSC conditions are also conditions amenable to primary care, except for specialized conditions that require outpatient care in hospitals, such as heart failure and cerebrovascular diseases. We use the intersection of both classifications as it is not expected that community-based healthcare improved the case management of such specialized conditions. Before the in-

[5] Kruk et al. (2018)'s is an influential study, reaching over 700 citations by January 2024. In Appendix A1 we present the full list of diseases and conditions amenable to healthcare according to this study, including the corresponding ICD-10 codes. We exclude maternal and neonatal disorders, as well as external causes, as these cannot be classified as CDs nor NCDs.

[6] Rodriguez Abrego (2012) adapts for the Latin American context the list proposed by Caminal et al. (2004)'s study, which has reached almost 500 citations by January 2024. In Appendix A1 we provide the full list of ambulatory-care sensitive conditions, including the ICD-10 codes, and its intersection with the list of conditions amenable to healthcare proposed by Kruk et al. (2018).

troduction of CHTs, on average, municipalities had per year 54 hospitalizations per 1,000 inhabitants, with 13 percent of those falling under the preventable hospitalizations category (7.32 per 1,000 inhabitants).

We further split amenable curative consultations and preventable hospitalizations into communicable and non-communicable groups. Before the creation of CHTs, the most common reason for amenable curative visits were common cold from the CDs (22%) and primary hypertension from the NCDs (11%). For preventable hospitalization, the most common reasons were gastroenteritis and colitis (26%) from the CDs and type 2 diabetes mellitus (12%) from the NCDs. Table A2 in the appendix presents the ten most common conditions for amenable curative consultations and for preventable hospitalizations for the CDs and NCDs groups. While there is some overlap in the ranking per disease across amenable curative consultations and preventable hospitalizations, it is not always the case. For instance, while being included in both outcomes, bacterial pneumonia and acute bronchitis are in the top 10 preventable hospitalizations caused by CDs and hypertensive heart disease for those caused by NCDs, but these are not in the top list for amenable curative consultations. This observation suggests that fewer of these cases were managed and contained at the primary level and thus more ended up in hospitalizations.

In 2009, NCDs made up only 23% of the amenable curative consultations and later on they increased to 35%, with the remaining percentage corresponding to amenable curative consultations due to CDs (see Table A3, columns (1) and (2) in the appendix). Before the start of the reform, NCDs made up less than half the preventable hospitalizations per year and this share increased slightly after the reform (see Table A3 in the appendix).

To present the main outcomes as a rate per inhabitants, we use population forecasts from the 2007 census, which 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 is mortality rates per 1,000 inhabitants for each municipality and year, which we further classified into amenable, Kruk et al. (2018)'s list of conditions amenable to effective primary care, and within this, into CDs and NCDs.

Finally, we rely on administrative records of the intervention status of municipalities using data collected by CHTs when conducting the census to register the population into the CHT system. We define treatment at the municipal level. We set the year of CHTs' initiation as the year in which a municipality registered 5% of their population into the CHTs system (based on the 2007 population census). We conduct sensitivity checks by setting the year of treatment as the one in which a municipality registered 10%, 15% and 20% of their population and the results remain robust as discussed in Section 5.5.

4 Empirical Strategy

4.1 Specification

The Ministry of Health of Salvador created CHTs in 186 municipalities out of a total of 254, leaving 68 as never-treated municipalities, which are part of the‘pure’ control group. The creation of CHTs across municipalities was staggered, with a rapid expansion of coverage between 2010 and 2013. Out of the treated municipalities, CHTs were created in 2010 (T2010) in 41.9%, in 2011 (T2011) in 52.2%, in 2012 (T2012) in 4.3% and in 2013 (T2013) in 1.6%. The map in Figure 1 illustrates how the roll-out of the CHTs took place by highlighting the calendar year in which municipalities started being treated.

We use an event-study strategy relying on the variation created across treated and pure control municipalities, as well as the roll-out of the CHT system across treated 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, as this is the level at which treatment is defined and outcomes are measured, to deal with serial correlation in the panel data structure.

β captures the static effect, which is the weighted average of all possible 2×2 difference-in-differences (DD) identifying the average treatment effect on the treated (ATT). The DD estimators compare timing groups (i.e. municipalities treated at the same time) with each other and with the pure control group: (i) treated as the treatment group vs. never-treated as the control group; (ii) treated at period k as the treatment group vs. treated at period l as the control group; and (iii) treated at period l as the treatment group vs. treated at period k as the control group (where $k < l$). The weights on the 2×2 DDs are proportional to timing group sizes and the variance of the treatment dummy in each pair, which is highest for units treated in the middle of the panel (**?**).

The fully dynamic specification takes the form:

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

Here 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 $\geq$ 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.

τ_h captures treatment effect dynamics with respect to length of exposure to the treatment, i.e. the creation of CHTs. For each timing group treated at period k, never-treated, not-yet-treated, and already-treated serve as the control group.

It has been well documented that traditional two-way fixed effects (TWFE) estimators, leveraging staggered roll-out, are subject to 'negative weights' because they use already-treated units act as the control group, and treatment effects may vary over time (Goodman-Bacon, 2021). To address this concern, we use the imputation estimator proposed by Borusyak et al. (2024). Briefly, Borusyak et al. (2024)'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 (27% 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.

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).

4.2 Internal validity

A Cox hazard model reveals that the timing of the creation of CHTs was unrelated to initial demographic characteristics of the municipality, the initial availability of inputs for healthcare production, as well as the initial level of healthcare services (Table B2, 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. registering families in the CHT system) was likely slower in poorer municipalities. Thus, the net effect of poverty on the timing of the start of CHTs' activities in null.

In line with the MoH mandate, the initial percentage of the population living in poverty was higher in the treatment group than in the never-treated group of municipalities (see Table B1 in the appendix). This difference persists even when controlling for initial levels of other municipal characteristics, healthcare inputs, and outcomes (see Table B2, Column (1)). Treated districts also had a larger share of rural population and were generally smaller in terms of population size, resulting in them having greater healthcare inputs per 1,000 inhabitants (see Table B1 in the appendix). However, these initial imbalances are not problematic, as the differences in levels are effectively controlled for by municipality fixed effects. Furthermore, as demonstrated in Section 5.5, the results remain robust to controlling for these initial municipality characteristics interacted with year dummies.

Additionally, we show in Section 5 that the parallel trends assumption in outcomes hold. An advantage of the dynamic 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 present up to three-year pre-trends. While we can test for the significance of $t-1$ for all the treated municipalities, and of $t-2$ for 58% of the treated municipalities, a limitation is that we can only test for the significance of $t-3$ for 6% of the treated municipalities when using the consultations data. Municipalities that implemented CHTs post-2012 only have sufficient data from 2009 onwards for the pre-trends analysis. To overcome this limitation, we additionally test for five-period pre-trends using data at the half-year level. Furthermore, exploiting the availability of hospital records from 2005 we are able to test for up to five-period pre-trends for all treated municipalities. We find no evidence of pre-trends using these alternatives, as discussed in Section 5.5.

5 The Effects of Community Health Teams

5.1 Changes in Inputs for Healthcare

We start by evaluating how the reform in El Salvador affected the availability of inputs for the production of 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 support workers. Table 1, Panel A, shows that on average primary care units increased by 0.06 units per 1,000 inhabitants in treated municipalities after the creation of CHTs, equivalent to a 4.1% increase from the 2009 mean of never-treated municipalities. Furthermore, the total number of health staff in municipalities increased by 0.21 per 1,000 inhabitants on average (10.7%). This overall increase is mostly driven by an increase in the number of nurses and support workers (0.07 per 1,000 inhabitants, 18.4% and 17.5% respectively compared to the 2009 mean). Although also positive, the effects on the number of doctors and CHWs are not precisely estimated.

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 1.0 and 2.0 percentage points (ppts) in the share of nurses and support workers, respectively, and a decrease by 2.0 ppts in the share of CHWs out of the total human resources, on average.

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

5.2 Expansion of Preventive Care

As explained in Section 2, CHTs kick-started their activities with outreach efforts when registering individuals, coupled with proactive follow-up in scheduling preventive appointments. As such, we next evaluate the effect of CHTs on the number of preventive consultations.

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 2 showing the linear combination of all the coefficients estimated for the years prior to the creation of the CHTs confirms that the effect in the pre-treatment years is insignificant (column (1)).

The creation of CHTs dramatically increased preventive healthcare in municipalities. The impact becomes significant after a one-year period, consistent with the timeline during which CHTs conducted household visits as part of their establishment. These household visits may have functioned as a substitute to preventive consultations at health centers. The effect jumps from 37 to 170 additional consultations per 1,000 inhabitants between $t+1$ and $t+2$, and it peaks in $t+5$ at 277 consultations per 1,000 inhabitants. The effect remains high even eight years after the creation of CHTs.

Table 3 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 187.6 per 1,000 inhabitants. This effect is equivalent to a 36.9% increase in preventive consultations with respect to the pre-treatment mean, and it is significant at the 1% level. We additionally estimate the static DiD effects following Equation 1. We find that the creation of CHTs increased by 72.3 preventive consultations per 1,000 inhabitants during the post-reform period (see Table 4). The lower magnitude in the coefficients of the static estimation compared with those from the imputation estimator is consistent with 'negative weights' introduced in traditional TWFE models, as discussed in Section 4.

5.3 Efficiency and Coverage Gains in Curative Care

We now investigate the effect of the creation of CHTs on the number of amenable curative consultations. As explained in Section 3, these include visits to restore health due to conditions for which effective management and treatment can be achieved in a primary care setting, potentially avoiding the need for specialized or tertiary care.

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

We estimate no significant effects on amenable curative consultations (see Figure 2, Panel B). The average dynamic effect for up to eight years after the creation of CHTs shows a statistically insignificant decrease in amenable curative consultations (see Table 3, Panel A, column 2). Figure B1 in the appendix also shows an insignificant effect on total curative consultations (Panel A).

We next explore whether the null effect on amenable curative consultations is the result of a *coverage effect* offsetting an *efficiency effect*. To do this, we classify amenable curative consultations as due to either CDs or NCDs. Focusing on amenable curative consultations due to CDs allows us to investigate potential efficiency gains. The initial outreach efforts by CHTs, along with their proactive follow-up in scheduling preventive appointments (as evidenced in Section 5.2), might have prevented the spread of infections and other CDs. CDs are often more easily preventable compared to NCDs, over which healthcare providers have less control. NCDs typically require lifestyle modifications and long-term management strategies, aspects that largely fall under the patient's control.

Panel A in Figure 3 reveal that the creation of CHTs decreased curative consultations for CDs. The effect is immediate, a drop by 36 consultations per 1,000 inhabitants, consistent with the initial outreach activities of CHWs helping prevent the need for curative care for CDs in health units. The negative effects strengthen over time, following with the increase in preventive consultations in health units (as estimated in Section 5.2). 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 amenable curative consultations due to CDs by 73.1 per 1,000 inhabitants, equivalent to a 8.5% drop with respect to the pre-treatment mean (Table 3, column (2)). The effect is significant at the 1% level. This result serves as evidence of an *efficiency effect* from greater preventive care.

Next, focusing on amenable curative consultations due to NCDs allows us to investigate potential coverage gains from CHTs for three reasons. First, there was a greater need for CDs, evidenced by lower coverage of curative care for these diseases prior to the creation of the

CHTs (855 CDs vs. 248 NCDs curative consultations per 1,000 inhabitants). Second, outreach activities by CHWs generated referrals to health units to treat illnesses and chronic conditions. Third, it is more resource-intensive to identify and follow-up on chronic conditions, like diabetes and asthma (Williams et al., 2006; Wang, 2018), and hence lower amenable curative consultations due to preventable CDs might have released resources that could be allocated for NCDs treatment.

In the year CHTs were created, curative consultations due to NCDs increased 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 (17.9%; Table 3, column (2)). This effect is also significant at the 1% level. This result serves as evidence of a *coverage effect* due to more resources available to manage previously unattended chronic conditions.

We additionally estimate the static effect following Equation 1. We show in Table 4 that the effect on amenable curative consultations is -25.0 per 1,000 inhabitants with a p-value of 0.16, and when split by disease type, the effect is -31.4 per 1,000 inhabitants for CDs and 6.3 per 1,000 inhabitants, though the latter is not significant. Overall, these findings suggest that the absolute gain in efficiency was greater in magnitude than the gain in coverage.

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 preventable hospitalizations. As explained in Section 3, these include conditions that can be effectively managed, treated, or prevented in a primary care or outpatient setting, and those that if not appropriately addressed, could lead to unnecessary hospitalizations or complications.

Figure 2 Panel C confirms the absence of significant pre-trend estimates. Column (3) in Table 2 also confirms that the average effects on preventable hospitalizations were statistically insignificant before the creation of CHTs. Because we have data on hospitalizations since 2005, we also present estimates for up to five-year pre-trends in Section 5.5. It is important to note that, while the negative point estimate of $t-1$ could be concerning (mostly for preventable hospitalizations for CDs), it gets closer to zero and even positive when imputing 5-year pre-trends and when using half-year data (see Figures C5 to C8 in the appendix). When omitting this first lead for normalizations, alternative TWFE estimators clearly show no pre-trends between $t-5$ and $t-2$ and a significant drop after t (see Figures C4 and C5 in the appendix).

The creation of CHTs decreased the number of preventable hospitalizations. 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. Figure B1 in the appendix shows that the creation of CHTs had no effect on total hospitalizations (Panel C).

The average dynamic effect after the creation of the CHTs is presented in Table 3 (Panel A, column 3). We find that CHTs decreased preventable hospitalizations by 0.8 per 1,000 inhabitants –a drop equivalent to 10.8% with respect to the pre-treatment mean and statistically significant at the 1% level. Admissions were reduced due to preventable conditions as extreme cases were avoided through better case management through outpatient care.

We evaluate efficiency as done for curative care. Figure 3, Panels C and D, reveal that after the introduction of CHTs preventable hospitalizations dropped for CDs and NCDs, though the effects on the latter are only precisely estimated in t and $t + 8$. In the year CHTs were created, preventable hospitalizations for CDs dropped by 0.4 per 1,000 inhabitants and for NCDs they dropped by 0.3 per 1,000 inhabitants. The magnitude of the negative effect on preventable hospitalizations due to CDs increased to 0.7 hospitalizations four years later and to 0.9 hospitalizations after eight years (Panel C).

The average dynamic effect for preventable hospitalizations by CDs is -0.6, equivalent to a drop by 13.6% with respect to the pre-treatment mean. This effect is statistically significant at the 1% level. The average effect on preventable hospitalizations for NCDs is -0.3, though it is not statistically significant at conventional levels (see Table 3, column 3). Consistent with the large increase in preventive care and curative care for amenable NCDs, more of these cases seem to have been resolved through outpatient care rather than requiring hospitalization.

We additionally estimate the static effect following Equation 1, presented in Table 4. The effect on preventable hospitalizations is -0.8 per 1,000 inhabitants with a p-value below 0.01. When split by disease type, the effect is -0.5 per 1,000 inhabitants for CDs and -0.3 per 1,000 inhabitants (12.3% and 6.7% compared to the pre-treatment mean, respectively). All estimated effects are significant at conventional levels.

As a placebo test, we additionally estimate the dynamic effect of the creation 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 due to external causes (see Figure 2 Panel D).

5.5 Robustness Checks

Sensitivity Checks. 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 registered 10%, 15% and 20% of the municipality's population (see Table C1 in the appendix). Throughout the different specifications, the estimates effects remain highly significant. The magnitude of the effects on consultations, if anything, increases slightly when the creation year is set when a higher percentage of the population was registered, suggesting that our main estimates are conservative.

Robustness for Effects on Inputs. 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 variable that equals to one in 2010 for municipalities treated after 2010. Before the creation of CHTs, we find no significant difference in inputs for healthcare production, neither in counts nor in shares, across later-treated (after 2010) and never-treated municipalities (see Table C2 in the appendix). We replicate the estimations in Table 1 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 Table C3 in the appendix). The latter table alleviates concerns that a different composition of municipalities drives the null effects in the placebo test, as we exclude 41% of the treated municipalities in this test.

Alternative estimators. We compare the results obtained with the imputation estimator of Borusyak et al. (2024) 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 C1, C2 and C3 in the appendix). The results validate the main findings based on the imputation estimator, as the point estimates of the effects of CHTs are very similar. These estimations alleviate further the concerns related to 'negative weights' in traditional OLS estimations and bias introduced by the different composition of treatment cohorts.

Additional pre-trends tests. Due to the availability of more rounds of hospital discharge records before the creation of CHTs (from 2005 onwards), we are able to test for pre-trends in these outcomes for additional periods for all treated municipalities. Figures C4 and C5 in the appendix show that there are no significant pre-trends when estimating up to five-year pre-trends and when using the alternative estimators of DCHF, SA and CS. For preventable hospitalizations by NCDs, the imputation estimator yields significant positive coefficients for $t-5$, $t-3$ and $t-2$. Yet, these pre-trend coefficients are in the in the opposite direction of the treatment effects and the DCHF, SA and CS estimators yield pre-trend coefficients that are close to zero and insignificant for this outcome.

To further study the pre-treatment patterns, we also utilize the availability of healthcare utilization data at the semi-annual level. The advantage of using semi-annual data is that it provides more variation in the rollout of the CHTs and allows us to test for longer pre-trends. When analyzing semi-annual data, we assume that the treatment begins in the semester before 5% of the municipality's population is registered in the CHT system. This is because outcomes are now measured over a shorter time span, and the initial activities of the CHTs can already be reflected in these outcomes. With this conservative approach, 41.9% of treated districts were treated in the first half of 2010, 43.0% in the second half of 2010, 9.2% in the first half of 2011, 1.6% in the second half of 2011, 2.7% in the first half of 2012, and 1.6% in the second half of 2012 (Figure C6 in the appendix shows the hazard plots for the event "Creation of CHTs" comparing half-yearly and yearly data). We can now test for up to two-year pre-trends in the first cohort (41.9%) and for up to three-year pre-trends in the second cohort (43.0%), which together constitute the majority of the treatment group. The negative side of using data at the semi-annual level is that the data is more noisy, mostly for rare events like hospitalizations.

Figures C7 and C8 in the appendix replicate Figures 2 and 3, respectively, using half-year data. We are able to rule out up to five-year pre-trends for all outcomes. We only find a significant positive coefficient in $t-1$ and $t-4$ for curative consultations due to CDs, but this imbalance is in the opposite direction of the treatment effect. The absence of pre-trends is confirmed in Table C4 showing insignificant average pre-trend coefficients for all outcomes when using the semi-annual data. Moreover, the average dynamic treatment effects remain in the same direction and, as expected, are half the magnitude when using semi-annual data compared to annual data (see Table C5 in the appendix). Notably, in Figure C7 we observe a drop in $t+1$ for preventive consultations, exactly in the period when CHTs were more intensively visiting households to register them in the CHTs system, crowding-out preventive visits in health units.

Alternative definition of preventable hospitalizations. We conduct robustness checks by employing alternative classifications of preventable hospitalizations. Figure C9 in the appendix shows that the estimated effects on hospitalizations remain robust (and are slightly larger in magnitude during the first years) when using only Kruk et al. (2018)'s list of conditions amenable to effective primary care, the same classification used for amenable curative consultations, as well as when using only Rodriguez Abrego (2012)'s list of ambulatory-care sensitive conditions (ACSC).

Adding controls. We address concerns regarding initial municipality characteristics influencing the trends in our outcomes of interest. Considering that the MoH prioritized poorer municipalities, and that we observe this in the data when comparing treatment and control municipalities, we control for initial poverty interacted with year dummies. We measure initial poverty as the share of the population in a municipality that fall below the poverty line, which was measured in the 2007 census. Figure C10 in the appendix shows that the results remain robust. Notably, some point-wise confidence intervals become narrower, particularly for the effects on preventable hospitalizations due to NCDs. Our results also remain robust to controlling for initial population and the share of rural population interacted with year dummies.

Other health shocks. We address concerns about other health policies and health shocks, such as epidemics, climate change, gangs and restrictions to mobility, affecting differently the regions where CHTs were deployed. Firstly, no other health reform was introduced in the targeted regions. Secondly, there is no specific geographical difference across treated and non-treated municipalities. Figure 1 shows that CHTs were deployed throughout the national territory without a specific spatial pattern. Thirdly, Figure C1, Panel (D), alleviates concerns about other health shocks due to violence being correlated with CHTs creation, as there are no significant effects on hospitalizations due to external causes. Finally, if other health shocks in treated municipalities, correlated with the timing of the creation of CHTs, were driving the results, we would expect to see effects in total curative consultations and total hospitalizations. However, Figure C1 in the appendix demonstrates that this is not the case.

5.6 Amenable Mortality

Finally, we anticipate that CHTs have improved health outcomes due to the increase in preventive care and the expanded coverage in curative care. To explore this, we utilize data on mortality rates available from 2011 to 2018 and estimate a static DiD model in accordance with Equation 1.

We use data on cause of death to compute mortality rates for conditions that are amenable to effective management and treatment that can be achieved in a primary care setting, potentially avoiding the need for specialized or tertiary care, following Kruk et al. (2018)'s classification. We further split amenable mortality rates by CDs and NCDs at the municipality level.

Consistent with our previous results, Table D1 in the appendix shows that mortality caused by CDs amenable to healthcare decreased by 10.7 deaths per 1,000 inhabitants after the creation of CHTs (Panel A). The point estimate is equivalent to a drop of 24.7% 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 effective primary healthcare, and that are easy to prevent.

As only 6% 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).

5.7 Cost-effectiveness of the Reform

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 preventable hospitalization gains because the overall effect on amenable curative care is zero, as coverage and efficiency gains offset each other. For this, 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 preventable hospitalizations per year. Using the coefficient of the effect on these hospitalizations of -0.8 per 1,000 inhabitants and per year per municipality (Table 3, 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.[7]

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. Using the post-treatment population forecasts and guidelines described in Section 2, the median number of CHTs in a treated municipality with an entirely rural population is 3.1, and in a municipality with an entirely urban population is 1.0. Hence, the total cost to run CHTs ranges between USD 45,654.5 and USD 141,528.9 per year per municipality.

This calculation suggests that the introduction of CHTs in Salvador was highly cost-effective. Per USD 1 invested in CHTs, El Salvador saved roughly between USD 4.4 and USD 13.5 in expenditures for preventable hospitalization. This calculation is a lower bound, as we are not monetizing gains in the health status of the population (as suggested by Table D1 in the appendix).

6 Conclusions

Our study investigates the efficiency gains resulting from a supply-side expansion of primary care through a nationwide reform in El Salvador, which introduced Community Health Teams (CHTs). These multidisciplinary teams, comprising physicians, nurses, and community health workers, offer a variety of preventive health services, including outpatient consultations, home visits, and community outreach.

While the benefits of community-based healthcare on health outcomes are acknowledged, less is known about its impact on efficiency in healthcare provision, particularly in low-income contexts. Our empirical strategy leverages the staggered rollout of the CHT system across municipalities between 2010 and 2013, constructing a comprehensive dataset covering 254 munici-

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

palities.

Our findings reveal that the CHT system, implemented through a task-shifting model, led to a more efficient allocation of care. The expansion of preventive care by CHTs reduced curative visits for avoidable communicable diseases, thereby decreasing the strain on health resources. Simultaneously, the reallocation of resources allowed for enhanced curative care for non-communicable diseases, demonstrating a shift towards more efficient and targeted healthcare provision.

This improvement in case management through outpatient care, primarily at the primary level, translated into a 10.8% reduction in preventable hospitalizations, primarily driven by a significant drop in hospitalizations related to communicable diseases. In settings where hospitals operate under tight capacity constraints, these gains can be substantial. A back-of-the-envelope calculation suggests that for every USD 1 invested in CHTs, El Salvador saved roughly between USD 4.4 and USD 13.5 in expenditures for preventable hospitalization.

In contributing to the literature, our study emphasizes the task-shifting model as a mechanism for the success of community-based healthcare. This model, which involves delegating tasks to skilled yet less-specialized health workers, proves effective in promoting efficiency without compromising quality, and is relevant for both low- and middle-income countries as well as developed nations aiming to address operational waste in healthcare spending.

Furthermore, our work complements existing research on health system efficiency, particularly in low-income contexts where primary care services play a crucial role. By evaluating the interplay between coverage and efficiency gains in outpatient care, we shed light on how a nationwide policy reform can enhance overall system efficiency.

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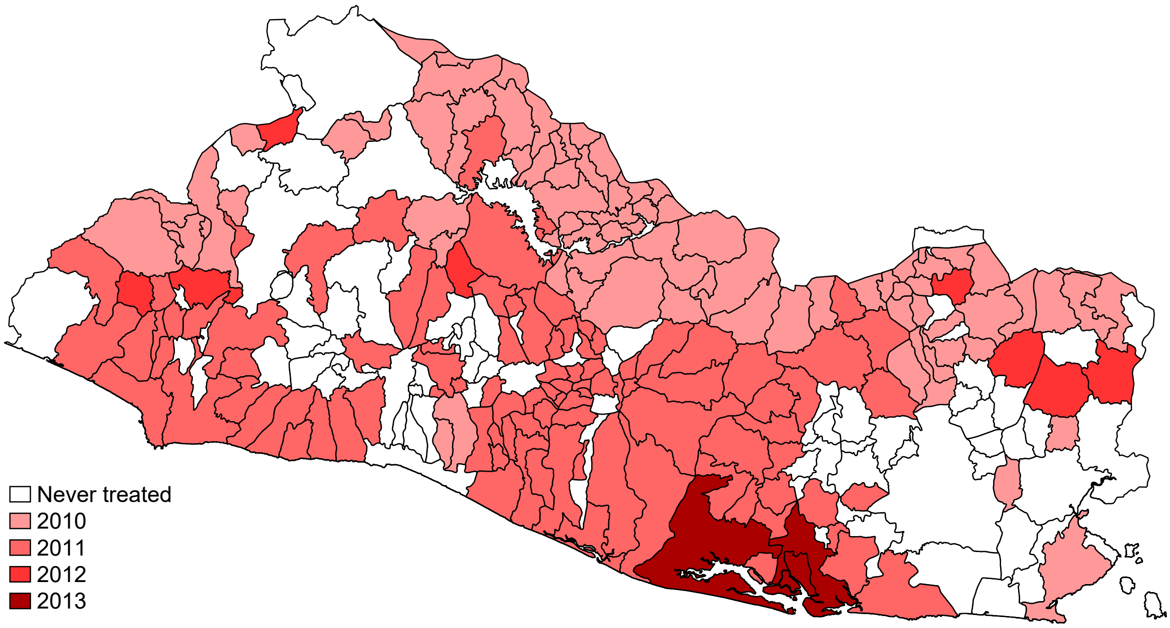
Figure 1: Spatial Distribution of CHTs' creation in El Salvador



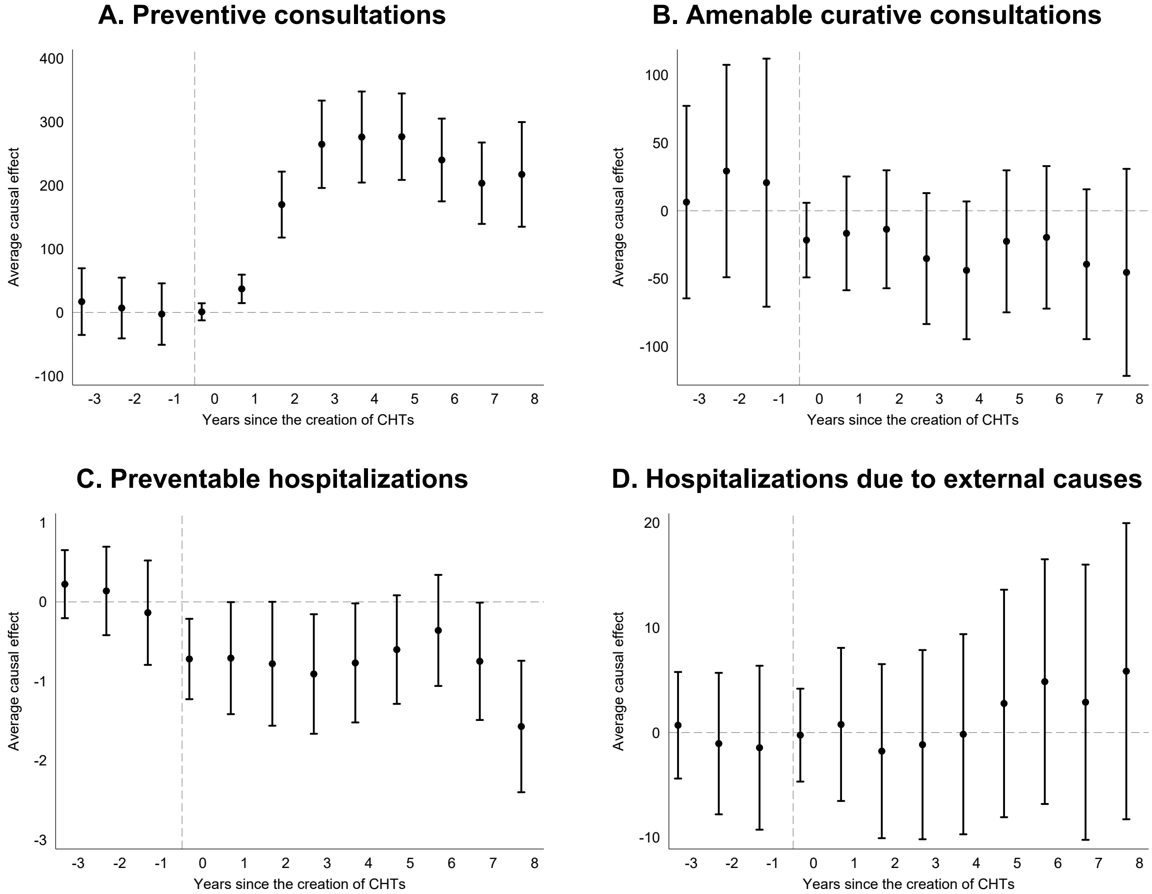
Notes: This map shows the date in which CHTs were created, proxied by the year in which municipalities registered at least 5% of its population.

Table 1: Inputs for Healthcare Production

	(1)	(2)	(3)	(4)	(5)	(6)
	Primary units	Human resources				
		Total	Doctors	Nurses	CHWs	Support
Panel A: Count						
CHTs creation	0.06	0.21	0.03	0.07	0.05	0.07
	(0.01)	(0.08)	(0.02)	(0.02)	(0.03)	(0.02)
	[0.00]	[0.01]	[0.20]	[0.00]	[0.13]	[0.00]
Pre-treatment mean	1.47	1.96	0.31	0.38	0.54	0.40
Panel B: Share						
CHTs creation			0.00	0.01	-0.02	0.02
			(0.01)	(0.00)	(0.01)	(0.00)
			[0.72]	[0.00]	[0.01]	[0.00]
Pre-treatment mean			0.14	0.19	0.29	0.19
Muni-year	729	729	729	729	729	729
Municipality	250	250	250	250	250	250

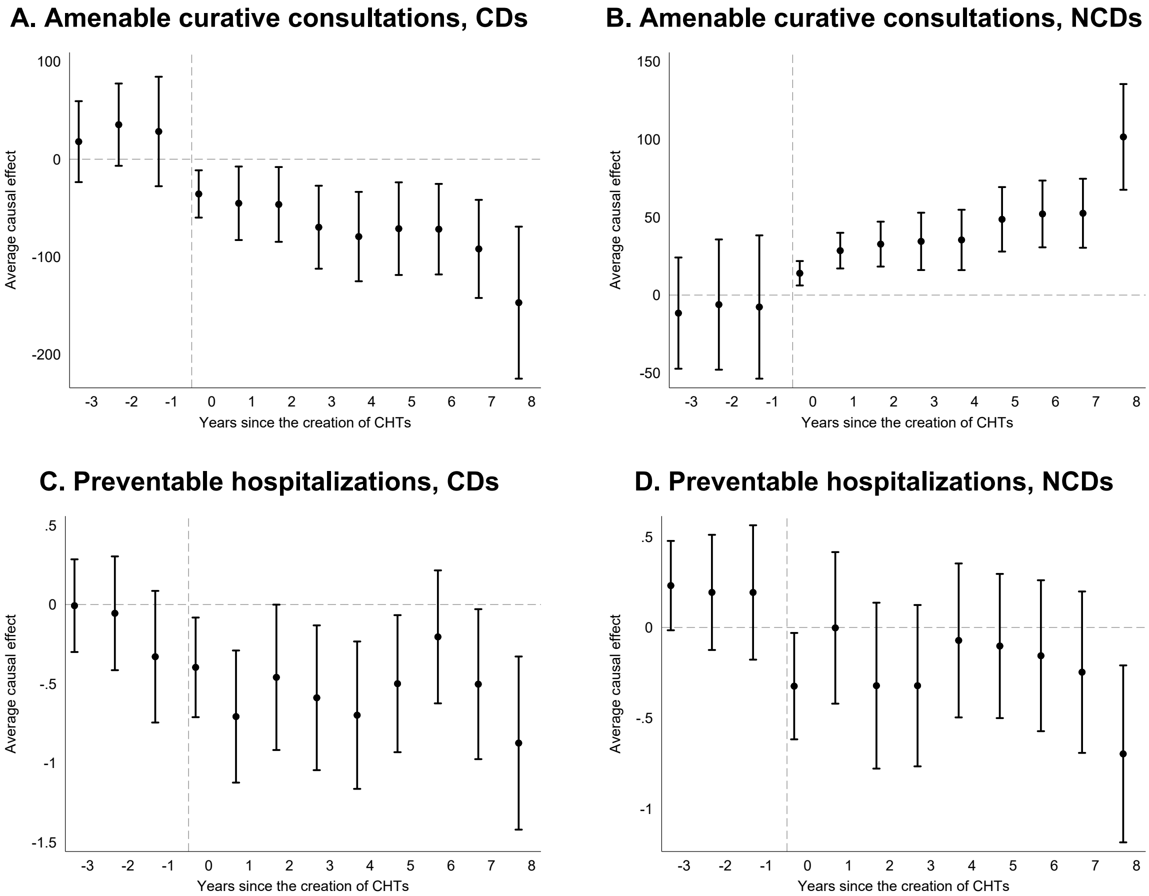
Notes: Estimated coefficients from an linear regressions of the dependent variable on a binary treatment indicator that takes values equal to one for treated municipalities, after the creation of CHTs (i.e. registered at least 5% of its population), and zero otherwise, following Equation 1. Dependent variables by panel: (A) absolute numbers, and (B) share out of total human resources. Dependent variables in Panel (A) are defined per 1,000 inhabitants. 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. (2024). 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 effective primary healthcare; (C) *Preventable hospitalizations*: total hospital discharges due to conditions that can be effectively managed, treated, or prevented in a primary care or outpatient setting, and that if not appropriately addressed, could lead to unnecessary hospitalizations or complications; 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: Amenable Curative Consultations and Preventable 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. (2024). The y-axis shows the average treatment effects and the x-axis the year relative to the creation of the CHTs. Panels (A) and (B) correspond to *Amenable curative consultations*, total curative consultations due to conditions amenable to effective primary healthcare, split by communicable (CDs) and non-communicable diseases (NCDs), respectively. Panels (C) and (D) correspond to *Preventable hospitalizations*, total hospital discharges due to conditions that can be effectively managed, treated, or prevented in a primary care or outpatient setting, and that if not appropriately addressed, could lead to unnecessary hospitalizations or complications, split by CDs and NCDs, respectively. All outcomes are measured per 1,000 inhabitants. Confidence intervals at the 95% level.

Table 2: Pre-treatment Effects on Consultations and Hospitalizations

	(1) Preventive consultations	(2) Amenable curative consultations	(3) Preventable hospitalizations
Panel A: Total			
CHTs creation	7.17	18.80	0.08
	(23.90)	(34.88)	(0.24)
	[0.76]	[0.59]	[0.76]
Pre-treatment mean	508.03	1103.59	7.41
Panel B. Communicable diseases			
CHTs creation		27.25	-0.13
		(19.15)	(0.15)
		[0.15]	[0.39]
Pre-treatment mean		855.16	4.03
Panel C. Non-communicable diseases			
CHTs creation		-8.46	0.21
		(18.17)	(0.14)
		[0.64]	[0.14]
Pre-treatment mean		248.43	3.38
Muni-year	2540	2540	3556
Municipality	254	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. (2024)'s methodology. Dependent variables by column: (1) *Preventive consultations*: total consultations for preventive care; (2) *Amenable curative consultations*: total curative consultations for conditions amenable to effective primary healthcare; and (3) *Preventable hospitalizations*: total hospital discharges due to conditions that can be effectively managed, treated, or prevented in a primary care or outpatient setting, and that if not appropriately addressed, could lead to unnecessary hospitalizations or complications. These three outcomes are split by communicable diseases in Panel B and non-communicable diseases in Panel C. All outcomes are measured per 1,000 inhabitants.

Table 3: Effects on Consultations and Hospitalizations

	(1) Preventive consultations	(2) Amenable curative consultations	(3) Preventable hospitalizations
Panel A: Total			
CHTs creation	187.56	-28.60	-0.80
	(24.75)	(22.90)	(0.31)
	[0.00]	[0.21]	[0.01]
Pre-treatment mean	508.03	1103.59	7.41
Panel B. Communicable diseases			
CHTs creation		-73.06	-0.55
		(21.28)	(0.18)
		[0.00]	[0.00]
Pre-treatment mean		855.16	4.03
Panel C. Non-communicable diseases			
CHTs creation		44.46	-0.25
		(8.56)	(0.17)
		[0.00]	[0.14]
Pre-treatment mean		248.43	3.38
Muni-year	2540	2540	3556
Municipality	254	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. (2024)'s imputation estimator. Dependent variables as presented in Table 2, all measured per 1,000 inhabitants. Standard errors clustered by municipality in parentheses and p-values in brackets.

Table 4: Static DiD - Consultations and Hospitalizations

	(1) Preventive consultations	(2) Amenable curative consultations	(3) Preventable hospitalizations
Panel A: Total			
CHTs creation	72.27	-25.02	-0.75
	(21.88)	(17.90)	(0.28)
	[0.00]	[0.16]	[0.01]
Pre-treatment mean	543.68	778.06	7.88
Panel B. Communicable diseases			
CHTs creation		-31.36	-0.49
		(14.64)	(0.17)
		[0.03]	[0.00]
Pre-treatment mean		551.08	3.99
Panel C. Non-communicable diseases			
CHTs creation		6.34	-0.26
		(7.27)	(0.15)
		[0.38]	[0.09]
Pre-treatment mean		226.98	3.90
Observations	2540	2540	3556
Municipalities	254	254	254

Notes: Same notes as Table 3. 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.

APPENDIX

This online appendix provides additional information on the data, methods, and robustness checks.

A Additional material for Section 3, Data

Table A1: ICD-10 Codes for Curative Consultations and Hospitalizations

ICD-10	Description	Amenable to Healthcare: Communicable	Amenable to Healthcare: Non-communicable	Ambulatory Care Sensitive Conditions
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		

Continued on next page

Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
A49	Bacterial infection of unspecified site	x		
A50	Congenital syphilis	x		x
A51	Early syphilis	x		x
A52	Late syphilis	x		x
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		

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Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
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		
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		

Continued on next page

Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
B65	Schistosomiasis [bilharziasis]	x		
B66	Other fluke infections	x		
B67	Echinococcosis	x		
B68	Taeniasis	x		
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

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Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
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
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	

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Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
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
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

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Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
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	
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	

Continued on next page

Table A1 – *Continued from previous page*

ICD-10	Description	AHC Communicable	AHC Non-communicable	ACSC
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	
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	

* Partially coded as Ambulatory Care Sensitive Conditions

Table A2: Descriptive Statistics: Most common ICD-10 codes

		Amenable curative consultations		Preventable hospitalizations	
		(1)	(2)	(3)	(4)
ICD-10	**Description**	**Pre-treatment mean**	**%**	**Pre-treatment mean**	**%**
Communicable diseases					
A04	Other bacterial intestinal infections			0.14	1.83
A06	Amoebiasis	19.64	1.92	0.24	3.31
A08	Viral and other specified intestinal infections			0.20	2.68
A09	Other gastroenteritis and colitis of infectious and unspecified origin	48.80	4.76	1.92	25.90
B35	Dermatophytosis	22.67	2.21		
B82	Unspecified intestinal parasitism	43.47	4.24		
J00	Acute nasopharyngitis [common cold]	233.78	22.81	0.08	1.15
J02	Acute pharyngitis	133.40	13.01		
J06	Acute upper respiratory infections of multiple and unspecified sites	143.68	14.02	0.10	1.37
J15	Bacterial pneumonia, not elsewhere classified			0.18	2.41
J18	Pneumonia, organism unspecified	14.57	1.42	0.07	0.94
J20	Acute bronchitis	24.75	2.41	0.33	4.43
J21	Acute bronchiolitis			0.32	4.36
J30	Vasomotor and allergic rhinitis	18.69	1.82		
Non-communicable diseases					
E11	Type 2 diabetes mellitus	24.62	2.40	0.90	12.20
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	11.82	0.49	6.66
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	1.61
J40	Bronchitis, not specified as acute or chronic	5.58	0.54		
J44	Other chronic obstructive pulmonary disease	3.60	0.35	0.36	4.85
J45	Asthma	18.32	1.79	0.63	8.52
J46	Status asthmaticus			0.07	0.91
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 A3: Descriptive Statistics: Consultations and Hospitalizations by Type

	All		Treated	
	(1) Pre-treatment	(2) Post-treatment	(3) Pre-treatment	(4) Post-treatment
Panel A: Consultations				
Total consultations	2398.66	2621.09	2582.37	2862.98
Preventive consultations	465.77	830.28	508.03	917.97
% of total consultations	20.75	32.31	21.41	32.96
Curative consultations	1932.88	1790.80	2074.34	1945.02
% of total consultations	79.25	67.69	78.59	67.04
Curative amenable consultations	1024.71	844.16	1103.59	916.14
% curative consultations	53.23	47.29	53.50	47.30
Curative amenable consultations - CDs	791.60	551.78	855.16	598.05
% amenable curative consultations	77.32	65.11	77.73	65.24
Curative amenable consultations - NCDs	233.11	292.38	248.43	318.09
% amenable curative consultations	22.68	34.89	22.27	34.76
Panel A: Hospitalizations				
Total hospitalizations	54.35	67.40	54.89	67.98
Preventable hospitalizations	7.32	8.64	7.41	8.58
% of total hospitalizations	13.14	12.44	13.17	12.29
Preventable hospitalizations - CDs	3.89	4.12	4.03	4.14
% preventable hospitalizations	52.96	48.02	54.26	48.55
Preventable hospitalizations - NCDs	3.43	4.52	3.38	4.44
% preventable hospitalizations	47.04	51.98	45.74	51.45

Note: This table reports the mean absolute numbers and percentage across municipalities for each type of care and condition. Pre-treatment period for curative and preventive consultations is 2009, and 2005-2009 for hospitalizations. Post treatment period is 2010-2018.

B Additional material for Section 5, The Effects of CHTs

Table B1: Balance in initial characteristics, by 'pure' control and treatment groups

	Control	**Treatment**	**Difference**
	(1)	(2)	(3)
Municipal characteristics:			
Total population	33542.54	18203.39	-15339.16**
	[49880.75]	[33273.57]	(6504.22)
% Rural population	0.49	0.65	0.16***
	[0.28]	[0.21]	(0.04)
% Pop in poverty	0.38	0.48	0.09***
	[0.09]	[0.10]	(0.01)
Inputs per 1,000 inhabitants:			
Primary units	0.11	0.20	0.09***
	[0.11]	[0.23]	(0.02)
Total HR	1.44	2.18	0.73***
	[0.84]	[1.26]	(0.14)
Doctors	0.18	0.34	0.17***
	[0.15]	[0.39]	(0.03)
Nurses	0.29	0.42	0.13***
	[0.21]	[0.35]	(0.04)
CHWs	0.41	0.61	0.20***
	[0.27]	[0.37]	(0.04)
Admin	0.28	0.45	0.16***
	[0.19]	[0.41]	(0.04)

Note. Municipal characteristics are from the 2007 census, and inputs for primary healthcare production are from 2009. Columns 1 and 2 report sample mean with standard deviation in brackets for the control and for the treatment group, respectively. Column 3 reports the difference between the 'pure' control group (never treated) and the 'pure' treatment group (treated at some point), estimated using OLS, with robust standard errors reported in parentheses. Statistical significance denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

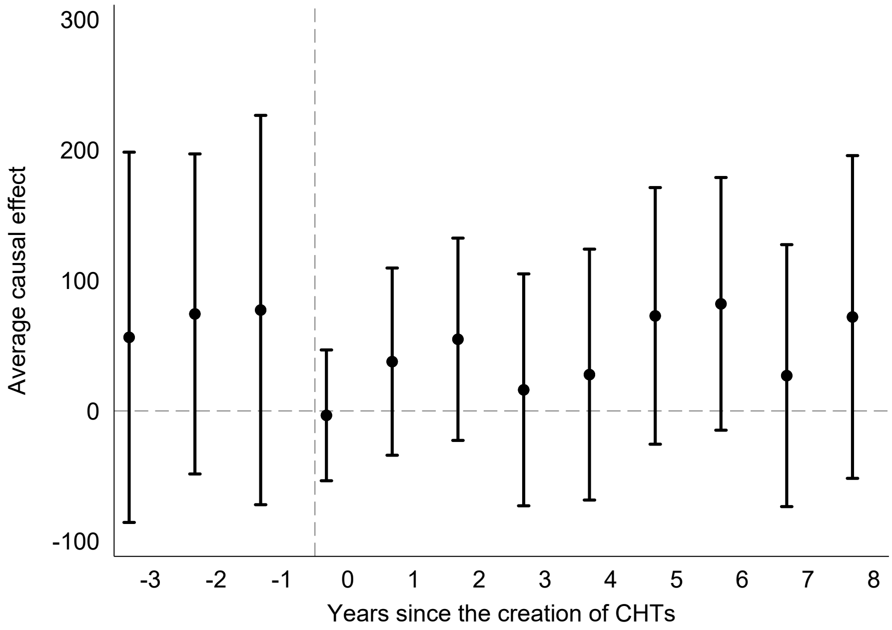
Table B2: Treatment status and timing to start CHTs

	Status		Timing	
	OLS		Cox hazard model	
	(1)	(2)	(3)	(4)
Municipal characteristics:				
Total population	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
% Rural population	0.05	0.00	0.27	0.30
	(0.18)	(0.19)	(0.49)	(0.55)
% Pop in poverty	0.99***	1.04***	1.21	1.32
	(0.34)	(0.35)	(1.06)	(1.09)
Outcomes				
Preventive consultations	0.00***	0.00**	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Curative consultations CDs	-0.00	-0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Curative consultations NCDs	0.00	0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Hospitalizations CDs	0.01	0.01	-0.05	-0.05
	(0.02)	(0.02)	(0.06)	(0.06)
Hospitalizations NCDs	-0.03	-0.03	0.00	0.02
	(0.03)	(0.03)	(0.07)	(0.08)
Inputs per 1,000 inhabitants:				
Primary units		-0.21		0.20
		(0.25)		(0.72)
Total HR		0.07		0.01
		(0.11)		(0.29)
Doctors		0.10		0.27
		(0.15)		(0.51)
Nurses		-0.19		0.11
		(0.14)		(0.46)
CHWs		0.14		-0.32
		(0.14)		(0.39)
Admin		-0.07		-0.34
		(0.20)		(0.59)
Observations	254	250	186	184

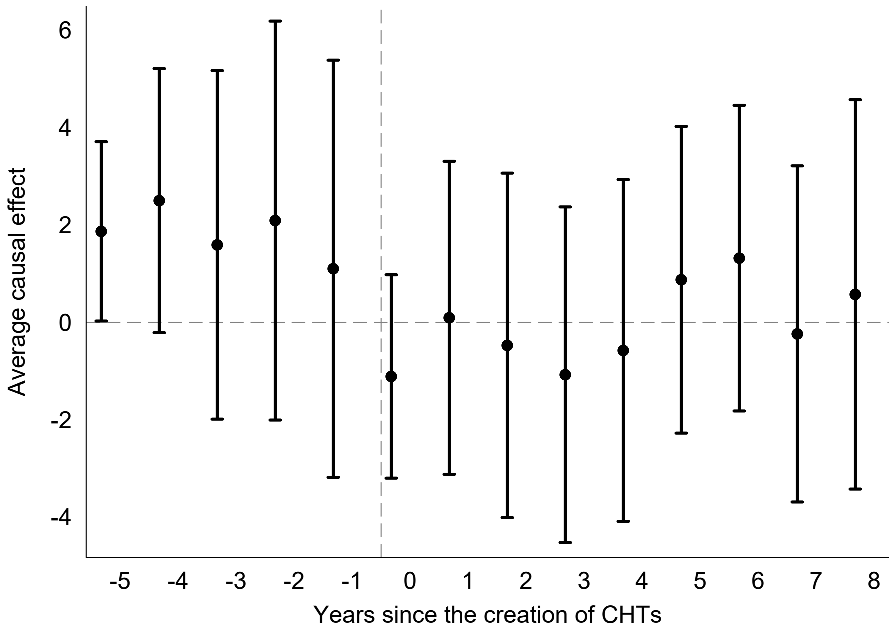
Note. Municipal characteristics are from the 2007 census, inputs for primary healthcare production are from 2009, and outcomes are the average of half-year observations in 2009 for consultations and 2005-2009 for hospitalizations. Column (1) shows coefficients of an OLS regression of being treated over 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.

Figure B1: Effects on Curative Consultations and Hospitalizations

A. Total curative consultations



B. Total hospitalizations



Notes: Same notes as Figure 2. Dependent variables by panel: (A) *Curative consultations*: total consultations for curative care; (B) *Total hospitalizations*: total hospital discharges.

C Additional material for Section 5.5, Additional tests

Table C1: Sensitivity Analysis by Year of CHTS creation

	(1) Preventive consultations	(2) Amenable curative consultations	(3) Preventable hospitalizations
Panel A: Total			
CHTs creation 5%	187.56	-28.60	-0.80
	(24.75)	(22.90)	(0.31)
	[0.00]	[0.21]	[0.01]
Pre-treatment mean 5%	508.03	1103.59	7.41
Municipalities treated 5%	186	186	186
CHTs creation 10%	199.96	-28.11	-0.65
	(24.78)	(22.77)	(0.30)
	[0.00]	[0.22]	[0.03]
Pre-treatment mean 10%	512.95	1108.11	7.35
Municipalities treated 10%	180	180	180
CHTs creation 15%	216.14	-31.78	-0.58
	(24.60)	(22.54)	(0.29)
	[0.00]	[0.16]	[0.05]
Pre-treatment mean 15%	520.02	1120.24	7.26
Municipalities treated 15%	172	172	172
CHTs creation 20%	230.59	-31.95	-0.55
	(24.56)	(22.93)	(0.28)
	[0.00]	[0.16]	[0.05]
Pre-treatment mean 20%	527.82	1137.37	7.33
Municipalities treated 20%	163	163	163
Panel B. Communicable diseases			
CHTs creation 5%		-73.06	-0.55
		(21.28)	(0.18)
		[0.00]	[0.00]
Pre-treatment mean 5%		855.16	4.03
Municipalities treated 5%		186	186
CHTs creation 10%		-74.58	-0.47
		(21.32)	(0.17)
		[0.00]	[0.01]
Pre-treatment mean 10%		859.70	4.02
Municipalities treated 10%		180	180
CHTs creation 15%		-78.40	-0.47
		(21.24)	(0.17)
		[0.00]	[0.01]
Pre-treatment mean 15%		870.22	3.98
Municipalities treated 15%		172	172
CHTs creation 20%		-80.56	-0.46
		(21.66)	(0.16)
		[0.00]	[0.01]
Pre-treatment mean 20%		883.95	4.03
Municipalities treated 20%		163	163
Panel C. Non-communicable diseases			
CHTs creation 5%		44.46	-0.25
		(8.56)	(0.17)
		[0.00]	[0.14]
Pre-treatment mean 5%		248.43	3.38
Municipalities treated 5%		186	186
CHTs creation 10%		46.47	-0.18
		(8.41)	(0.17)
		[0.00]	[0.27]
Pre-treatment mean 10%		248.41	3.33
Municipalities treated 10%		180	180
CHTs creation 15%		46.63	-0.12
		(8.36)	(0.16)
		[0.00]	[0.46]
Pre-treatment mean 15%		250.03	3.28
Municipalities treated 15%		172	172
CHTs creation 20%		48.61	-0.10
		(8.38)	(0.15)
		[0.00]	[0.53]
Pre-treatment mean 20%		253.43	3.30
Municipalities treated 20%		163	163

Notes: Same notes as Table 3. In each specification, the year of the creation of CHTs varies depending on the percentage of the municipality's population that health teams enrolled.

Table C2: Placebo for Inputs for Primary Healthcare Production using Later-Treated

	(1)	(2)	(3)	(4)	(5)	(6)
	Primary units	Human resources				
		Total	Doctors	Nurses	CHWs	Support
Panel A: Count						
CHTs creation	0.00	-0.01	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)
	[0.95]	[0.75]	[0.43]	[0.75]	[0.58]	[0.97]
Pre-treatment mean	1.561	1.764	0.233	0.323	0.539	0.340
Panel B: Share						
CHTs creation			-0.00	0.00	-0.00	0.00
			(0.00)	(0.00)	(0.00)	(0.00)
			[0.319]	[0.353]	[0.319]	[0.319]
Pre-treatment mean			0.13	0.18	0.31	0.18
Muni-year	329	329	329	329	329	329
Municipality	165	165	165	165	165	165

Notes: Same notes as Table 1. 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.

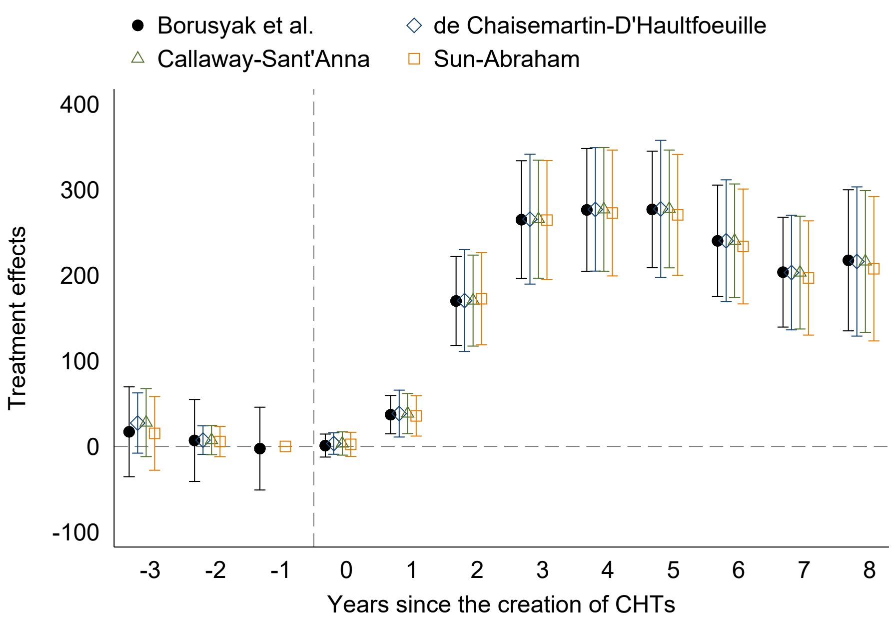
Table C3: Inputs for Primary Healthcare Production, Excluding T2010

	(1)	(2)	(3)	(4)	(5)	(6)
	Primary units	Human resources				
		Total	Doctors	Nurses	CHWs	Support
Panel A: Count						
CHTs creation	0.06	0.21	0.03	0.07	0.05	0.07
	(0.01)	(0.08)	(0.02)	(0.02)	(0.03)	(0.02)
	[0.00]	[0.01]	[0.20]	[0.00]	[0.13]	[0.00]
Pre-treatment mean	1.47	1.96	0.31	0.38	0.54	0.40
Panel B: Share						
CHTs creation			0.00	0.01	-0.02	0.02
			(0.01)	(0.00)	(0.01)	(0.00)
			[0.72]	[0.00]	[0.01]	[0.00]
Pre-treatment mean			0.14	0.19	0.29	0.19
Muni-year	719	719	719	719	719	719
Municipality	240	240	240	240	240	240

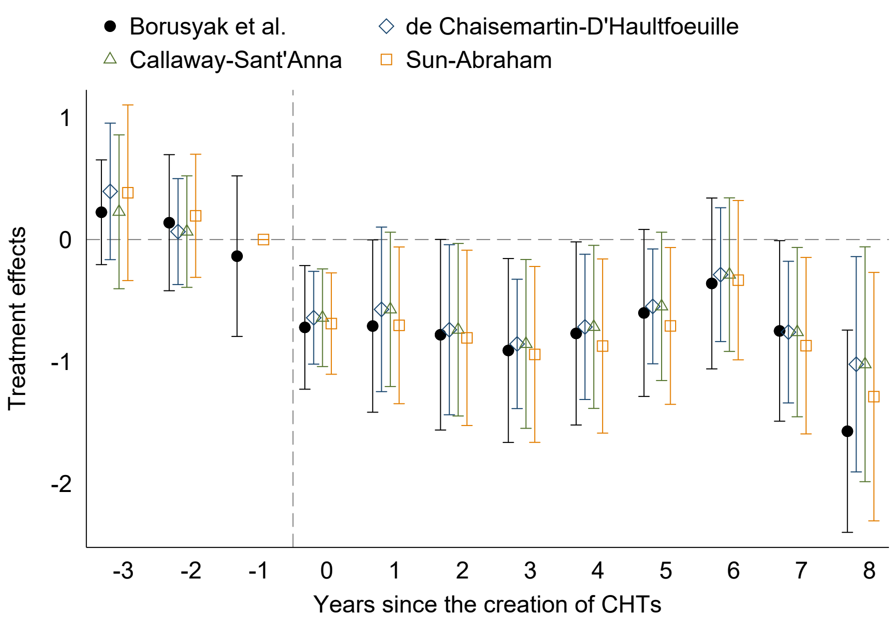
Notes: Same Notes as Table 1. Analysis excludes the cohort of municipalities treated in 2010 (T2010). Sample includes the years 2009, 2010 and 2015.

Figure C1: Consultations and Hospitalizations, Alternative TWFE Estimators

A. Preventive consultations



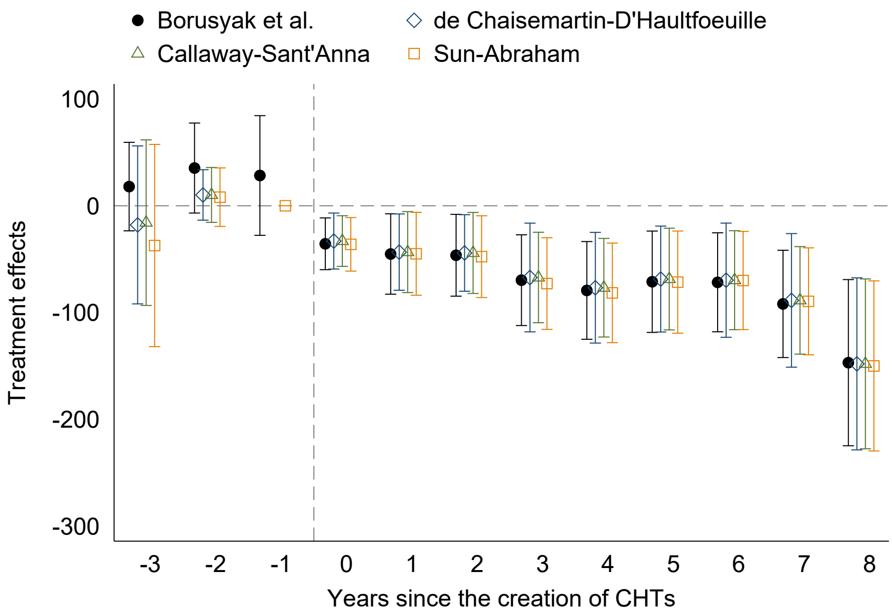
C. Preventable hospitalizations



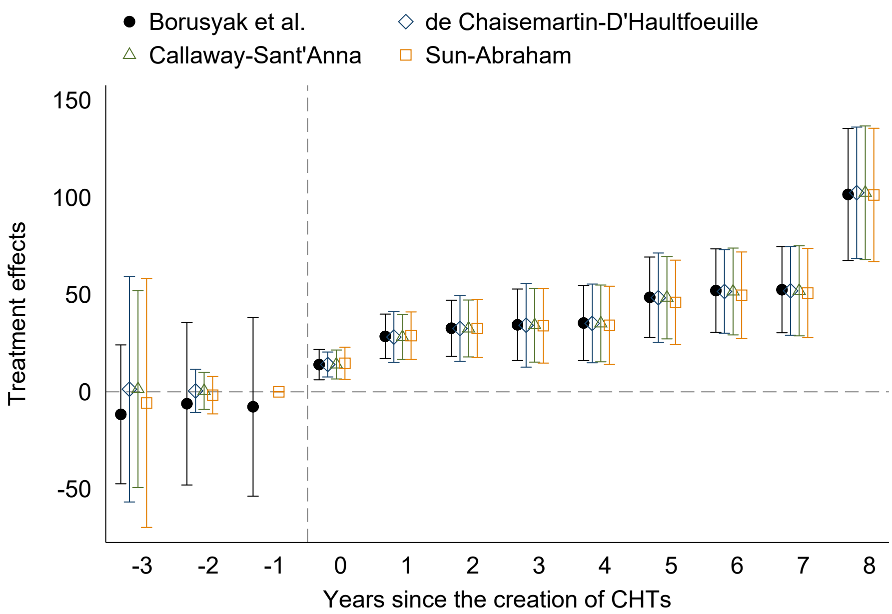
Notes: Same notes as Figure 2. In addition to the imputation estimator of Borusyak et al. (2024), we use three robust estimators: De Chaisemartin and d'Haultfoeuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021).

Figure C2: Amenable Curative Consultations by Disease Type, Alternative TWFE Estimators

A. Amenable curative consultations, CDs



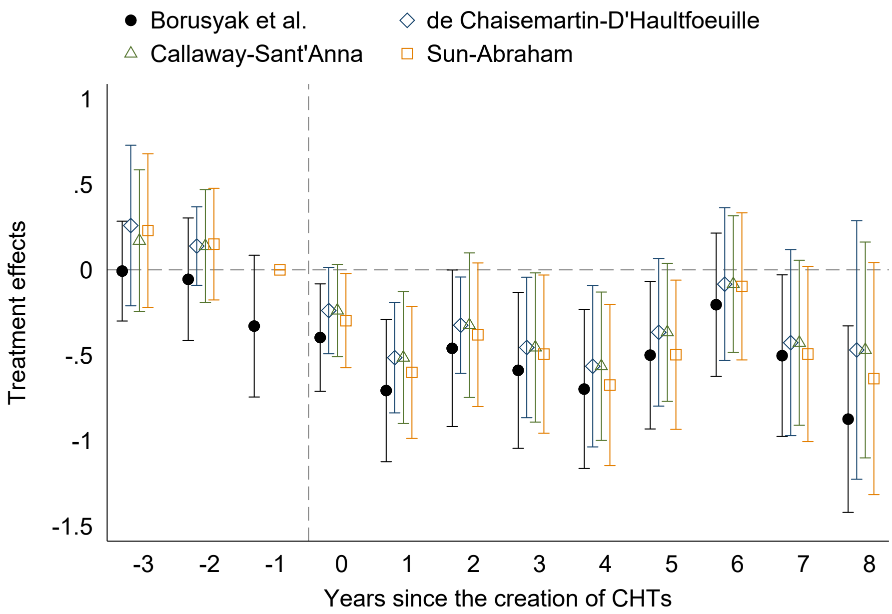
B. Amenable curative consultations, NCDs



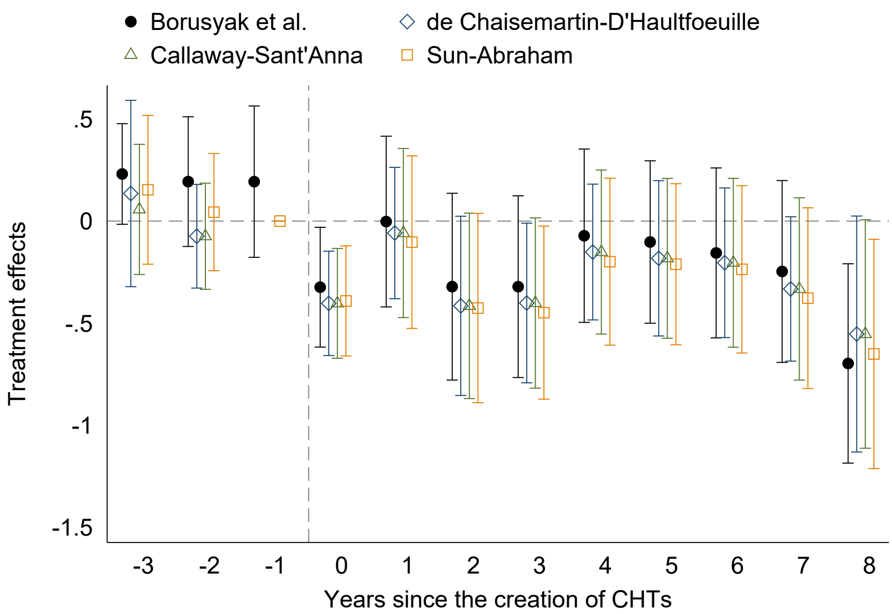
Notes: Same notes as Figure 3. In addition to the imputation estimator of Borusyak et al. (2024), we use three robust estimators: De Chaisemartin and d'Haultfoeuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021).

Figure C3: Preventable Hospitalizations by Disease Type, Alternative TWFE Estimators

C. Preventable hospitalizations, CDs

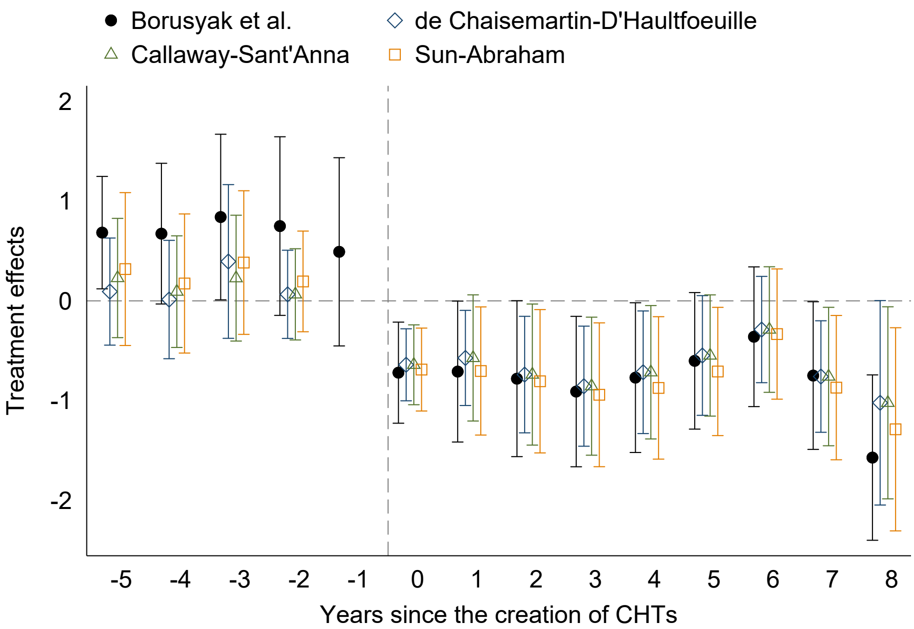


D. Preventable hospitalizations, NCDs



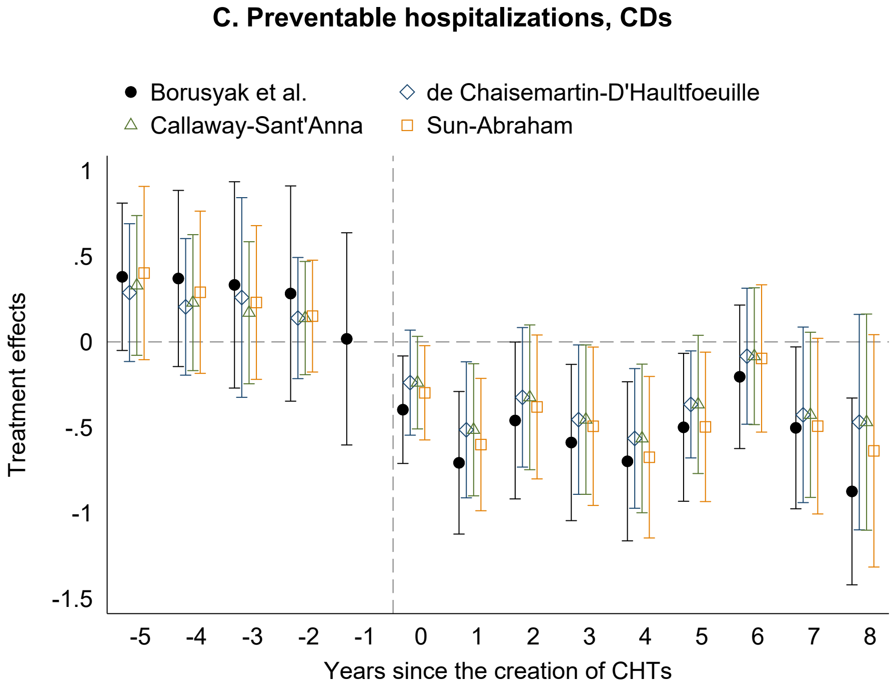
Notes: Same notes as Figure 3. In addition to the imputation estimator of Borusyak et al. (2024), we use three robust estimators: De Chaisemartin and d'Haultfoeuille (2020), Sun and Abraham (2021), and Callaway and Sant'Anna (2021).

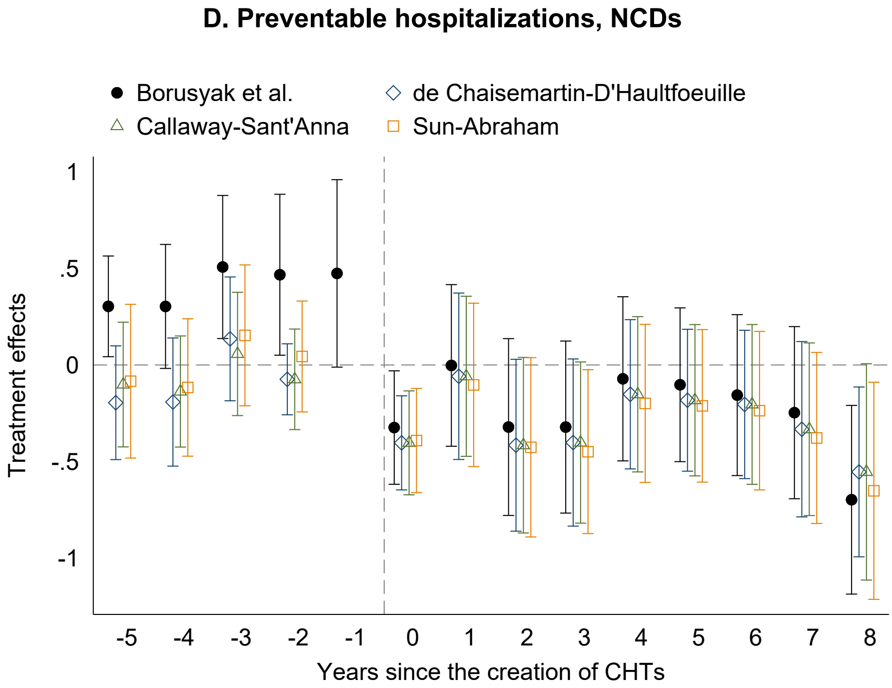
Figure C4: Preventable Hospitalizations, Alternative TWFE Estimators, 5-Year Pre-Trends



Notes: Same notes as Figure C1.

Figure C5: Preventable Hospitalizations by Disease Type, Alternative TWFE Estimators, 5-Year Pre-Trends

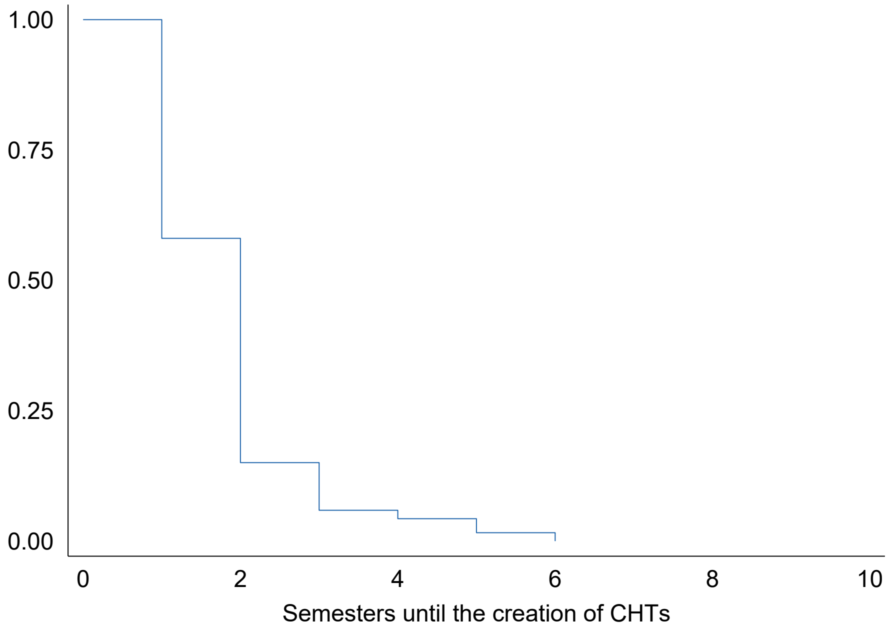




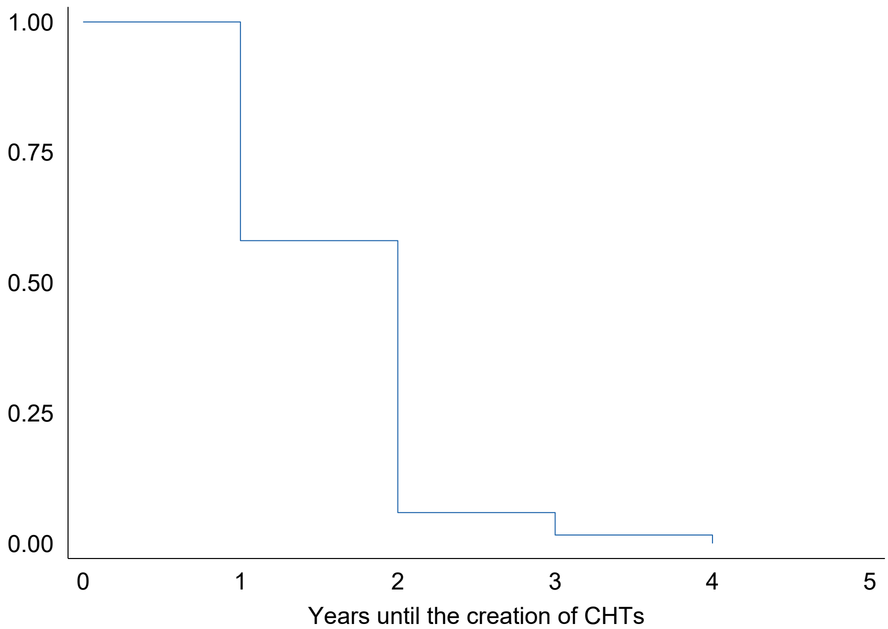
Notes: Same notes as Figure C3.

Figure C6: Hazard plot - Creation of CHTs

A. Half-yearly data

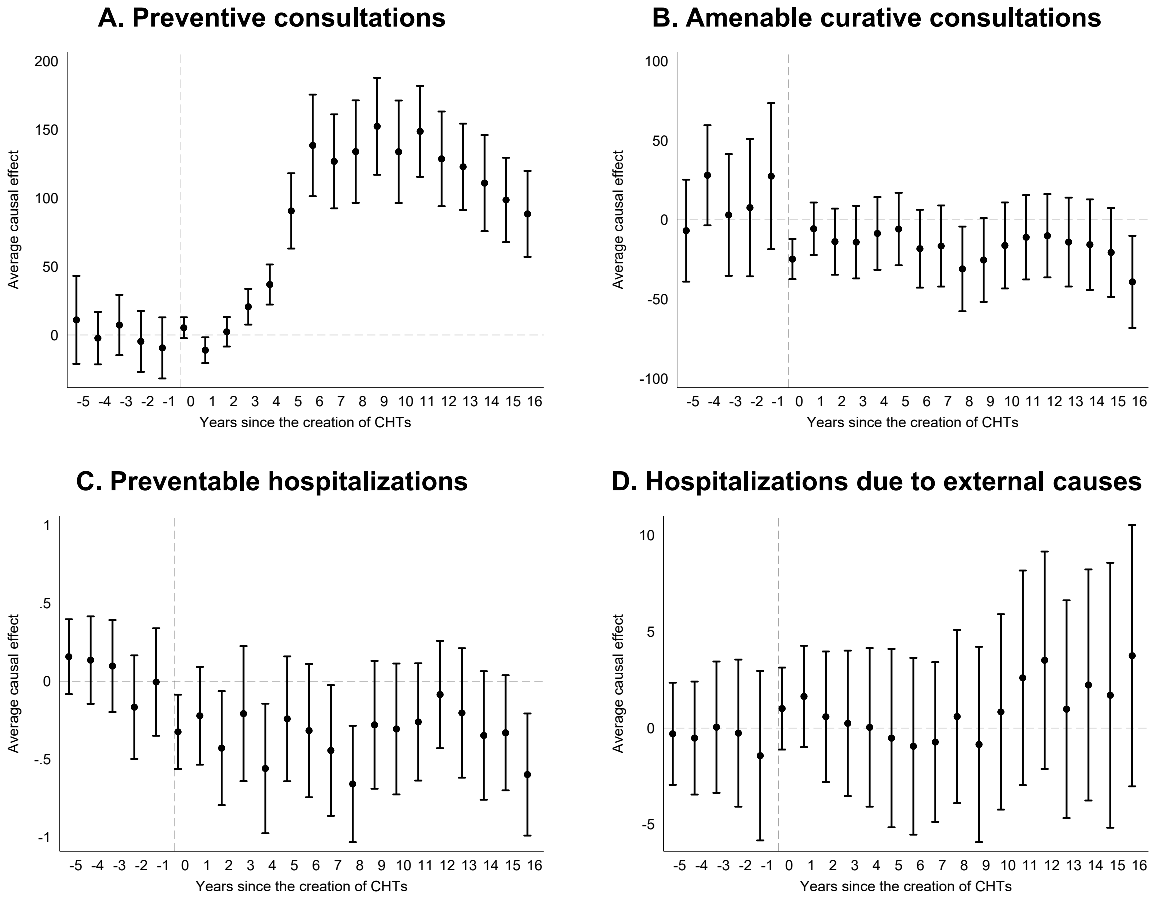


B. Yearly data



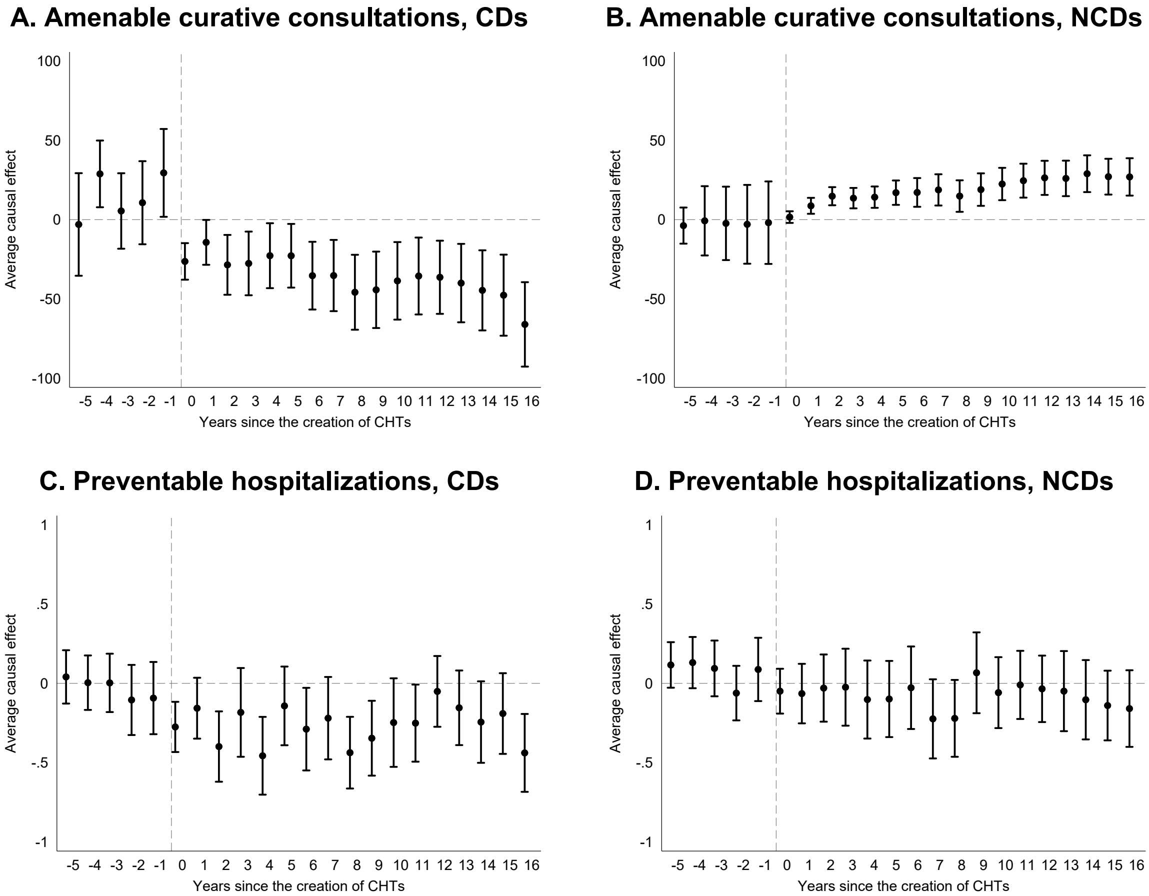
Notes: Periods until the creation of CHTs since 2009, the first year when we have data on medical consultations.

Figure C7: Consultations and Hospitalizations, Half-Year Data



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

Figure C8: Curative Consultations and Hospitalizations by Disease Type, Half-Year Data



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

Table C4: Pre-treatment Effects on Consultations and Hospitalizations, Half-Year Data

	(1) Preventive consultations	(2) Amenable curative consultations	(3) Preventable hospitalizations
Panel A: Total			
CHTs creation	0.37	11.97	0.04
	(10.69)	(14.63)	(0.12)
	[0.97]	[0.41]	[0.72]
Pre-treatment mean	254.01	551.79	3.70
Panel B. Communicable diseases			
CHTs creation		14.30	-0.03
		(9.36)	(0.08)
		[0.13]	[0.70]
Pre-treatment mean		427.58	2.01
Panel C. Non-communicable diseases			
CHTs creation		-2.33	0.07
		(10.25)	(0.07)
		[0.82]	[0.28]
Pre-treatment mean		124.22	1.69
Muni-year	5080	5080	7112
Municipality	254	254	254

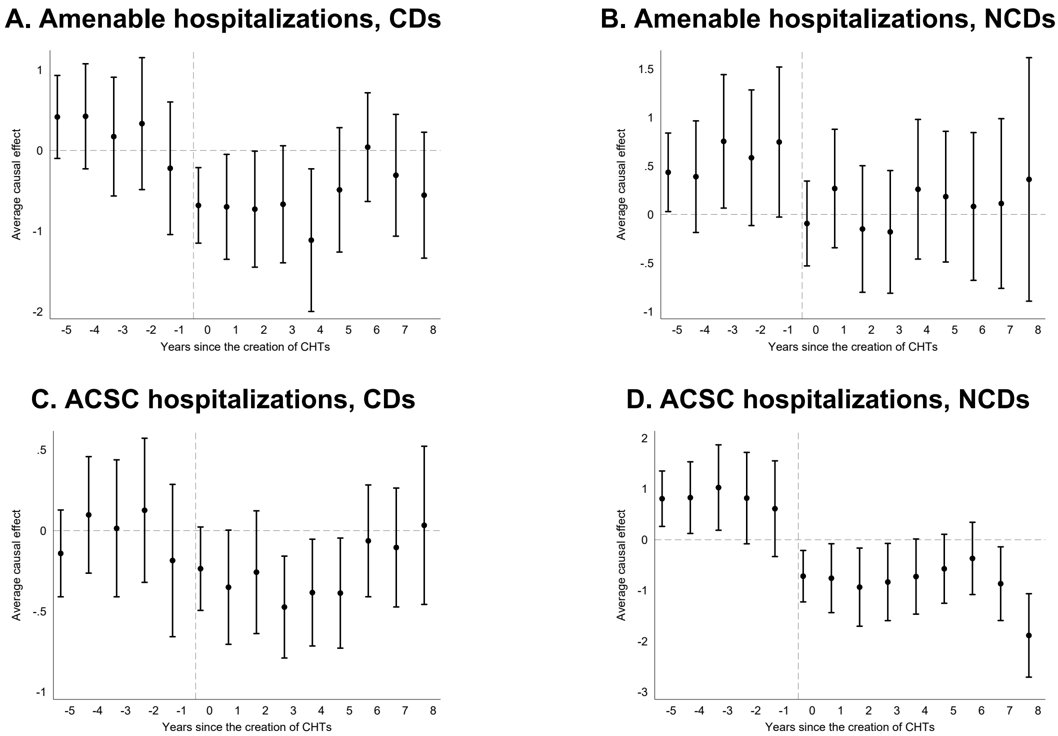
Notes: Same Notes as Table 2. Data at the half-year level.

Table C5: Consultations and Hospitalizations, Total and by Type, Half-Year Data

	(1) Preventive consultations	(2) Amenable curative consultations	(3) Preventable hospitalizations
Panel A: Total			
CHTs creation	60.47	-15.31	-0.38
	(8.68)	(9.82)	(0.16)
	[0.00]	[0.12]	[0.02]
Pre-treatment mean	254.01	551.79	3.70
Panel B. Communicable diseases			
CHTs creation		-28.73	-0.28
		(8.80)	(0.09)
		[0.00]	[0.00]
Pre-treatment mean		427.58	2.01
Panel C. Non-communicable diseases			
CHTs creation		13.42	-0.09
		(3.14)	(0.09)
		[0.00]	[0.31]
Pre-treatment mean		124.22	1.69
Muni-year	5080	5080	7112
Municipality	254	254	254

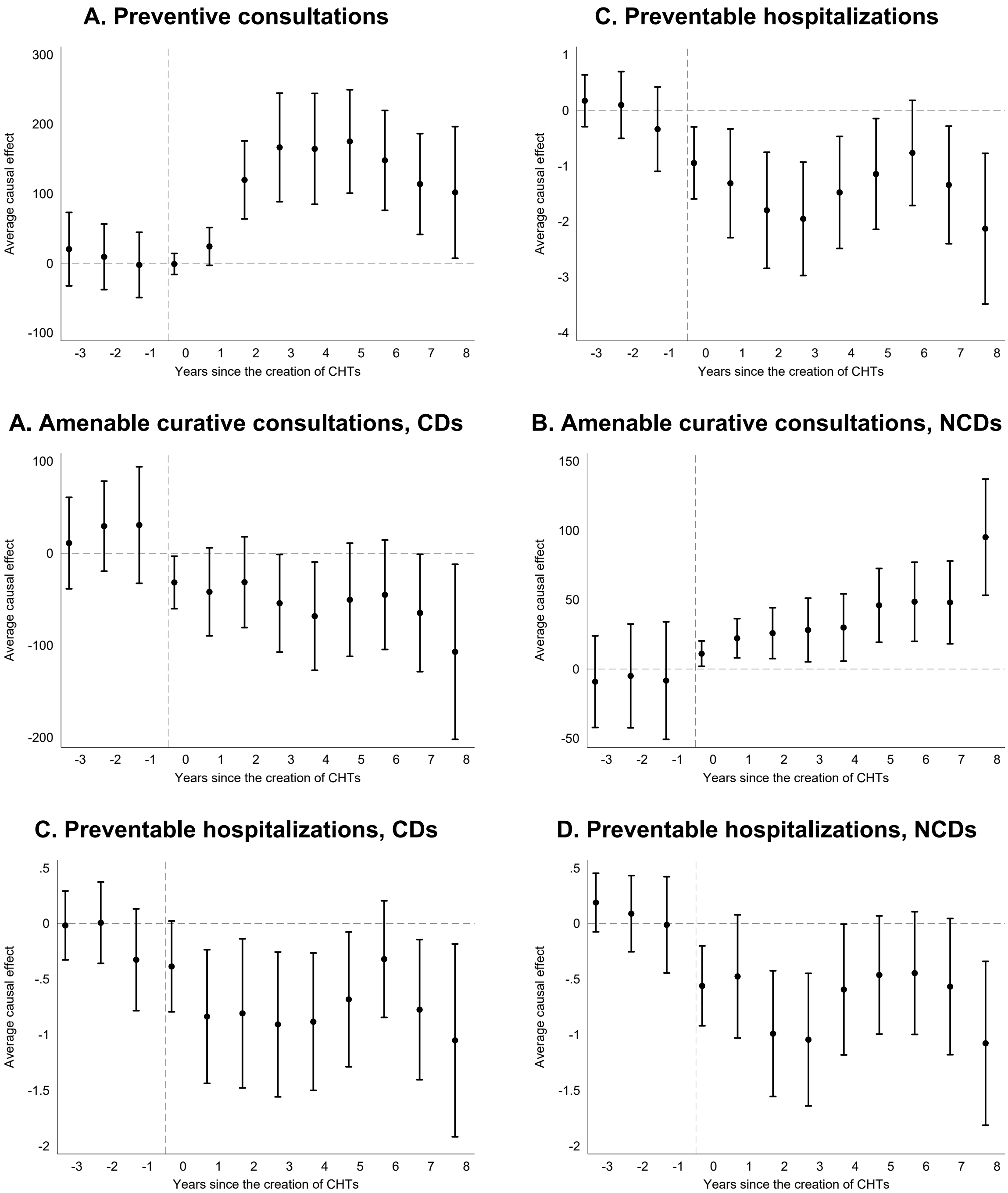
Notes: Same Notes as Table 3. Data at the half-year level.

Figure C9: Effects on Amenable Hospitalizations and ACSC Hospitaizations



Notes: Same notes as Figure 3. Dependent variables are: in Panels (A) and (B) the total hospital discharges due to conditions amenable to effective primary care following Kruk et al. (2018)'s classification (the same one used for amenable curative care), split by communicable (CDs) and non-communicable diseases (NCDs), respectively; in Panels (C) and (D) the total hospital discharges due to ambulatory care sensitive conditions, following Rodriguez Abrego (2012)'s classification, split by communicable (CDs) and non-communicable diseases (NCDs), respectively.

Figure C10: Consultations and Hospitalizations, Poverty x Year Dummies



Notes: Same notes as Figures 2 and 3. All specifications control for the initial share of poor population (from the 2007 census) interacted with year dummies.

D Additional material for Section 5.6, Amenable Mortality

Table D1: Effects on Mortality Rates

	(1)	(2)	(3)
	Amenable MR		**Non-amenable MR**
	Communicable	Non-communicable	Total
Panel A: Static effect			
CHTs creation	-10.68	-16.77	-5.35
	(5.07)	(19.88)	(22.99)
	[0.04]	[0.40]	[0.82]
Municipality-year	2032	2032	2032
Municipality	254	254	254
Panel B: Placebo using later treated			
Treated municipalities	1.16	3.17	23.33
	(9.01)	(23.72)	(33.49)
	[0.90]	[0.89]	[0.49]
Municipalities	79	79	79
Panel C: Static effect using early treated			
CHTs creation	-11.73	-14.98	-4.06
	(5.29)	(20.59)	(24.31)
	[0.03]	[0.47]	[0.87]
2011 control mean	42.33	123.37	331.03
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.