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Health Workforce Reallocation in the Aftermath of Conflict: Evidence from Colombia*

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Abstract

Healthcare workers are in great deficit worldwide, especially in rural and vulnerable areas of developing countries. By leveraging a permanent ceasefire that ended over five decades of armed conflict between the Colombian government and the FARC insurgency, we study the extent to which conflict termination affected the health workforce gap between areas more exposed to FARC violence and other places. Based on individual-level administrative records of all healthcare workers in Colombia and a *difference-in-differences* strategy, we find that the ceasefire caused a differential 11.4% *decrease* in the share of employed healthcare workers per 1,000 people in places more exposed to FARC violence relative to the rest of the country. We find a stronger decrease among healthcare workers with less human capital levels and open-ended labor contracts. We show that this effect is likely explained by lifting mobility restrictions in previously violent areas, and document that, because the net reduction in healthcare workers increased the within-municipality share of (more productive) physicians, it did not translate into a deterioration of mortality rates or healthcare service provision.

Keywords: healthcare workers; armed conflict; violence

JEL codes: I12; I15

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1 Introduction

One of the most pressing issues worldwide is a shortage of healthcare workers (hereafter HCWs). The World Health Organisation (WHO) projects a global deficit of 10 million by 2030, primarily affecting low- and lower-middle-income countries.[1] The health workforce deficit is more pronounced in conflict-affected countries, often afflicted by humanitarian and public health emergencies, along with a low capacity of both the state and the international community to address such challenges. Moreover, the precarious access to essential healthcare eases the rise of communicable and non-communicable diseases. There is, however, little research on the extent to which conflict termination affects the health workforce gap.

This paper addresses this question in the case of Colombia, a country that, because of its long civil conflict history, features both a large shortage of HCWs and a wide gap between conflict-affected areas and the rest of the country. After five decades of conflict, in October 2012 the Colombian government started peace negotiations with the Revolutionary Armed Forces of Colombia (FARC from the Spanish acronym). An important milestone of the peace process was FARC's declaration of a permanent ceasefire at the end of 2014, which was largely met and made FARC's violence plummet by 98% (CERAC, 2016). In this paper, we study the extent to which the end of the conflict with FARC changed the health workforce gap between areas highly affected by FARC violence and the rest of the country.

Using raw data of our main outcome of interest (see section 3), Figure 1 characterizes the main stylized facts that motivate our formal empirical analysis by plotting the evolution of the number of employed healthcare workers per 1,000 people (hereafter "share of HCWs") over our sample period, averaged over municipalities highly exposed to FARC violence and those less exposed/unexposed (as defined prior to the start of the permanent ceasefire).[2] Despite an upward trend in the share of HCWs across all municipalities, the gap between areas highly exposed to FARC violence and the rest of the country was roughly kept constant prior to the ceasefire, with highly affected municipalities having on average 0.8 HCWs per 1,000 people less than less affected areas. However, since 2015 the gap started widening, owing both to a decrease in the share of HCWs in highly affected areas and to an increase in places less affected/unaffected. It peaked in 2017, when it more than doubled, reaching 1.9 HCWs per 1,000 people.

We test formally if the ceasefire caused the observed widening of the health workforce gap. To

[1] Available at https://www.who.int/health-topics/health-workforce#tab=tab_1 (last accessed 01/12/2024).

[2] All figures are based on our preferred estimation sample, which considers municipalities with less than 200,000 inhabitants. This effectively removes the country's large urban areas, where the bulk of the supply of healthcare services is concentrated.

that end, we leverage a unique administrative enrollment system that records key labor market outcomes of every HCW in Colombia (such as place of work and type of contract) and employ a *difference-in-differences* empirical strategy that exploits the timing of the permanent ceasefire and the prior exposure to FARC violence. We find that areas that were exposed to more intense FARC violence prior to the start of the ceasefire experienced a *reduction* in the share of HCWs. In particular, a municipality that experienced a one standard deviation higher FARC violence intensity witnessed a post-ceasefire differential decrease of 0.39 in the share of HCWs, relative to less exposed places. This decrease is equivalent to a 11.4% reduction relative to the mean, and implies an *increase* in the workforce gap between municipalities more affected by the conflict and other areas.

We also document that the differential post-ceasefire contraction of HCWs was not homogeneous across types of professionals. The drop in the rate of physicians (hereafter MDs) was half that of nurses and vocational (or auxiliary) nurses (6% vs. 13%). This implies that the start of the ceasefire also changed the composition of HCWs, differentially *increasing* the share of MDs to total HCWs in more FARC-affected areas

Our findings are robust to several alternative specifications, treatment definitions, comparison groups, and dependent variable measurements. They are also robust to potential spillovers due to sorting, as patients might relocate or commute to neighboring areas to seek medical care, and HCWs might migrate to neighboring areas for work or personal reasons.

We also explore the mechanisms of the documented increase in the health workforce gap. Note that, conceptually, the effect of conflict termination on the share of HCWs is ambiguous. This owes to both demand and supply channels, both of which have inconclusive predictions. Several demand factors may affect the share of HCWs upon conflict termination, many of which are related to the fact that conflict decreases people's mobility and access to markets (see, e.g. Vargas et al., 2024, Prem et al., 2022, Melnikov et al., 2020, and Urrego-Mendoza, 2015), and thus conflict termination lifts such restrictions.[3] Indeed, the end of conflict may: i) increase hospital visits for non-violence related diseases; ii) displace the demand for healthcare services away from areas formerly affected by violence and into neighboring municipalities with (objective or perceived) better healthcare providers (Preyra and Pink, 2006); iii) change migration patterns to and from municipalities formerly affected by violence may. Moreover, –albeit unrelated to lifting mobility constraints– conflict victimization and the damage of key healthcare infrastructure (see, e.g. Parada et al., 2023) imply that, on the one hand, conflict termination likely reduces healthcare

[3] Palacio et al. (2020) interview former FARC combatants who describe how communities and HCWs in areas under their control faced stringent mobility restrictions in the form of curfews and threats. Syed et al. (2013) show that transportation barriers are an important obstacle to healthcare access, particularly for those with lower incomes or who are under or uninsured.

demand for violence-related injuries (Perilla et al., 2024) and, on the other hand, post-conflict reconstruction investments could increase the number of healthcare providers and therefore the demand for HCWs (Kruk et al., 2010).

Similarly, there are various post-conflict supply forces that could influence the number of HCWs in ambiguous directions. For instance, the relaxation of mobility constraints: i) allows HCWs based in areas formerly affected by conflict, who otherwise would be forced to stay, to move into other places; ii) lowers entry costs to the arrival of additional HCWs or new healthcare providers. Conversely, the vulnerability associated with violence exposure may attract HCWs with intrinsic motivation, who would be less appealed by less violent areas.[4] Finally, conflict termination could rend obsolete the role of healthcare services and professionals that specialize in conflict-related conditions, thus creating a skills mismatch relative to the needs of the local population (Roome et al., 2014).

Importantly, to the extent that they differentially affect the preferences and constraints of HCWs with different levels of human capital, in addition to determining the net number of HCWs, many of the described demand and supply mechanisms may also change their skill composition. This is likely in health systems that follow WHO's recommendations regarding *task shifting*, whereby specific tasks are transferred from highly qualified HCWs (e.g., MDs) to less qualified ones (e.g. nurses) to temporarily expand healthcare services in situations characterized by health workforce shortages (WHO, 2007). Indeed, in Colombia, the most prevalent HCWs are vocational nurses (2.7 per 1,000 people).

Our findings are consistent with the idea that conflict termination lifts mobility restrictions in areas previously affected by violence. We provide evidence aligned with this mechanism. First, the post-ceasefire differential reduction in the share of HCWs in highly FARC-affected areas is larger in municipalities better connected to either the road network or to waterways that facilitate fluvial transportation. Second, the differential reduction in the share of HCWs it is also larger in areas located close to department capitals, which are generally bigger, more urbanized, and with thicker, more formal, and more dynamic labor markets.[5] Third, the share of deaths in road accidents increases, and so do the number of ambulances.

In contrast, our findings provide little support for a range of alternative mechanisms. First, using administrative records on the affiliations to the compulsory health insurers of the country,

[4] On the importance of intrinsic motivations for the HCWs decision to work in conflict-affected areas see Kallström et al. (2022) and Serneels et al. (2007). The latter documents that the income premium needed to move physicians into rural areas in Ethiopia drops by half (from 80% to 40%) for professionals with relatively high levels of intrinsic motivation.

[5] Colombian departments are equivalent to states in the U.S. There are 32 mainland departments in Colombia, encompassing over 1,100 municipalities.

we find no evidence of a differential in- or out-migration of (endured) patients after the start of the ceasefire in areas formerly affected by more intense FARC violence. Second, we explore whether the start of the ceasefire attracted new healthcare providers which would presumably affect the demand for HCWs. We find no evidence of a change in this variable, neither in absolute terms nor in its per capita rate. However, even in the absence of a deferential change in the number of providers, the ceasefire could have changed the balance of power among the existing providers, producing potential changes in the concentration of consultations or procedures and, as a consequence, in the number of HCWs. Indeed, it has been shown that, in the U.S., changes in economic conditions that favor the growth of the most productive firms in an industry lead to product market concentration at the expense of the labor share (Autor et al., 2020; Ashenfelter et al., 2022). Third, we show no systematic differential changes in key health infrastructure after the start of the ceasefire, in the form of hospital beds, intensive care units, delivery rooms, and operation rooms.[6]

We also explore the extent to which the documented differential reduction in the share of HCWs in more FARC-affected municipalities after the start of the ceasefire affected municipal-level health-care outcomes. As a validity check of the sharp reduction in violence that followed the declaration of the ceasefire, we find that mortality due to war-related actions significantly decreased in areas highly affected by FARC violence relative to the rest of the country. In turn, and related to the idea that mobility restrictions were lifted with the ceasefire (and also that the absence of violence attracted new infrastructure investment), we also find that mortality due to road-related accidents differentially increased in these areas. Importantly, however, the ceasefire had no effect on mortality due to all other causes. In line with the latter, we find no differential changes in the usage of the healthcare system, as measured either by patients visiting healthcare facilities or by them being visited by a HCW. In addition, and consistent with the aforementioned lack of an effect on patient migration patterns, we document that the ceasefire had no effect in the proportion of the costs accrued to healthcare episodes that take place in the municipality of patients' residency, a proxy of the number of healthcare episodes.[7]

We argue that the fact that the HCW reduction did not precipitate changes in either mortality or health care usage proxies can be explained by the reduction in violence entailing a reduction

[6] Consistent with the increase in mobility and accessibility, however, the total number of ambulances differentially increased by 6% in highly FARC-affected areas.

[7] The combination of the documented differential reduction in the share of HCWs on the one hand, and of the lack of change either: i) mortality rates (for episodes other than war or road accidents); ii) health care usage; iii) and health care episodes, suggests that the workload of the HCWs who remained in areas formerly affected by more intense FARC violence increased. Consistent with this, we find that the number of patient visits to MDs divided by the total number of MDs rose by between 9 and 12%, an amount remarkably similar to the documented differential reduction in the share of HCWs.

in the missallocation of healthcare jobs (Heise and Porzio, 2022). This existed because, consisting with task-shifting (WHO, 2007), violence-affected municipalities relied disproportionally on low-human-capital HCWs. In turn, conflict termination allows MDs to work at full capacity and unconstrained, making the local healthcare system keep the same level of operation with fewer (albeit more productive) HCWs. Our finding regarding the larger post-ceasefire differential reduction in the share of nurses and vocational nurses supports the reduced missallocation argument.

In addition to contributing to the literature on conflict and the health workforce (Kruk et al., 2010; Roome et al., 2014) by studying the effect of conflict *termination*, our paper contributes to other strands of the literature. First, regarding the factors causing health workforce shortages in rural areas (which have been studied by McPake et al., 2014; Mbemba et al., 2016 and WHO, 2020 among others), we show that violence reductions (and therefore increases in the attractiveness of certain areas for work reallocation) can widen preexisting workforce wedges instead of reducing them. Second, we contribute to the literature on how mobility barriers affect healthcare access and imply a sub-optimal distribution of health resources (including HCWs, see e.g., Syed et al., 2013). Finally, we add to the existing studies on the socio-economic effects of conflict termination, and in particular on that of the intended and unintended consequences of Colombia's peace agreement (Prem et al., 2020, 2022, 2023, 2022, 2023; Guerra-Cújar et al., 2024; de Roux and Martinez, 2021; Bernal et al., 2024; Perilla et al., 2024).

2 Context

2.1 Colombia's internal armed conflict and the ceasefire

Colombia's internal armed conflict started with the launch of two nationwide socialist guerrilla movements in the 1960s: FARC and the *National Liberation Army* (ELN from the Spanish acronym). While they were initially located in a few peripheral rural areas, the guerrillas have sought to expand their territorial dominance over decades. In turn, territorial contestation with government forces as well as with illegal right-wing paramilitary groups, has resulted in violence throughout a large part of the country's territory. Violence is further shaped by the scope of illegal activities that fuel the conflict. These include kidnapping, extortion, looting, and the production and trafficking of illegal drugs. Consequentially, most of the almost 9 million officially recognized victims of the conflict are from rural areas.[8]

[8]Source: Victims' Registry, from the Unit for the Victims Assistance and Reparation, November 2020 figure. Available from: https://www.unidadvictimas.gov.co/en (last accessed 12/05/2022).

In October 2012, the Colombian government and FARC started peace negotiations in Cuba. One of the most significant milestones of the peace negotiations was the establishment of a unilateral and permanent ceasefire by FARC on December 20, 2014. While a temporal cease of hostilities was commonly announced by FARC to observe the Christmas festivities, a permanent ceasefire declaration by FARC was unprecedented and unexpected. FARC did so to signal to the government negotiating team its unified nationwide command structure as well as its commitment to reaching a peace agreement. Ultimately, the ceasefire was largely met until it was replaced by the definitive bilateral ceasefire and the subsequent disarmament of FARC in September 2016, when the final peace agreement was reached. This explains why FARC's offensive activities dropped by 98% during this period (CERAC, 2016).[9]

Figure 2 plots the change in the incidence of different proxies of conflict-related violence four years before and after the start of the permanent ceasefire. There is a clear, sharp decrease across all the measures. Our empirical model builds on this differentiated reduction in violence to determine how the ceasefire affected the distribution of HCWs across Colombia and thus the health workforce gap between conflict-affected areas and other municipalities.

Before the start of the ceasefire, the incidence and intensity of violence in FARC-affected areas largely limited the mobility of HCWs and patients. Roadblocks, checkpoints, curfews, and antipersonnel mines, caused fear and reduced people's mobility in and out of places controlled by the FARC (Prem et al., 2022; Vargas et al., 2024). This created obstacles in access and provision of health services. Based on interviews with victims of FARC, Palacio et al. (2020) conclude that "Mobility restrictions imposed by armed groups is one of the aspects that most affected the provision of healthcare, both for the movement of people and for the Medical Mission (...)." In addition, FARC restricted the mobility of HCWs, both in and out of the municipality (Bernal et al., 2022). And even in some cases, medical mission neutrality was not respected (Urrego-Mendoza, 2015). These violations included repression, threats, kidnapping, withholding of supplies, and damage to health infrastructure.

2.2 Colombia's healthcare system

Colombia's healthcare system is organized under a managed care competition, in a compulsory health insurance system introduced by Law 100 of 1993. Law 100 also introduced a purchaser-

[9]While for our purposes, the ceasefire is the most important regime change for the reasons mentioned, it was not the only milestone of the peace process. Others include the announcement of the peace negotiations in October 2012, partial agreements reached over the course of the negotiation on specific items of the negotiation agenda, the actual signature of the agreement in September 2016, its public rejection after a national referendum in October that year, and its definitive ratification by Congress in December. We show empirical support for our choice of the start of the ceasefire as our main source of temporal variation.

provider split, and free consumer choice (of both insurers and providers). According to the OECD: "Colombia offers a remarkable example of rapid progress toward universal health coverage that deserves to be better known internationally" (OECD, 2015, pg. 11).

While Law 100 facilitated the surge of insurance coverage (from 24% of the population in 1993 to 97% in 2014), especially among the poorer and in rural areas, it also brought structural changes in the labor market of HCWs. HCWs are directly hired by healthcare providers, who compete in terms of salaries, type of contracts (open-ended, fixed term, or fee-for-service), and working conditions (e.g. hours of work). In practice, there is an open market for HCWs, where health providers advertise job positions without a centralized allocation mechanism. As part of that competition, healthcare providers in rural areas pay a premium to attract and retain HCWs in compensation for their locations' lower amenities and career prospects (Roa-Gómez and Rodríguez-López, 2021).

While by 2022 there were about 11,500 healthcare providers in the country, HCWs are in high deficit. With 2.3 physicians and 1.4 nurses and midwives per 1,000 people in 2019, Colombia falls short by over 65,000 physicians and 380,000 nurses to reach the OECD per capita average (respectively, 3.6 and 8.8 per 1,000 people in 2021).[10]

People living in areas exposed to high violence levels have on average worse health outcomes across a range of dimensions than people living in less exposed municipalities. For instance, several studies document that they exhibit higher mortality from diarrhea (Alvis-Zakzuk et al., 2018), worse mental health (Pérez-Olmos et al., 2005; Sanchez-Padilla et al., 2009; Bell et al., 2012; Tamayo-Agudelo and Bell, 2018; Ricaurte et al., 2019), and worse indicators associated with health-related quality of life (Yang et al., 2021). These differences may be directly associated with the incidence and intensity of conflict-related violence, o with underlying factors that distinguish highly FARC-affected areas from other places. Indeed, Table A.1 suggests that municipalities with FARC presence are, on average, more rural and poorer. Rurality, in turn, is associated with both ecological factors that directly affect the prevalence of certain diseases (e.g., vector-borne diseases such as Chagas and Malaria, Yu et al., 2014), and with worse state presence, which is concomitant with a weak public health system (García et al., 2022; Garcia-Ramirez et al., 2020; Hessel et al., 2020), as well as with worse health infrastructure (e.g., fewer hospital beds and fewer ambulances).[11]

[10] Source: World Development Indicators, available at https://databank.worldbank.org/source/world-development-indicators (last accessed 01/12/2024).

[11] Victims of the conflict also face higher barriers to accessing health services; in particular, women (Wirtz et al., 2014) and the population with disabilities (Rodríguez Caicedo et al., 2023).

3 Data

Our main outcome of interest is the municipal-specific number of of employed HCWs per 1,000 people, which we refer to as the "share of HCWs," To construct it, we rely, for the numerator, on administrative information from the *Sistema Integrado de Información de la Protección Social* (SISPRO), a centralized information system that captures key labor market characteristics of every single HCW in Colombia (such as place of work, type of contract, and hours worked), as well as characteristics from the healthcare providers and healthcare infrastructure (Guarin et al., 2021). For the denominator, we use the population projections of Colombia's statistics bureau, based on the 2005 population census.

We distinguish between MDs, nurses, and vocational (or auxiliary) nurses. In 2014, these three categories amounted to 55% of the HCWs in Colombia.[12] MDs include general practitioners with undergraduate degrees in medicine as well as specialized physicians. Vocational nurses must have a high school degree plus one year of formal education from a technical college to acquire basic nursing skills. They are not trained in healthcare decision-making. Rather, their tasks include assisting both MDs and nurses in the provision of healthcare, taking vital signs, feeding patients, and taking care of the sanitary conditions of the patient's environment, materials, and instruments (Matallan et al., 2005).[13]

To construct a measure of high exposure to FARC violence before the start of the ceasefire, we use the conflict dataset originally compiled by Restrepo et al. (2003), and updated through 2019 by Universidad del Rosario. This dataset codes violent events recorded in the *Noche y Niebla* reports from the NGO *Center for Research and Popular Education* (CINEP from the Spanish acronym), which provides a detailed description of the violent event, its date of occurrence, the municipality in which it took place, the identity of the perpetrator, and the count of the victims involved in the incident.[14] Specifically, for our treatment variable we created a continuous measure based on the total number of FARC attacks that took place between 2011 and 2014 (before the start of the ceasefire), and normalized it by 10,000 people. We then standardize the continuous measure using the mean and standard deviation from the empirical distribution.[15] Figure A.1 portrays the

[12] The slack is taken by HCWs whose tasks are not interchangeable with those of MDs or nurses. These include dentists, psychologists, pharmacists, microbiologists, and physiotherapists.

[13] The occupational profile for vocational nurses was formally defined by Decree 3616 of 2005.

[14] *Noche y Niebla* sources include 1. Press articles from more than 20 daily newspapers of both national and regional coverage. 2. Reports gathered directly by members of human rights NGOs and other organizations on the ground, such as local public ombudsmen and, particularly, the clergy (Restrepo et al., 2003). Notably, since the Catholic Church is present in even the most remote areas of Colombia, we have extensive coverage of violent events across the entire country.

[15] We focus on FARC violence rather than *presence*. While the latter is conceptually important, as areas controlled by FARC likely experienced a change in governance after the ceasefire, it is much more difficult to operationalize in a systematic fashion with observable actions.

variation in the extensive margin (municipalities with at least one FARC attack).

To examine potential mechanisms, we leverage a variety of data sets. First, we compute movements in and out of a municipality (or between health insurance companies) from the official health insurance affiliation administrative records (known as the *Base de Datos Única de Afiliados*, BDUA). Second, we obtain health infrastructure information and the count of healthcare providers from the healthcare providers registry database (known as *Registro Especial de Prestadores de Servicios de Salud*, REPS). Third, we compute mortality rates from official vital statistics, aggregated at the municipality.[16] Fourth, information about healthcare provision services comes from the *Registros Individuales de Prestación de Servicios de Salud* (RIPS), which records every attention provided by a HCW. Finally, we use the individual survey data from the Colombia chapter of the DHS survey (for years 2010/11 and 2015/16, Gómez-Restrepo et al., 2016), which includes a subset of Colombian municipalities, including half of those coded as being exposed to FARC violence in the extensive margin.[17] From the DHS we study the effect of the ceasefire on the demand for health services.

Table A.1 reports descriptive statistics in municipalities exposed and not exposed to FARC violence before the start of the ceasefire, as measured in both the extensive margin and as a continuous variable of exposure. Exposed municipalities are, on average, more rural, further away from their department capital, and poorer than non-exposed municipalities. Our sample throughout the paper includes all Colombian municipalities except department capitals, large towns and cities (with populations of at least 200,000 people in 2010), and islands. The resulting number of municipalities is 1,092 (out of 1,123 municipalities). These are observed from 2011 to 2019, which determines our sample period.

4 Empirical Strategy

We estimate a *difference-in-differences* model that relies on two sources of variation. The temporal variation is given by the timing of the permanent ceasefire, announced in December 2014. The cross-section variation comes from the exposure of municipalities to different levels of FARC violence prior to the ceasefire. More formally, using the sub-index m to denote municipalities, d for departments, and t for years, we estimate:

$$y_{mdt} = \alpha_m + \delta_{d\times t} + \beta\left(Cease_t \times FARC_m\right) + \sum_{c\in\mathbf{X_m}} \gamma'(c \times \delta_t) + \varepsilon_{mdt}, \tag{4.1}$$

[16] In particular, we explore deaths related to external causes according to the WHO/PAHO 666 list.

[17] The survey covers 193 municipalities in 2010/11 and 220 in 2015/16. 99 of those have historic FARC violence.

where y_{mdt} is the share of HCWs. α_m and $\delta_{d\times t}$ are respectively municipal and department/year fixed effects. The former captures any time-invariant municipal-level heterogeneity and the latter any shock that differentially affects specific departments over time. $Cease_t$ is a dummy that equals one after the start of the permanent ceasefire (hence 2015 onward) and $FARC_m$ measures pre-ceasefire exposure to FARC violence. X_m is a vector of various municipality characteristics measured before the start of the ceasefire that we interact with year fixed effects to flexibly control for differential trends in the outcome parametrized by each one of the municipal attributes included in the vector. Finally, ε_{mdt} is the error term, which we cluster at the municipality level. We use as regression weights the municipal population in 2011. Our coefficient of interest, β, captures the differential change in the share of HCWs after the start of the ceasefire relative to before, in municipalities more exposed to FARC violence relative to those less exposed (or unexposed) to it.[18]

The main assumption behind the *difference-in-differences* strategy is that, in the absence of the ceasefire, the share of HCWs in municipalities more exposed to FARC violence would have evolved similarly to those in municipalities less exposed. The validity of this parallel trends assumption can be partially assessed by estimating the following dynamic version of the main specification:

$$y_{mt} = \alpha_m + \delta_{d\times t} + \sum_{j\in T} \beta_j (FARC_m \times \delta_j) + \varepsilon_{mdt} \tag{4.2}$$

where T includes all years of our sample period except 2014, which is the year prior to the ceasefire. Therefore, the parameters β_j can be interpreted as the difference in the share of HCWs health workers in municipalities more exposed to FARC attacks compared to municipalities less exposed, in year j relative to 2014.

To study the extent to which our results are driven by the potential migration of HCWs or patients away from highly FARC-affected areas and into neighboring control municipalities after the start of the ceasefire, we estimate an augmented version of equation (4.1) that includes an indicator of municipalities that did not experience FARC violence prior to the ceasefire but are located in the proximity of a treated municipality, interacted with the ceasefire dummy. We estimate:

$$y_{mdt} = \alpha_m^{(r)} + \delta_{d\times t}^{(r)} + \beta^{(r)} \left(Cease_t \times FARC_m\right) + \eta^{(r)} \left(Cease_t \times Neighbor_m^{(r)}\right) + \varepsilon_{mdt}^{(r)} \tag{4.3}$$

where the dummy $Neighbor_m^{(r)}$ takes the value of one for municipalities without any FARC violence located within r kilometers from the nearest municipality exposed to any FARC violence before

[18] When analyzing individual-level survey data as part of the mechanisms, the specification above includes fixed effects by age, marital status, and education level.

the ceasefire.[19] The coefficient η^r captures the effect of the ceasefire in non-FARC municipalities that are in the proximity of FARC-affected areas. Conversely, $\beta^{(r)}$ capture our effect of interest net of any potential spillover to neighboring areas, as defined by a radius r. By using different radii, we can test the robustness of this analysis to account for potential spillovers closer or farther away from treated areas.

Finally, we also explore heterogeneous effects as part of our analysis of the potential mechanisms that can help explain the effect of the ceasefire on the health workforce gap. To do so, we consider a range of municipal characteristics that were measured prior to the ceasefire, and construct for each one of them and an indicator Z_m that equals one if the value of the characteristic in municipality m is larger than its empirical distribution across municipalities. We then augment the main specification in equation (4.1) by adding Z_m as a third interaction term. We estimate:

$$\begin{aligned} y_{mdt} =& \alpha_m + \delta_{d\times t} + \beta_1 \left(Cease_t \times FARC_m \times Z_m\right) \\ &+ \beta_2 \left(Cease_t \times Z_m\right) + \beta_3 \left(Cease_t \times FARC_m\right) + \varepsilon_{mdt}. \end{aligned} \tag{4.4}$$

where the coefficient of interest, β_1, captures the differential change in the share of HCWs in places highly exposed to FARC violence, that, in addition, feature characteristic Z_m.

5 Results

Table 1 reports our estimates of the effect of the ceasefire on the share of HCWs. Column 1 adds municipality and year fixed effects, Column 2 changes the latter for department/year fixed effects and, keeping the latter set of fixed effects, Column 3 includes a range of pre-ceasefire municipal characteristics interacted with the year fixed effects.[20]

We find that, after the start of the ceasefire and relative to the rest of the country, places highly exposed to FARC violence experienced a significant reduction in the share of HCWs. Because our measure of exposure to FARC violence is standardized, based on the specification of Column 2, our estimate suggests that a municipality that experienced a one standard deviation higher FARC violence intensity, witnessed a post-ceasefire differential decrease of 0.39 HCWs per 1,000 people. This is equivalent to 11.4% of the sample mean.

We also investigate the effect of the ceasefire on the share of different types of HCWs. This is motivated by the fact that the number of vocational nurses in Colombia is 2.5 times that of

[19] In the extensive margin, there are 99 municipalities at at least one FARC attack between 2011 and 2014 and 993 without any attack.

[20] These include population, distance to the department capital, a rurality index, and a poverty index.

MDs and 4.5 times that of professional nurses. As discussed in Section 2, this disparity in favor of HCWs with low human capital, together with the larger deficit of HCWs in conflict-affected areas, has facilitated a situation of task-shifting, whereby the tasks that normally would be carried out by higher human capital professionals are taken over by lower human capital workers (WHO, 2007). Based on the specification that includes municipality and department/year fixed effects, Table 2 summarizes these findings. For reference, the effect on the aggregate share of HCWs is reported in Column 1, with Columns 2, 3, and 4 reporting the estimated effects on the share of vocational nurses, (professional) nurses, and MDs respectively. Further, we discriminate between HCWs with any type of labor contract (Panel A), and those with either open-ended contracts (Panel B), or working as independent (that is, on task-based contracts, Panel C).

Relative to the mean of each specific health worker, the ceasefire decreased the share of vocational nurses on any labor contract by 13% (0.28/2.13) differentially in areas exposed to high levels of FARC violence relative to other places. It also differentially decreased the share of nurses by the same amount, and that of MDs by half that magnitude (6%). For the case of HCWs on open-ended contracts, the ceasefire differentially decreased the share of vocational nurses by 19% and that of professional nurses by 21%. There is no effect on the share of MDs working under these types of contracts. Regarding HCWs on task-specific (temporary) contracts, the ceasefire only differentially decreased the share of vocational nurses (by 9%).[21] These findings suggest that the ceasefire triggered a differential reallocation of HCWs in terms of their human capital, type of contract, and gender. By reducing in a much higher proportion the share of nurses (vocational and to a lesser extent professional), it differentially increased the share of MDs relative to all HCWs in the most FARC-affected areas. It also increased the relative proportion of male HCWs. Moreover, at least for less qualified HCWs, the ceasefire had a toll on job security by deferentially reducing the share of open-ended contracts.

5.1 Validity of the identification assumption

Recall the validity of these results hinges on the so-called parallel trends assumption (see section 4). To assess its validity, Figure 3 plots the coefficients estimated from equation (4.2), together with the 95% confidence interval. In grade shades and different markers for the point estimates, the figure plots the coefficients of the three alternative specifications reported in Table 1. Reassuringly, across all specifications we find no differential trends in the share of HCWs before

[21] Regarding the gender of the HCWs affected by the start of the ceasefire, Table A.2 documents that most of the effect is driven by males, and in particular those working as vocational nurses, for which the differential decrease is 14% of the mean. In the case of professional nurses, the decrease is very similar across genders (10% for women and 9% for men).

the start of the ceasefire.[22] However, after its announcement municipalities previously more exposed to FARC violence experienced a decline in the share of HCWs relative to other areas. The figure also reveals interesting dynamics, as the documented differential decline is increasing in magnitude for the entirety of our post-ceasefire sample period.

Figure A.2 is equivalent to Figure 3 but focuses on the different types of HCWs. For comparison purposes, it keeps constant the domain of the vertical axis, which allows us to visually compare the relative differential reduction of the share of HCWs across different levels of specialization and human capital. Reassuringly, in all cases, we find no differential trends before the start of the ceasefire. The differential reduction in the share of HCWs is significant across all types, but much bigger in magnitude for the case of vocational nurses (Panel d).

As a parametric counterpart, to ensure that the effect of the ceasefire on the health workforce gap was not driven by already diverging trends across municipalities exposed to high levels of violence and other areas, in Table A.3, we report placebo estimates of equation (4.1) in which the treatment period is defined prior to the actual start of the ceasefire (i.e., in years 2012, 2013, and 2014) and the sample period ends in 2014. In neither case, we find a statistically significant effect of the placebo treatments on the share of HCWs.

5.2 Additional robustness

Table 3 examines the robustness of our main findings to a range of alternative empirical exercises that we describe in this subsection. We begin by showing that our results are robust to defining the treatment as a dummy variable that takes value one if the total number of FARC attacks experienced over the period 2011-2014 and divided by 10,000 people is above the 25th percentile of the empirical distribution. We find that these municipalities experienced a differential decrease of 1.06 HCWs per 1,000 people. This is equivalent to almost a third of the mean.

Second, we acknowledge that one potential threat to identification is that municipalities highly exposed to FARC violence may be different from other areas along non-observed characteristics, some of which may have been exposed to shocks other than the start of the ceasefire but that took place concomitantly. To alleviate this concern, we estimate our main model using different sets of control municipalities. First, we restrict the estimation sample only to municipalities that were affected by conflict from 2011 to 2014, either by FARC or by other illegal armed group (see Section 2). As shown in Column 2, the magnitude of the point estimate is extremely similar to that of the baseline specification (Column 2 of Table 1). Alternatively, we follow Crump et al.

[22] A joint significance test does not reject the null of all the pre-ceasefire coefficients being equal to zero at conventional levels.

(2009) and truncate the sample of municipalities based on the distribution of the propensity score, so as to increase the overlap in municipality characteristics between highly FARC-affected and other municipalities.[23] Column 3 suggests that the results are also robust to changing the control group in this way (and if anything their magnitude is somewhat larger).

Third, Columns 4 and 5 imply that our estimates are not driven by outlier observations. We show that is the case by winsorizing the dependent variable, respectively, at the 1% and 5% of the empirical distribution.

Finally, we estimate equation (4.3) to test for potential spillovers to neighboring municipalities not affected by FARC violence. Figure 4 summarizes these findings. The horizontal axis varies r, the radius (in km) that defines the neighboring municipalities considered for the spillover analysis. Panel A reports estimates of β^r, the impact of the ceasefire on the share of HCWs after controlling for the potential spatial spillovers, together with their 95% confidence interval. It also plots (blue line with diamond markers) the number of municipalities in the control group, which decreases on the size of the considered radius, r. The figure suggests that the baseline effect is stable across spillovers of different radii. Naturally, the estimate becomes somewhat more imprecise as the number of pure controls decreases.[24] In turn, Panel B reports estimates of η^r, the spillover effect of the ceasefire in neighboring municipalities. The 95% confidence interval of the estimates overlaps with zero across all different radii, suggesting that the ceasefire had rather negligible spillover effects regarding the share of HCWs.

6 Mechanisms

6.1 Lifting mobility restrictions

We first explore potential heterogeneous effects to indirectly test the hypothesis that, by lifting mobility restrictions (in the form of roadblocks, curfews, landmines, etc., see Section 2), the sharp reduction in FARC's violent activity that followed the announcement of the permanent ceasefire facilitated the mobility of HCWs or patients. Using the specification described by equation (4.4), Table 4 reports heterogeneous effects across a range of factors related to this hypothesis.

[23] We use the following municipal characteristics to construct the propensity score: poverty and rurality indexes, distance to the county's capital, total population, coca and gold, and literacy rate. The resulting optimal cut-off is 5.2%.

[24] The stability of the effect is consistent with the fact that our baseline specification compares FARC areas exposed to high levels of violence with areas exposed to lower levels (as well as with non-exposed areas). Thus part of the variation comes from the intensive margin. It also suggests that to the extent that HCWs are moving to other areas, by and large they do not settle (for working purposes) in the neighborhood of their municipality of work before the ceasefire.

Columns 1 and 2 explore whether the reduction in the share of HCWs is larger in places better connected to the existing road network. Road connectivity is either measured by the total road length of all the roads (paved or unpaved) that pass through municipality m, or by the number of such roads.[25] Similarly, Column 3 looks at potential heterogeneity in terms of the distance to the closest waterway infrastructure, as fluvial transportation is prevalent in rural Colombia. Finally, Column 4 studies a potential heterogeneity concerning the distance to the capital of the department hosting municipality m. In all four cases, we find that the differential reduction in the share of HCWs following the start of the ceasefire is exacerbated in areas that are better connected or closer to bigger cities.

Clearly, the increasing mobility opportunities could also change migration patterns and therefore the demand for health care services (and thus indirectly that for HCWs). For instance, some of the people living in areas affected by high levels of FARC violence may be inclined to leave when violence deescalates. Alternatively, former conflict victims (e.g., internally displaced people) may choose to return to the land and re-connect to pre-established networks of family or friends. We explore this possibility in Appendix Table A.4, through a range of migration proxies. For instance, Column 1 reports the estimated difference-in-differences coefficient (using equation 4.1) of the effect of the ceasefire on the share of individuals who changed an insurance company. Indeed, to the extent that insurance companies are region-specific in rural Colombia (where there is free competition of insurers, see Section 2), this is a reasonable proxy of mobility across regions. In any case, Columns 2 and 3 look directly at the share of migrants, respectively out or in municipality m. In turn, Columns 4 and 5 estimate the effect of the ceasefire, respectively, on the share of people who, because of their socioeconomic status, are eligible for subsidized health coverage, and to the (log) of people affiliated to the contributive health regime. In all cases, the estimated coefficients of the differential effect of the ceasefire in areas highly affected by FARC violence is very close to zero and not statistically significant. Overall, we find no evidence of any significant in or out-migration of patients following the ceasefire, which suggests that changes in the demand for healthcare services are an unlikely mechanism of our baseline results.

6.2 Changes in healthcare providers

The ceasefire may have also changed the demand for HCWs by differentially changing the number or market power of the healthcare providers or the health insurance companies present in the municipalities traditionally exposed to higher levels of FARC violence. We explore the possibility of differential changes in the number of healthcare providers or health insurance companies in

[25] See the main such roads, together with a proxy of exposure to FARC violence in the extensive margin in Appendix Figure A.1.

Appendix Table A.5. Using our preferred specification, we estimate the effect of the ceasefire on the absolute number of health care providers (insurance companies) in Column 1 (3) and the per capita normalized counterpart in Column 2 (4). We only find a significant increase in the normalized number of insurance companies. However, the size effect is rather small (2% of the mean) and significant at the 10% level. This suggests that this alternative demand channel is unlikely to explain the documented effect of the ceasefire in the share of HCWs.

Alternatively, and even in the absence of differential changes in the number of healthcare providers or insurers, the demand of HCWs could have changed following the ceasefire as a result of changes in the concentration of healthcare services across municipalities. This could be the case if the ceasefire allowed the health system to specialize across geographical lines. We explore this alternative in Columns 3 and 4 of Appendix Table A.6, where we estimate the effect of the ceasefire on a municipality-specific Herfindahl–Hirschman Index (HHI) of healthcare services (using as proxies of services healthcare consultations and procedures).[26] We find no evidence of a change on the concentration of services.

6.3 Healthcare infrastructure

We also examine if incumbent healthcare providers changed the provision of services in the extensive margin through changes in healthcare infrastructure, for instance by updating equipment technology or by selling capital goods used in the production of healthcare. Indeed, an important cost of conflict is the high risk of investment in infrastructure, given that capital goods are strategic targets during military confrontations. Conversely, the end of conflict may trigger new incentives to change the available infrastructure. Appendix Table A.7 reports regression results from estimating equation (4.1), using as a dependent variable several measures of healthcare infrastructure. We examine the effect of the ceasefire on the share of adult hospitalization beds per 1,000 people (Column 1), the likelihood of having at least one intensive care unit (Column 2), the share of delivery rooms per 1,000 people (Column 3), the likelihood of having an operating room (Column 4), the share of basic ambulances per 1,000 people (Column 5), and the likelihood of having at least one ambulance with advanced life support (Column 6). In line with the results of Guerra-Cújar et al. (2024), who study the effect of the ceasefire on fertility, our results show no evidence of changes on key healthcare infrastructure with the exception of the rate of basic ambulances per 1,000 people, which increases by 6% relative to the mean. Incidentally, however, this finding is consistent with the idea that the start of the ceasefire lifts the mobility restrictions

[26] We compute the HHI for municipality i as follows: $HHI_i = \sum_{j=1}^{J} s_{ij}^2$, where s_{ij} corresponds to the share of total expenditures of residents of municipality i delivered by municipality j. An HHI of one is equivalent to having only one provider, of 0.5 to having a duopoly with equal shares, of 0.33 to having three firms with equal shares, and so on. An HHI above 0.25 is typically considered a concentrated market.

that were in place over the course of the conflict.

6.4 Compositional changes, service provision and productivity

Recall that the documented reduction in the average share of HCWs hides important compositional dynamics related to the type of HCW, especially in terms of human capital and contract type. We documented that, following the ceasefire, the differential reduction in the share of HCWs in formerly FARC-affected areas is driven by nurses and especially by auxiliary (vocational) nurses rather than professionals, and particularly by those under open-ended contracts. We also argued that these heterogeneities are consistent with a task-shifting strategy carried out in conflict-affected areas, where most of the tasks that otherwise would be performed by MDs, are carried out by other, less specialized, HCWs. Once the conflict ends and mobility is freed, this "distortion" corrects itself leaving formerly violent municipalities with a differentially higher share of MDs. In this subsection, we ask whether these dynamics have consequences in terms of the provision of healthcare services and the outcomes associated with such provision.

We start by studying whether, by largely reducing the share of (vocational and professional) nurses, the ceasefire caused differential changes in the share of medical services provided by MDs. In Table 5, we estimate our baseline specification (equation 4.1) using two proxies of the share of services provided by MDs.[27] The first is the share of medical visits (Columns 1 to 4) and the second is the share of patient visits to an MD (Columns 5 to 8). To explore the potential differential effects driven by the change in the health workforce composition in municipality m relative to other places, we also measure visits according to the place of residence of the patient (Panel A) and by the place of service provision (Panel B).

Column 1 shows that the ceasefire differentially increased the share of medical visits per MD in places highly exposed to FARC violence relative to other municipalities. This is however not statistically significant, but the magnitude is similar between the place of residence of the patient (228 additional medical visits per MD or a 6.3% increase relative to the mean) and the place of service provision (162, 6.6%). This suggests no differentiated composition by location of the attention. Column 2 shows a similar story for medical visits related to external causes (that includes violence-related injuries directly related to the armed conflict). While these results are not statistically significant either, we do find a statistically significant increase in the services provided by MDs when we consider that patients could be counted twice (Columns 5 and 6). These results suggest an increase in the services provided by MDs after the ceasefire–in a similar amount if we consider the place of residence that of service provision. Finally, Columns 3 and 4

[27] This is because a patient can have multiple medical visits in a year.

show that the ceasefire had virtually no effect on the share of medical visits per 1,000 people (an insignificant 3.5% reduction).

Moreover, the HCW net reduction and its compositional change caused by the ceasefire could have also affected mortality rates by different causes in FARC highly affected municipalities relative to other areas. To explore this possibility, Table A.8 examines the effect of the ceasefire on mortality rates (as measured per 100,000 people) across different dimensions of external causes, particularly related to violence and accidents.[28] Violence is an important cause of mortality in Colombia: homicides correspond to 16% of all deaths, and casualties due to war efforts correspond to nearly 2%. In turn, road accidents, which are one of the leading causes of external death causes correspond to 5% of all deaths.

The table shows three pieces of evidence. First, there is a mechanic effect of the ceasefire whereby the mortality due to war actions differentially drops in these areas (see column 4). This reduction is also large, amounting to almost a third of the mean. Second, consistent with the main mechanism that, as we have argued, explains the observed dynamics in the share of HCWs, namely an increase in mobility, we find that the mortality rate due to road accidents increases by about 10% (see Column 6). Third, and consistent with the idea that the overall demand for HCWs did not change–in spite of the two aforementioned facts, which cancel one another–we find that the overall mortality rate is unchanged. This is not just noise: taking the point estimate at face value (Column 1) it decreases by 0.5%.

In addition to the overall lack of change in mortality rates, we document that the usage of health services did not differentially change in treated municipalities relative to the control group. To this end, we rely on two waves of the Colombia chapter of the Demographic Health Survey (DHS, see Section 3) to estimate whether the ceasefire had an effect on the probability that survey respondents visited a healthcare facility, and of the probability that they were visited by a HCW in their home.

As a first test, we re-estimate our baseline specification of the effect of the ceasefire on the share of HCWs in the sub-sample of municipalities covered by the DHS. In spite of being about 20% of Colombia's municipalities, half of our FARC-treated municipalities in the extensive margin are available in that sub sample. Column 1 of Appendix Table A.9 shows that the point estimate of our preferred specification is remarkably similar in this sub-sample to the one estimated in the entire sample of municipalities (see Column 2 of Table 1). The ceasefire differentially reduced the share of HCWs by 0.34. This is equivalent to 8.5% of the mean (compared to 0.39 HCW per

[28] While the national mortality rate in this period was between 400 and 600, the mean of 225 observed in column 1 reflects the differential demographic composition of the treated municipalities in our sample (on average, a population younger than in cities).

1,000 people, 11.4% of the mean in the entire sample).

After establishing that the DHS sub-sample is valid to test for the effect of the ceasefire on proxies of healthcare usage, we document that it did not differentially change the probability that a survey respondent visited a healthcare facility (Column 2 of Table A.9), or the probability that she was visited by a HCW in her home (Column 3).

Overall, this evidence suggests that, perhaps because of their higher initial human capital levels the HCWs (MDs) remaining in formerly FARC-affected places after the start of the ceasefire are on average more productive. The reason for the productivity increase may be twofold, but exceeds the scope of this paper. We posit that, on the one hand, the remaining HCWs face a largely less stressful and fearful environment. On the other, they are able to produce better results by complementing their healthcare provision with referrals to healthcare services in other areas, which is facilitated by the absence of mobility constraints.

7 Conclusions

HCWs are in great deficit worldwide, especially in rural and vulnerable areas of developing countries. In this paper, we focus on Colombia, a country that experienced five decades-long armed conflict, and study the extent to which the ending of such conflict decreased the pre-existing health workforce gap between conflict-affected areas and the rest of the country. To that end, we implemented a difference-in-differences empirical strategy that exploits a permanent ceasefire announced and implemented by FARC amid peace negotiation, along with the differential exposure to FARC violence before the ceasefire across the country. We find a differential reduction in the share HCWs after the start of the ceasefire in municipalities previously highly affected by FARC's violence. This implies that the reduction in violence increased the workforce gap instead of reducing it. The effect is larger for HCWs with lower human capital levels, which are relatively abundant in Colombia and thus usually take on tasks that would normally be the responsibility of specialized physicians.

While the differential decrease in the share of HCWs seems a priory unexpected. The paper also presents different pieces of evidence suggesting that the reduction in violence lifted mobility restrictions in affected municipalities, thus increasing access and the ability to move within previously violent municipalities as well to neigboring areas. This also facilitated the work of more specialized HCWs. We also provide evidence against mechanisms related to migration, changes in the composition of healthcare providers, or changes in healthcare infrastructure. Importantly, we document that the differential decrease in the share of HCWs did not translate into a significant deterioration of healthcare outcomes, thus suggesting that it triggered a re-organization of the

health workforce towards better-educated and more productive HCWs.

Even if the lack of adverse effects in average health outcomes and overall mortality is encouraging, and suggests that the ceasefire largely triggered an efficiency improvement in the healthcare labor marker of traditionally conflict-affected areas, there persists a substantial gap in health conditions, which translate into higher mortality and morbidity levels (Guerra-Cújar et al., 2024). From this perspective, and leading to no changes in healthcare provision and access, the plummeting violence levels in Colombia open up a unique opportunity for closing these gaps. However, this can only be achieved through active policy initiatives, that include: implementing mechanisms that facilitate the mobility of patients seeking care, improving amenities and wage differential in remote areas to attract highly productive HCWs, and promoting programs to provide healthcare remotely.

References

Alvis-Zakzuk, N., D. Diaz-Jimenez, S. Valencia, J. Gutierrez-Clavijo, K. Cotes, C. Castañeda-Orjuela, N. A. Guzman, and F. De la Hoz Restrepo (2018). Armed conflict and infant mortality due to diarrhea in colombian children. *Value in Health 21*, S133.

Ashenfelter, O., D. Card, H. Farber, and M. R. Ransom (2022). Monopsony in the labor market: new empirical results and new public policies. *Journal of Human Resources 57*(3), S1–S10.

Autor, D., D. Dorn, L. F. Katz, C. Patterson, and J. Van Reenen (2020). The fall of the labor share and the rise of superstar firms. *The Quarterly Journal of Economics 135*(2), 645–709.

Bell, V., F. Méndez, C. Martínez, P. P. Palma, and M. Bosch (2012, November). Characteristics of the colombian armed conflict and the mental health of civilians living in active conflict zones. *Conflict and Health 6*(1).

Bernal, C., M. Prem, J. F. Vargas, and M. Ortiz (2024). Peaceful entry: Entrepreneurship dynamics during colombia's peace agreement. *Journal of Development Economics 166*, 103119.

Bernal, O., T. Garcia-Betancourt, S. León-Giraldo, L. R. Moreno, and C. González-Uribe (2022). Impact of the armed conflict in colombia: Consequences in the health system, response and challenges.

CERAC (2016). Un año de desescalamiento: Conflicto casi detenido, pero que se resiste a desaparecer. Technical report, Centro de Recursos para el Análisis de Conflictos.

Crump, R. K., V. J. Hotz, G. W. Imbens, and O. A. Mitnik (2009). Dealing with limited overlap in estimation of average treatment effects. *Biometrika 96*(1), 187–199.

de Roux, N. and L. R. Martinez (2021). Forgone investment: Civil conflict and agricultural credit in colombia. *University of Chicago, Becker Friedman Institute for Economics Working Paper* (2021-36).

García, M. F., P. Hessel, and P. Rodríguez-Lesmes (2022). Wealth and inequality gradients for the detection and control of hypertension in older individuals in middle-income economies around 2007-2015. *Plos one 17*(7), e0269118.

Garcia-Ramirez, J., Z. Nikoloski, and E. Mossialos (2020). Inequality in healthcare use among older people in colombia. *International journal for equity in health 19*(1), 1–15.

Gómez-Restrepo, C., C. de Santacruz, M. N. Rodriguez, V. Rodriguez, N. T. Martínez, D. Matallana, and L. M. Gonzalez (2016). Encuesta nacional de salud mental colombia 2015. protocolo del estudio. *Revista colombiana de psiquiatría 45*, 2–8.

Guarin, A., C. Posso, E. Saravia, and J. Tamayo (2021). The luck of the draw: The causal effect of physicians on birth outcomes.

Guerra-Cújar, M., M. Prem, P. Rodríguez-Lesmes, and J. F. Vargas (2024). A peace baby boom? evidence from colombia's peace agreement.

Heise, S. and T. Porzio (2022). Labor misallocation across firms and regions. Technical report, National Bureau of Economic Research.

Hessel, P., P. Rodríguez-Lesmes, and D. Torres (2020). Socio-economic inequalities in high blood pressure and additional risk factors for cardiovascular disease among older individuals in colombia: Results from a nationally representative study. *Plos one 15*(6), e0234326.

Kallström, A., O. Al-Abdulla, J. Parkki, M. Häkkinen, H. Juusola, and J. Kauhanen (2022, January). I don't leave my people; they need me: Qualitative research of local health care professionals' working motivations in syria. *Conflict and Health 16*(1).

Kruk, M. E., L. P. Freedman, G. A. Anglin, and R. J. Waldman (2010). Rebuilding health systems to improve health and promote statebuilding in post-conflict countries: a theoretical framework and research agenda. *Social science & medicine 70*(1), 89–97.

Matallan, M. A., E. J. Córdoba, R. Y. Rubio-González, F. González, M. Barragán, H. Cañón, L. D. Garavito, F. Ruiz-Gómez, and S. P. Varela (2005). *Perfiles ocupacionales y normas de competencia laboral para auxiliares en las áreas de la salud*. Bogotá: Fundación Cultural Javeriana de Artas Gráficas.

Mbemba, G. I. C., M.-P. Gagnon, and L. Hamelin-Brabant (2016). Factors influencing recruitment and retention of healthcare workers in rural and remote areas in developed and developing countries: an overview. *Journal of public health in Africa 7*(2).

McPake, B., A. Scott, and I. Edoka (2014, June). *Analyzing Markets for Health Workers: Insights from Labor and Health Economics*. The World Bank.

Melnikov, N., C. Schmidt-Padilla, and M. M. Sviatschi (2020). Gangs, labor mobility and development. Technical report, National Bureau of Economic Research.

OECD (2015, December). *OECD Reviews of Health Systems: Colombia 2016*. OECD Reviews of Health Systems. OECD.

Palacio, I. C. G., S. milena Ramos, N. Q. Toro, M. A. G. Jiménez, M. O. Sierra, E. B. Bedoya, and L. E. R. Sánchez (2020). Experiencias de la misión médica en colombia. voces en medio del conflicto armado. *Gerencia y Políticas de Salud 19*, 1–18.

Parada, V., L. Fast, C. Briody, C. Wille, and R. Coninx (2023). Underestimating attacks: comparing two sources of publicly-available data about attacks on health care in 2017. *Conflict and Health 17*(1), 3.

Pérez-Olmos, I., P. E. Fernández-Piñeres, and S. Rodado-Fuentes (2005, November). Prevalencia del trastorno por estrés postraumático por la guerra, en niños de cundinamarca, colombia. *Revista de Salud Pública 7*(3), 268–280.

Perilla, S., M. Prem, M. E. Purroy, and J. F. Vargas (2024). How peace saves lives: Evidence from colombia. *World Development 176*, 106529.

Prem, M., M. E. Purroy, and J. F. Vargas (2022). Landmines: The local effects of demining.

Prem, M., A. F. Rivera, D. A. Romero, J. F. Vargas, et al. (2022). Selective civilian targeting: The unintended consequences of partial peace. *Quarterly Journal of Political Science 17*(3), 317–354.

Prem, M., S. Saavedra, and J. F. Vargas (2020). End-of-conflict deforestation: Evidence from colombia's peace agreement. *World Development 129*, 104852.

Prem, M., J. F. Vargas, and D. Mejía (2023). The rise and persistence of illegal crops: Evidence from a naive policy announcement. *The Review of Economics and Statistics 105*(2), 344–358.

Prem, M., J. F. Vargas, and O. Namen (2023). The human capital peace dividend. *Journal of Human Resources 58*(3), 962–1002.

Preyra, C. and G. Pink (2006). Scale and scope efficiencies through hospital consolidations. *Journal of health economics 25*(6), 1049–1068.

Restrepo, J. A., M. Spagat, and J. F. Vargas (2003). The dynamics of the colombian civil conflict: A new data set. *CEPR Discussion Paper*.

Ricaurte, J. C., L. L. Karim, M. A. M. Botero, and P. Hessel (2019, May). The invisible wounds of five decades of armed conflict: inequalities in mental health and their determinants in colombia. *International Journal of Public Health 64*(5), 703–711.

Roa-Gómez, Z. E. and L. M. Rodríguez-López (2021, April). *Déficit de médicos en Colombia en área rural: exploración de incentivos para aumentar la participación de médicos en el servicio social obligatorio-SSO en zonas vulnerables de Colombia*. Ph. D. thesis, Pontificia Universidad Javeriana, Bogotá.

Rodríguez Caicedo, N., S. León-Giraldo, C. González-Uribe, and O. Bernal (2023). Access to health services during the colombian armed conflict: a challenge for the population with disabilities in the department of

meta. *BMC health services research 23*(1), 1–10.

Roome, E., J. Raven, and T. Martineau (2014). Human resource management in post-conflict health systems: review of research and knowledge gaps. *Conflict and health 8*(1), 1–12.

Sanchez-Padilla, E., G. Casas, R. F. Grais, S. Hustache, and M.-R. Moro (2009, December). The colombian conflict: a description of a mental health program in the department of tolima. *Conflict and Health 3*(1).

Serneels, P., M. Lindelow, J. G. Montalvo, and A. Barr (2007, 04). For public service or money: understanding geographical imbalances in the health workforce. *Health Policy and Planning 22*(3), 128–138.

Syed, S. T., B. S. Gerber, and L. K. Sharp (2013). Traveling towards disease: transportation barriers to health care access. *Journal of community health 38*, 976–993.

Tamayo-Agudelo, W. and V. Bell (2018, May). Armed conflict and mental health in colombia. *BJPsych International 16*(02), 40–42.

Urrego-Mendoza, D. Z. (2015). Conflicto armado en colombia y misión médica: narrativas médicas como memorias de supervivencia. *Revista de la Facultad de Medicina 63*(3), 377–388.

Vargas, J. F., M. E. Purroy, F. Coy, S. Perilla, and M. Prem (2024). Fear to vote: Explosions, salience, and elections.

WHO (2007). *Task Shifting: Global Recommendations and Guidelines*. World Health Organization.

WHO (2020). *Retention of the health workforce in rural and remote areas: a systematic review*. Human Resources for Health Observer Series No. 25. Geneva: World Health Organization.

Wirtz, A. L., K. Pham, N. Glass, S. Loochkartt, T. Kidane, D. Cuspoca, L. S. Rubenstein, S. Singh, and A. Vu (2014). Gender-based violence in conflict and displacement: qualitative findings from displaced women in colombia. *Conflict and health 8*(1), 1–14.

Yang, F., S. Leon-Giraldo, and R. Moreno-Serra (2021). Health-related quality of life of a conflict-affected population in colombia. *Quality of life research*, 1–11.

Yu, W., R. E. Bain, S. Mansour, and J. A. Wright (2014). A cross-sectional ecological study of spatial scale and geographic inequality in access to drinking-water and sanitation. *International journal for equity in health 13*, 1–15.

Figures and Tables

Table 1: The relationship between the ceasefire, number of employed healthcare workers per 1,000 people

	Share of employed healthcare workers		
	Mun. FE Year FE	Dept-Year FE	Covariates
	(1)	(2)	(3)
Cease×FARC	-0.33***	-0.39***	-0.24**
	(0.10)	(0.11)	(0.12)
Observations	9,828	9,828	9,828
Municipalities	1,092	1,092	1,092
Mean Dep. Var.	3.43	3.43	3.43
Std. Dev. Dep. Var.	3.67	3.67	3.67
Municipality FE	Yes	Yes	Yes
Year FE	Yes	No	No
Dept-Year FE	No	Yes	Yes
Baseline covariates	No	No	Yes

Notes: This table presents the results from the main specification in equation (4.1). The dependent variable is the number of employed healthcare workers per 1,000 people. All columns include municipality-fixed effects. Column (1) includes year-fixed effects. Column (2) includes department-by-year fixed effects. Columns (3) includes department-by-year fixed effects and pre-determined municipality covariates (population, distance to the department capital, and a rurality and poverty index) interacted with year-fixed effects. *Cease* is a dummy that takes the value of one after 2014. *FARC* is a continuous measure of the total number of FARC attacks over 10,000 inhabitants from 2011 to 2014, and is standardized by the mean and standard deviation to ease interpretation. *Mean Dep. Var.* is the mean of the dependent variable measured in 2014, the year before the ceasefire, among municipalities with FARC presence. All regressions are weighted by the relevant municipality population in 2011. Clustered robust standard errors at the municipality level are presented in parentheses. $*p$ is significant at the 10% level, $**p$ is significant at the 5% level, $***p$ is significant at the 1% level.

Table 2: The relationship between the ceasefire and the number of employed healthcare workers per 1,000 people, by type of professional and type of contract

	(1) HCW	(2) Vocational Nurses	(3) Nurses	(4) MDs
Panel A. Any type of labor contract				
Cease×FARC	-0.39***	-0.28***	-0.06***	-0.05*
	(0.11)	(0.08)	(0.02)	(0.03)
Observations	9,828	9,828	9,828	9,828
Municipalities	1,902	1,902	1,902	1,902
Mean Dep. Var.	3.43	2.13	0.45	0.85
Std. Dev. Dep. Var.	3.67	2.34	0.64	1.07
Panel B. Open-Ended				
Cease×FARC	-0.22**	-0.18**	-0.04**	0.002
	(0.10)	(0.08)	(0.02)	(0.01)
Observations	9,828	9,828	9,828	9,828
Municipalities	1,902	1,902	1,902	1,902
Mean Dep. Var.	1.18	0.95	0.19	0.04
Std. Dev. Dep. Var.	2.17	1.75	0.44	0.10
Panel C. Task-Specific				
Cease×FARC	-0.13**	-0.09**	-0.01	-0.03
	(0.06)	(0.04)	(0.01)	(0.02)
Observations	9,828	9,828	9,828	9,828
Municipalities	1,902	1,902	1,902	1,902
Mean Dep. Var.	1.64	1.04	0.21	0.39
Std. Dev. Dep. Var.	1.97	1.32	0.36	0.69

Notes: The dependent variable in the number of HCWs per 1,000 people by the type indicated in each column. The dependent variable in columns 1 to 3 is the share of employed physicians (MDs), vocational nurses, or nurses per 1,000 people, respectively. All columns add department-by-year fixed effects and municipality-fixed effects. Robust standard errors are clustered at the municipality level and presented in parentheses. See Table 1 for further details. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table 3: Robustness exercises of the relationship between the ceasefire, number of employed healthcare workers per 1,000 people

	Different treatment:	Comparison group:		Measurement dep. variable:	
	High int. violence	Within conflict	Truncation optimal	Outliers 1%	Outliers 5%
	(1)	(2)	(3)	(4)	(5)
Cease×FARC	-1.06***	-0.40***	-0.43***	-0.39***	-0.35***
	(0.26)	(0.12)	(0.13)	(0.11)	(0.10)
Observations	9,828	4,968	5,481	9,828	9,828
R-squared	0.91	0.93	0.94	0.93	0.94
Mean Dep. Var.	3.31	3.31	3.33	3.31	3.31
Std. Dev. Dep. Var.	3.46	3.46	3.62	3.46	3.44

Notes: This table presents robustness exercises for the relationship between the ceasefire and employment of healthcare workers. The dependent variable is the number of employed healthcare workers per 1,000 people. We estimate all regressions using municipality-fixed effects and department-by-year fixed effects. Column 1 uses a dummy for those municipalities that experience a total number of attacks over 10,000 inhabitants from 2011 to 2014 in the top three quartiles of the empirical distribution. Column 2 only keeps in the sample municipalities that were affected by conflict between 2011 and 2014, either by FARC or other illegal armed groups. Column 3 truncates the sample based on a propensity score following Crump et al. (2009), the optimal cut-off in our case is 5.2%. Finally, Columns 4 and 5 present the results for the dependent variable winsorized at 1% and 5%, respectively. See Table 1 for further details. Clustered robust standard errors at the municipality level are presented in parentheses. $*p$ is significant at the 10% level, $**p$ is significant at the 5% level, $***p$ is significant at the 1% level.

Table 4: Heterogeneity in the relationship between the ceasefire and employment, by municipality pre-determined characteristics.

Z (above median):	Density of Roads		Distance to	Distance
	Length	Count	Waterways	to capital
	(1)	(2)	(3)	(4)
Cease×FARC×Z	-0.47*	-0.53**	-0.23*	-0.10
	(0.27)	(0.25)	(0.14)	(0.19)
Cease×FARC	-0.30***	-0.27***	-0.28***	-0.30**
	(0.10)	(0.10)	(0.08)	(0.12)
Cease×Z	0.20	0.33	0.23	-0.45
	(0.23)	(0.23)	(0.25)	(0.30)
Observations	9,828	9,828	9,828	9,828
Municipalities	1,092	1,092	1,092	1,092
Mean Dep. Var.	3.43	3.43	3.43	3.43
Std. Dev. Dep. Var.	3.67	3.67	3.67	3.67

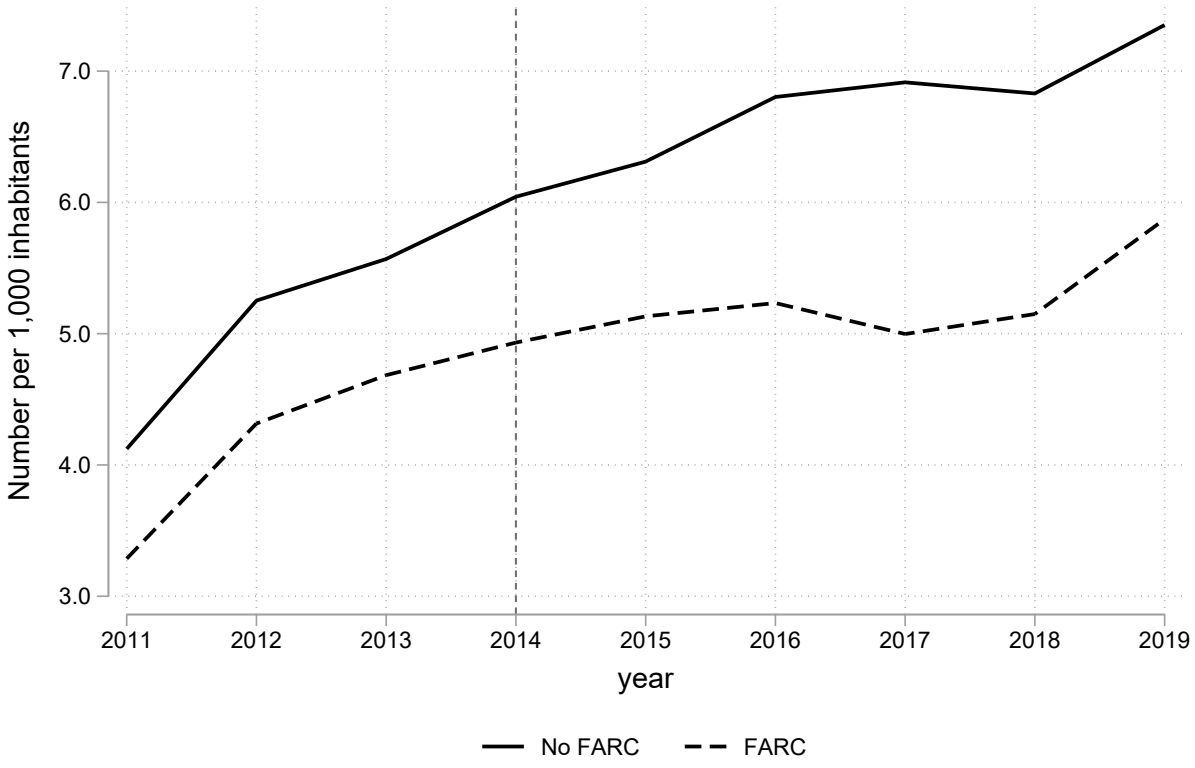
Notes: This table presents heterogeneous effects based on pre-determined municipality characteristics. The dependent variable is the number of employed healthcare workers per 1,000 people. *Density of roads* is either the length of roads (measured in kilometers) or the absolute count of rounds relative to the area of the municipality. *Count of roads* is the number of roads relative to the area of the municipality. *Distance to capital* is the distance to the department capital (not to Bogotá). Each variable is measured as a dummy for municipalities above the median of the empirical distribution. All columns add department-by-year fixed effects and municipality-fixed effects. Robust standard errors are clustered at the municipality level and presented in parentheses. See Table 1 for further details. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table 5: The relationship between the ceasefire and the share of medical services provided by physicians

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Numerator:	Medical visits				Patients's visits to MD			
Denominator:	per MD		per 1,000 people		per MD		per 1,000 people	
Class:	Total	External Cause	Total	External Cause	Total	External Cause	Total	External Cause
PANEL A. By place of residence of the patient								
Cease×FARC	228.22	186.37	-23.22	-17.52	112.47**	79.60**	-0.06	-0.81
	(247.75)	(212.29)	(25.52)	(21.58)	(44.22)	(31.51)	(3.76)	(2.45)
Observations	7,751	7,751	9,828	9,828	7,751	7,751	9,828	9,828
Municipalities	1,014	1,014	1,092	1,092	1,014	1,014	1,092	1,092
Mean Dep. Var.	3,621.05	3,047.89	1,305.12	1,108.09	1,229.17	935.43	393.07	298.97
Std. Dev. Dep. Var.	5,914.06	5,131.85	907.64	807.54	2,107.03	1,664.27	203.59	157.99
PANEL C. By place of service provision								
Cease×FARC	161.96	151.25	-35.08	-16.39	115.94**	94.01***	2.28	1.32
	(277.45)	(203.51)	(36.83)	(24.34)	(47.77)	(31.83)	(6.69)	(3.06)
Observations	7,751	7,751	9,828	9,828	7,751	7,751	9,828	9,828
Municipalities	1,014	1,014	1,092	1,092	1,014	1,014	1,092	1,092
Mean Dep. Var.	2,450.75	2,054.50	1,006.28	841.56	951.54	726.36	362.03	274.87
Std. Dev. Dep. Var.	3,887.91	3,346.46	830.56	723.28	1,557.71	1,216.82	234.54	180.71

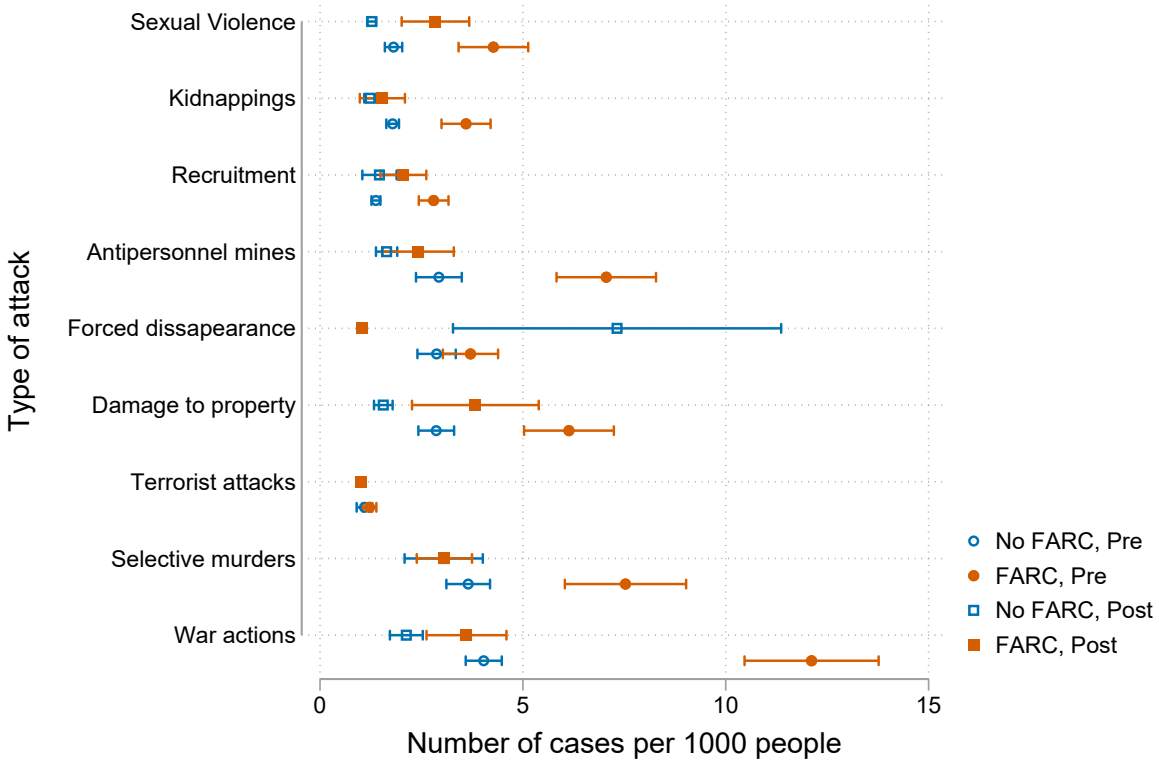
Notes: Something Clustered robust standard errors at the municipality level are presented in parentheses. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Figure 1: Trends in the share of employed healthcare workers per 1,000 people by pre-ceasefire FARC violence level



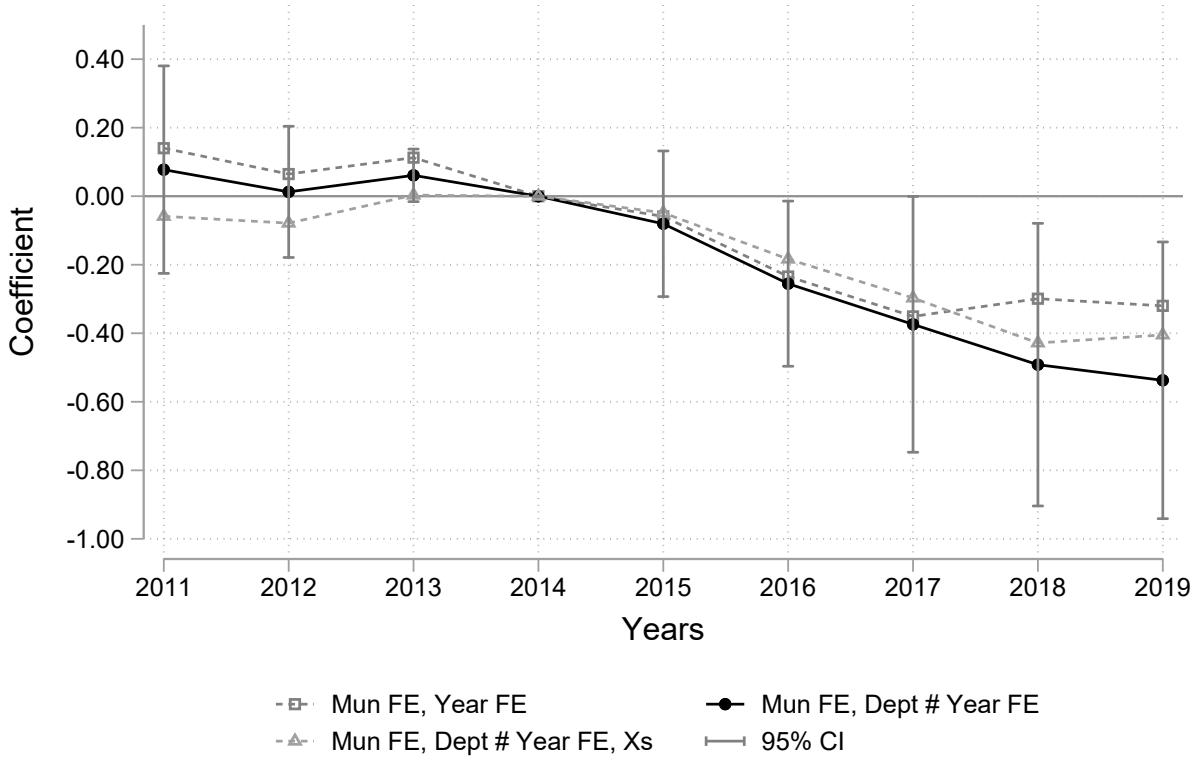
Notes: This figure presents the number of healthcare workers per 1,000 inhabitants. No FARC represents municipalities without FARC violence by 2014, and *FARC* those with at least one attack between 2011 and 2014. Numbers are based on population-weighted averages across municipalities with less than 200,000 inhabitants by 2011, and 95% confidence intervals.

Figure 2: Change in conflict after ceasefire



Notes: This figure presents the average number of attacks per 1,000 people registered in the pre (2011-2014) and post (2015-2018 ceasefire, for both municipalities affected or not by FARC violence in the 2011-2014 period. Information comes from the Centro Nacional de Memoria Histórica. The graph includes 95% confidence intervals of the means.

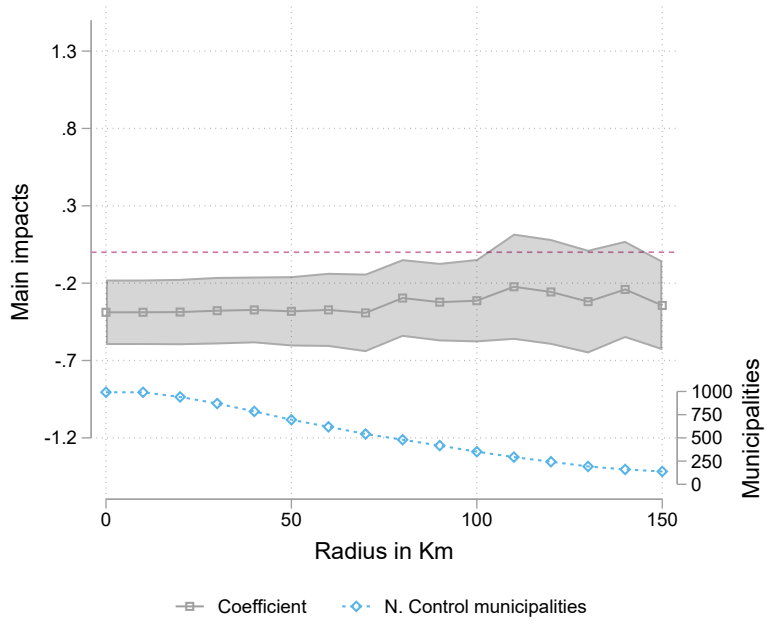
Figure 3: Dynamic difference-in-difference estimate of the relationship between the ceasefire and the share of employed healthcare workers per 1,000 people.



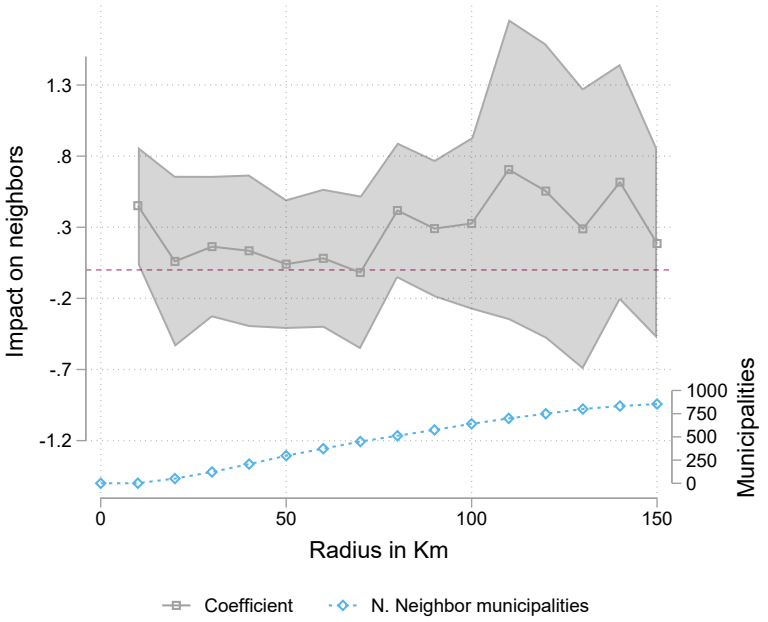
Notes: This figure presents dynamic difference-in-difference estimates of the relationship between the ceasefire and the share of employed healthcare workers per 1,000 people. The whiskers represent the 95 per cent confidence interval with clustered standard errors at the municipality level. The confidence interval is constructed using the specification with municipality-fixed effects and department-by-year fixed effects. See Table 1 for further details.

Figure 4: Estimates of the impact on the number of healthcare workers while considering potential spillovers

(a) Main effect: impact on FARC municipalities ($\beta^{(r)}$)



(b) Spillovers: impact on neighbors ($\eta^{(r)}$)



Notes: Panel (a) presents the impact on the main estimate by excluding FARC-neighbor municipalities from the control group according to their distance of a centroid to the closest FARC-affected municipality centroid. The panel also presents the remaining number of observations in the control group. Panel (b) presents the coefficient of the impact of the FARC-neighbor municipalities and the number of municipalities that belong to such groups. The area around the coefficient estimate represents the 95 per cent confidence interval with clustered standard errors at the municipality level. The confidence interval is constructed using the specification with municipality-fixed effects and department-by-year fixed effects. See Table 1 for further details.

Online Appendix (Not for publication)

A Additional Tables and Figures

Table A.1: Municipality characteristics by exposure to FARC violence before the ceasefire

		FARC Presence	
	Avg without FARC presence	Discrete	Continuous
	(1)	(2)	(3)
HCWs x 1,000 inhabitants	6.04	-1.13	-0.68**
	(9.52)	(0.86)	(0.28)
HCWs yearly reported income†	9.71	0.41	-0.16
	(4.82)	(0.59)	(0.21)
Medical doctors x 1,000 inhabitants	1.78	-0.34	-0.27***
	(2.91)	(0.29)	(0.07)
Medical doctors yearly reported income†	16.26	0.32	-0.31
	(13.20)	(1.53)	(0.52)
Professional nurses x 1,000 inhabitants	0.84	-0.12	-0.07
	(1.46)	(0.14)	(0.05)
Professional nurses yearly reported income†	12.83	0.65	0.29
	(9.86)	(1.32)	(0.69)
Vocational nurses x 1,000 inhabitants	3.42	-0.66	-0.34*
	(5.41)	(0.50)	(0.17)
Vocational nurses yearly reported income†	6.84	0.60	0.06
	(3.24)	(0.40)	(0.17)
Adult beds x 1,000 inhabitants	0.46	-0.09	-0.05***
	(0.45)	(0.05)	(0.01)
At least one intensive care unit	0.18	0.02	-0.04***
	(0.39)	(0.08)	(0.01)
Delivery room x 1,000 inhabitants	0.05	-0.01**	-0.00
	(0.05)	(0.00)	(0.00)
At least one operating room	0.48	-0.01	-0.04
	(0.50)	(0.08)	(0.03)
Basic ambulances x 1,000 inhabitants	0.11	-0.02**	0.00
	(0.13)	(0.01)	(0.00)
At least one ambulance with advanced life support	0.31	0.02	-0.05***
	(0.46)	(0.08)	(0.02)
Medical visits per person	1.76	-0.19	-0.10**
	(1.04)	(0.12)	(0.04)
Medical visits per MD	2777.26	341.20	150.42
	(3849.81)	(796.37)	(172.22)
Victims of anti-personnel mines	0.93	20.97**	7.01**
	(4.43)	(8.96)	(3.29)
Rural share	0.44	0.09**	0.05***
	(0.26)	(0.04)	(0.01)
Distance to capital	76.71	22.74**	6.08*
	(60.32)	(11.45)	(3.15)
Poverty index	63.45	11.02***	4.15***
	(20.37)	(2.46)	(0.97)
Population in ten-thousands	5.37	0.58	-0.35
	(5.09)	(1.06)	(0.31)
FARC attacks	-0.20	1.46***	1.00
	(0.01)	(0.18)	(0.00)

Notes: Column 1 presents the average of the variable in each row before the ceasefire for municipalities non-exposed to FARC violence (without any violent event by FARC between 2011 and 2014), standard deviation in parenthesis. Columns 2 and 3 present estimated coefficients and robust standard errors in parenthesis from univariate regressions $Y_i = \alpha + \beta FARC_i + \varepsilon_i$ where Y_i is specified in each row, and *FARC* measures the presence of FARC using a continuous (in column 2) or a discrete treatment (in column 3). The sample size is 1,092 municipalities. † Numbers in thousands of USD using an exchange rate of 3,500 COP per USD.

Table A.2: The effect of the ceasefire on the share of healthcare workers per 1,000 people

	HCW		Physicians		Vocational Nurses		Nurses	
	Women	Men	Women	Men	Women	Men	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cease×FARC	1.833	-0.040***	-0.002	-0.000	1.886	-0.033***	-0.051**	-0.006**
	(2.394)	(0.010)	(0.002)	(0.002)	(2.393)	(0.008)	(0.020)	(0.003)
Observations	9,828	9,828	9,828	9,828	9,828	9,828	9,828	9,828
Municipalities	1,092	1,092	1,092	1,092	1,092	1,092	1,092	1,092
Mean Dep. Var.	2.77	0.35	0.04	0.05	2.22	0.24	0.51	0.07
Std. Dev. Dep. Var.	5.89	1.08	0.18	0.16	4.45	0.75	1.41	0.25

Notes: *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table A.3: The effect of the ceasefire on the the share of healthcare workers per 1,000 people using placebo treatment years

Treatment Year:	2012	2013	2014
	(1)	(2)	(3)
Cease×FARC	-0.05	-0.01	-0.05
	(0.12)	(0.12)	(0.09)
Observations	4,368	4,368	4,368
Municipalities	1,092	1,092	1,092
Mean Dep. Var.	3.43	3.43	3.43
Std. Dev. Dep. Var.	3.67	3.67	3.67

Notes: This table presents the results from the main specification in equation (4.1). The sample includes observations between 2011 and 2014. All regressions are weighted by the number of inhabitants in 2011. *Cease* is a dummy that takes the value in 2012 or later in column (1), in 2013 or later in column (2), and in 2014 or later in column (3). *FARC* is a continuous measure of the total number of FARC attacks over 10,000 inhabitants from 2011 to 2014, and is standardized by the mean and standard deviation to ease interpretation. Clustered robust standard errors at the municipality level are presented in parentheses. $*p$ is significant at the 10% level, $**p$ is significant at the 5% level, $***p$ is significant at the 1% level.

Table A.4: The effect of the ceasefire on different proxies of patients' migration

	Changed insurer (t and t+1) (1)	Migration Out (t-1 and t) (2)	Migration In (t-1 and t) (3)	Percentage SISBEN 1/2 (4)	Log Affiliates (5)
Cease×FARC	-0.002	-0.000	-0.000	-0.001	0.004
	(0.002)	(0.000)	(0.000)	(0.002)	(0.003)
Observations	8,650	8,650	8,650	8,650	8,650
Municipalities	1083	1083	1083	1083	1083
Mean Dep. Var.	0.07	0.05	0.04	0.18	9.18
Std. Dev. Dep. Var.	0.07	0.03	0.02	0.10	1.21

Notes: This table presents the results from the main specification in equation (4.1). All regressions are weighted by the number of inhabitants in 2011. *Cease* is a dummy that takes the value for the period after 2014. *FARC* is a continuous measure of the total number of FARC attacks over 10,000 inhabitants from 2011 to 2014, and is standardized by the mean and standard deviation to ease interpretation. Clustered robust standard errors at the municipality level are presented in parentheses. $*p$ is significant at the 10% level, $**p$ is significant at the 5% level, $***p$ is significant at the 1% level.

Table A.5: The relationship between the ceasfire, healthcare providers and insurance companies

	Healthcare Providers		Insurance Companies	
	Absolute number	Per 10,000 people	Absolute number	Per 10,000 people
	(1)	(2)	(3)	(4)
Cease×FARC	0.03	0.03	-0.23	0.16*
	(0.11)	(0.02)	(0.24)	(0.10)
Observations	9,828	9,828	9,828	9,828
Municipalities	1,902	1,902	1,902	1,902
Mean Dep. Var.	4.72	1.50	17.51	7.19
Std. Dev. Dep. Var.	7.72	1.18	13.26	5.15

Notes: This table presents regression results from the main specification in equation (4.1). The dependent variables are the number of healthcare providers (column 1), the share of healthcare providers per 1,000 people (column 2), the number of insurance companies (column 3), and the share of insurance companies per 1,000 people (column 4). See Table 1 for further details. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table A.6: The effect of the ceasefire on the concentration of consultations and procedures

	(1) HHI Consultations	(2) HHI Procedures
$Cease \times FARC$	0.003	0.001
	(0.004)	(0.005)
Observations	9,623	9,622
Municipalities	1,902	1,902
Mean Dep. Var.	0.55	0.42
Std. Dev. Dep. Var.	0.15	0.16

Notes: Columns 1 and 2 correspond to concentration indexes (HHI). All calculations are based on RIPS public data. See Table 1 for further details. Clustered standard errors are presented in parentheses. Significance: *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table A.7: The relationship between the ceasefire and health infrastructure

VARIABLES	(1) Adult beds x 1000 people	(2) Has ICU	(3) Delivery room x 1000 people	(4) Has an OR	(5) Basic ambulances x 1000 people	(6) Has ALS ambulances
Cease × FARC	-0.007	-0.003	0.001	0.007	0.007**	-0.001
	(0.009)	(0.003)	(0.001)	(0.005)	(0.003)	(0.011)
Observations	8,474	8,474	8,474	8,474	8,474	8,474
Municipalities	1078	1078	1078	1078	1078	1078
Mean Dep. Var.	0.32	0.06	0.05	0.21	0.12	0.12
Std. Dev. Dep. Var.	0.30	0.24	0.04	0.41	0.11	0.33

Notes: The dependent variable in column (1) is the number of adult hospitalization beds in the municipality per 1,000 inhabitants; in column (2) is whether the municipality has an intensive care unity; in column (3) is the number of delivery rooms per 1,000 inhabitants; in column (4) is whether the muncipality has an operating room; in column (5) the number of basic ambulances per 1,000 inhabitants; and in column (6) if the municipality has at least one ambulance with ALS. Basic ambulances only provide basic life support and are operated by a vocational nurse. Ambulances with advanced life support (ALS) are operated by a physician, a nurse, or a highly trained emergency trained technician and have specialised equipment. See Table 1 for further details. Clustered robust standard errors at the municipality level are presented in parentheses. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table A.8: The relationship between the ceasefire and external cause mortality and morbidity, by the municipality of residence of the patient

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	All	External	Suicide	Homicide	War action	Road	Others
$Cease \times FARC$	-1.185	0.167	-0.042	-0.001	-1.348***	1.121***	0.278
	(2.297)	(1.709)	(0.159)	(1.301)	(0.275)	(0.389)	(0.339)
Observations	8,728	8,728	8,728	8,728	8,728	8,728	9,828
Municipalities	1091	1091	1091	1091	1091	1091	1,902
Mean Dep. Var.	225.08	72.94	5.00	35.33	4.45	11.62	16.54
Std. Dev. Dep. Var.	142.86	45.33	7.89	28.17	13.58	14.31	15.60

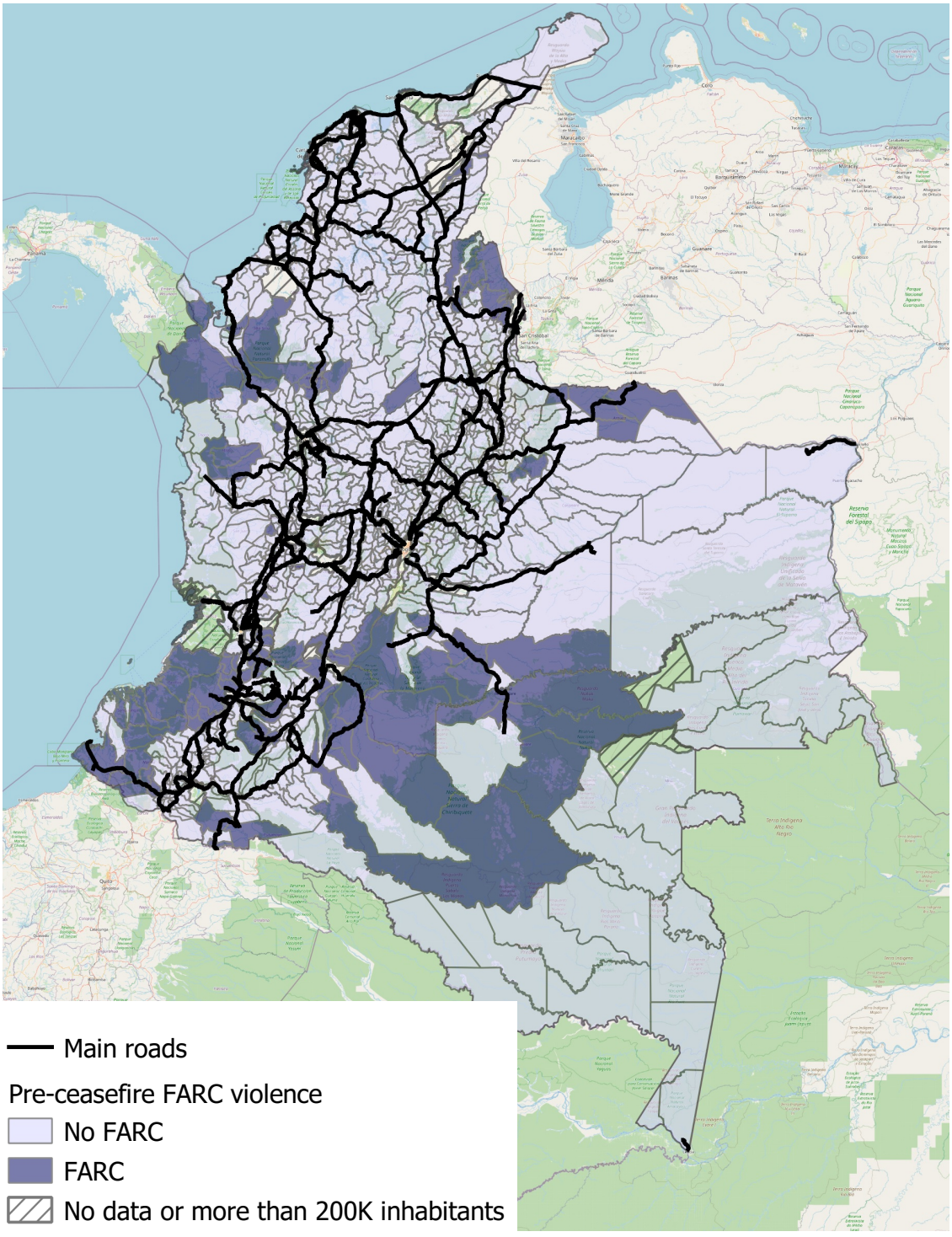
Notes: In columns 1 to 7, the dependent variables correspond to mortality rates based on the 100,000 people in the municipality. Column 1 includes all mortality causes, column 2 all external causes, and 3 to 7 its components. The homicide classification is based on intentional aggression actions which are not the result of an armed clash. The classification is based on DANE's 666 mortality causes. Columns 8 to 9 are related to health consultations and/or procedures registered in the information system for patients domiciled in the municipality and with an ICD-10 code linked related to external causes. Column 8 is the total number of patients per 1,000 people, and column 9 the the total number of appointments (events) per 1,000 people. Clustered at municipality level standard errors are presented in parentheses. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Table A.9: Usage of health services and end of conflict - DHS

VARIABLES	(1) HCW	(2) Visited Facility	(3) Visited by HCW
Cease × FARC	-0.335***	0.004	0.002
	(0.093)	(0.009)	(0.005)
Observations	3,456	57,091	57,091
R-squared	0.933	0.074	0.020
Municipalities	384	384	384
Mean Dep. Var.	3.95	0.75	0.06
Std. Dev. Dep. Var.	3.65	0.43	0.24

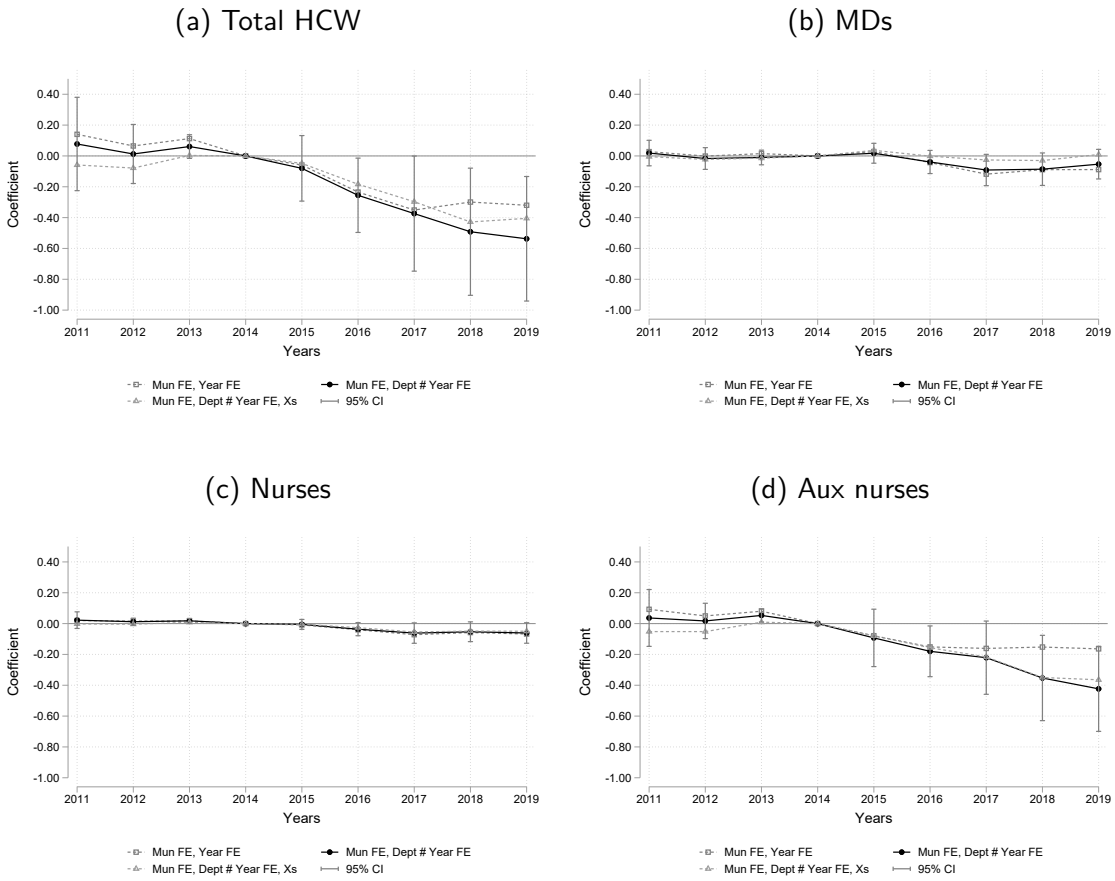
Notes: Column 1 presents results of the main exercise but restricting the sample to municipalities present either on the DHS 2005/6 or 2010/1 waves. In the rest of columns, the unit of observation is the individual respondent of the survey. The dependent in column (2) is whether the respondent has visited a healthcare facility in the last 12 months; in column (3) if the respondent have been visited by a HCW; and in column (4) if the respondent had had a cytology in the last 2 years (for 18 years or more who had started sexual activity). Clustered robust standard errors at the municipality level are presented in parentheses. *p is significant at the 10% level, **p is significant at the 5% level, ***p is significant at the 1% level.

Figure A.1: Exposition to FARC violence



Notes: No FARC represents areas without FARC violence by 2014. The base map comes from Open Street Map.

Figure A.2: Dynamic difference-in-difference estimate of the relationship between the ceasefire, the number of employed healthcare workers per 1,000 people.



Notes: These figures present dynamic difference-in-difference estimates of the relationship between the ceasefire and the number of employed healthcare workers per 1,000 people (in Panel A), or their (log) average annual income (in Panel B). The whiskers represent the 95 per cent confidence interval with clustered standard errors at the municipality level. The confidence interval is constructed using the specification with municipality-fixed effects and department-by-year fixed effects. See Table 1 for further details.