Mistrust in Medicine: The Legacy of Colonial Medical Campaigns in Central Africa*

Sara Lowes† Eduardo Montero‡

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Abstract: We examine how historical experiences with modern medicine affect present day engagement with the health sector by examining the legacy of French colonial medical campaigns. Between 1921 and 1958, the French military organized medical campaigns to treat and prevent sleeping sickness. The military forced villagers to participate and used medications with harsh, sometimes fatal, side effects. We digitized over thirty years of French colonial records that document the locations of campaign visits and the intensity of treatment at a granular geographic level for five African countries. We examine how exposure to the historical campaigns affects trust in medicine – measured by willingness to take a blood test for anemia or HIV. Using an IV strategy, we show a significant and positive effect of historical exposure to campaigns on refusal to consent to a blood test. We provide evidence that the mistrust generated by this experience is specific to the medical sector, rather than to institutions more generally. Finally, we examine the importance of these historical campaigns for present day health policy by demonstrating differential response to a universal measles campaign.

Keywords: Trust, medicine, colonialism, health.

JEL Classification: N47, O1.

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†Bocconi University, Department of Economics and IGIER, Via Roentgen, 1, Milano 20136. Email: sara.lowes@unibocconi.it. Website: www.saralowes.com.

‡Harvard University, Department of Economics, 1805 Cambridge Street, Cambridge, MA, 02138. Email: emontero@fas.harvard.edu. Website: http://scholar.harvard.edu/emontero.

1. Introduction

Sub-Saharan Africa accounts for a disproportionate percentage of the global disease burden. The region accounts for 90% of all malaria deaths and 70% of people living with HIV, and has some of the highest under-five mortality rates in the world (WHO, 2017a; UNAIDS, 2014; WHO, 2017b). Yet, even when there is access to high quality preventative and therapeutic tools, evidence suggest that in some cases demand remains puzzling low (Dupas, 2011; Dupas and Miguel, 2017). A potential constraint on demand for health services may be mistrust in medicine. There are many examples of mistrust in medicine leading to its underutilization. For example, during the 2014 Ebola outbreak in West Africa, some communities rejected health workers and did not follow recommended practices to avoid transmission of the virus (Blair et al., 2015). In northern Nigeria, communities boycotted the polio vaccination leading to a large outbreak of a nearly eradicated disease (Grossman et al., 2015). In the United States, anti-vaccination movements have led to outbreaks of childhood diseases such as measles. This anecdotal evidence suggests that is critical to understand the origins of mistrust in medicine to increase the success of public health campaigns and to improve individual health outcomes.

We examine an understudied determinant of demand: historical negative experiences with the modern medical sector. Specifically, we examine the effects of forced treatment of and prophylaxis for sleeping sickness during the colonial era in Central Africa on trust in medicine and the implications of this mistrust for present day health policy. Between the 1920s and 1950s, the French colonial governments undertook extensive medical campaigns aimed at managing tropical diseases. In Cameroon and former French Equatorial Africa (present day Chad, Central African Republic, Republic of Congo, and Gabon, henceforth AEF, see Figure 1), the colonial governments organized campaigns against a variety of diseases, including sleeping sickness, leprosy, yaws, syphilis, and malaria.[1]

These campaigns were potentially effective at reducing the prevalence of some of the targeted diseases. However, the campaigns may have also had a series of unintended effects on both beliefs about the efficacy of modern medicine and on the spread of contagious diseases. The campaigns may have affected trust in medicine because villagers were forced to receive injections and many of the medications had serious negative side effects. Additionally, the campaigns may have also

[1] Yaws is a skin infection caused by a sub-species of the bacterium that causes venereal syphilis.

caused the spread of contagious diseases because of the re-use of unsanitary needles during the campaigns (Pepin, 2011; Lachenal, 2014).

We measure how historical exposure to colonial medical campaigns affects trust in modern medicine today in Cameroon and former AEF countries. To measure exposure to medical campaigns, we compile a novel data set from over 30 years of archival data from French military archives for five countries. We digitized hundreds of tables documenting the locations of campaign visits at a geographic granular level – either the ethnicity district or sub-district level – between 1921 and 1956. This data itself is a unique and valuable contribution to understanding the medical history of sub-Saharan Africa.

We measure trust in medicine by whether an individual consents to a free and non-invasive blood test for either anemia or HIV in the Demographic and Health Survey (DHS). We find that increased exposure to colonial medical campaigns is correlated with lower levels of trust in medicine today. Approximately 4.8% of the sample refuse the blood tests. Being visited by the colonial medical campaigns 15 years, the average number of years an area is visited, increases refusals by 6.5 percentage points. Equivalently, a one standard deviation increase in the times a region was visited by the medical campaigns increases refusal rates by 0.10 standard deviations. The results are robust to a variety of geographic, colonial, and individual level controls. The strong correlation remains when we examine HIV blood test refusal or anemia blood test refusals separately.

After presenting the correlations between medical campaign exposure and trust in medicine, we address concerns of omitted variable bias using an instrumental variable strategy. A natural instrument might be the tsetse fly suitability index (TSI) developed by Alsan (2015), which predicts where the tsetse fly is able to live and therefore is correlated with the prevalence of sleeping sickness. However, as shown in Appendix Figure A1a, our areas of interest are all highly suitable for the tsetse fly. Thus, rather than use it as an instrument, we include it as a disease suitability control in our specifications. We instrument for exposure to the medical campaigns using relative suitability for cassava versus traditional crops (e.g. millet and sorghum) to estimate the causal effect of medical campaign exposure on trust in medicine. The logic of the instrument is explained in greater detail in the text, but in short, cassava produces more calories per hectare than traditional crops, such that less land needs to be cleared to produce a given amount of calories. This leads to more tsetse fly-harboring "bush". With the IV specification, we find that

medical campaigns have a large and significant effect on willingness to submit to a blood test, increasing blood test refusals by 8 percentage points relative to the mean.[2]

Given potential concerns with the instrument, we present results from a falsification test comparing former British Cameroon with French Cameroon. British Cameroon was not exposed to medical campaigns, and therefore, the suitability for cassava relative to traditional crops should have no predictive value for blood test refusal in former British Cameroon. The results from the falsification test confirm that the instrument only has predictive power for blood test refusal in former French Cameroon. This suggests that suitability for cassava relative to traditional crops does not directly affect trust in medicine.

We then examine whether the effect of exposure to the campaigns persists through internal beliefs or the external environment by examining those who are presently located outside of their ethnic groups homeland as in Nunn and Wantchekon (2011). Using the detailed ethnicity data from the archives and the 2004 DHS for Cameroon, we present evidence that it is an individual's ethnic group's exposure to the historical medical campaigns that predicts blood test refusal, rather than the exposure of the group where the individual is presently located. However, the coefficient on the exposure of other ethnicities located in an individual's present location is positive and sizable.

We also explore whether the observed results are specific to trust in medicine or more generalizable to trust in other institutions or people. We use Afrobarometer data from Cameroon and Gabon on trust in a variety of other institutions and people – e.g. neighbors, people you know, local government, police, traditional leaders – to test whether exposure to medical campaigns affects other forms of trust. Both the average effect size (AES) coefficients and the coefficients on individual questions suggest that there is no effect of exposure to the medical campaigns on trust in these non-medical institutions and individuals. These results highlight that the effect is specific to medicine. The Afrobarometer also has a series of questions on interaction with the health sector, frequency of seeking treatment, and ease of access. We find that despite no differential access to a health clinic, individuals from areas more exposed to the campaigns are more likely to report no interaction with the health sector and a longer amount of time without

[2]We also present an alternative instrument, which is the interaction between distance to colonial district capital and suitability for cassava relative to traditional crops. Distance to colonial district capital serves as a proxy for how easily a medical team could access a location. However, we are only able to use this instrument for the Cameroon data because the DHS aggregates to higher administrative levels for the other countries.

seeking treatment.

Given that the health campaigns predict measures of trust in medicine, it is important to examine the implications for health outcomes. We show that lower trust in medicine is correlated with worse health outcomes: in areas with greater exposure to the campaigns, women report having more children that have died and children are less likely to have been vaccinated. A one standard deviation increase in colonial medical visits increases child deaths by .04 standard deviations and reduces vaccination rates of children by .064 standard deviations.

Finally, we examine how differential exposure to colonial medical campaigns affects response to present day health campaigns. We use a difference-in-differences strategy and a universal vaccination campaign in Cameroon to show that in areas that were more exposed to the historical medical campaigns, individuals are less likely to consent to have their children vaccinated during the modern vaccination campaign. Our results highlight the importance of historical events for understanding the efficacy of present day health policies.

The paper speaks to several diverse literatures. First, the paper is related to the a growing literature exploring how culture and history matter for development policy. For example, recent work has shown how the practice of bride price payment matters for investment in daughters (Ashraf et al., 2016; Corno and Voena, 2016) and how matrilineal kinship affects the well-being of women and children (Lowes, 2017; Jayachandran and Pande, 2017). In this project we present specific evidence on how historical experiences affect interaction with the health system and response to health policy.

We contribute to the broader literature on how historical events are important determinants for understanding African comparative development (Nunn, 2009). In particular, many papers have focused on exploring the long-term impacts of pre-colonial institutions and colonial policies in Africa on modern development outcomes (Michalopoulous and Papaioannou, 2013, 2014, 2016; Nunn, 2008). Other work has examined the role of geography, such as Alsan (2015) who examines the effect of tsetse fly suitability and sleeping sickness in animals on long-run development. Perhaps most related is work by Huillery (2009), who examines the effects of colonial investments in education in former French West Africa. Similarly, Cagé and Rueda (2017) document the relationship between HIV prevalence and exposure to Christian missionaries. We provide detailed empirical evidence on how even well-intentioned colonial policies can have counter-intuitive and long-lasting negative effects on development.

Third, the paper is related to the literature on the economic impacts of historical health interventions (e.g. Acemoglu and Johnson, 2007; Bleakley, 2007, 2010). For Africa in particular, Osafo-Kwaako (2012) finds large effects on educational attainment from a WHO campaign to eliminate yaws in the late 1950s in Ghana. We contribute to this literature by constructing a novel historical data set and by examining a unique setting in which the campaigns affected millions of people over several decades. Relatedly, we hope to speak to the large body of evidence from randomized controlled trials trying to understand barriers to use of health services, such as liquidity constraints, present bias, and psychological costs of accessing healthcare (see Dupas and Miguel, 2017 for a review). We present evidence on how mistrust may be another important demand constraint.

Finally, our project is also related to a broader literature on the historical origins of trust. Trust has been shown to matter for economic development in a variety of settings (Nunn and Wantchekon, 2011; Algan and Cahuc, 2010). Our paper is related to a growing interest in the relationship between trust and health. Recent work examines the relationship between information disclosure and trust. For example, Alsan and Wanamaker (2017) examine how the revelation of the Tuskegee experiments on black men with syphilis in the US affects subsequent trust in medicine for black men, and Martinez-Bravo and Stegmann (2017) examine the effects of anti-vaccine propaganda on vaccination rates. We demonstrate that forced exposure to low quality medications can affect the health-seeking behavior of subsequent generations and that it is important to understand this history when constructing health policy.

The paper is structured as follows. Section 2 provides background on the colonial medical campaigns including the motivation for them, how they were organized, and the various unintended consequences of these campaigns. Section 3 describes the archival and modern data used in the empirical analysis. Section 4 presents the OLS and IV results on the association between the medical campaigns and trust in modern medicine. Section 5 examines how health outcomes vary by exposure to historical medical campaigns and tests for differential responses to present day health campaigns and section 6 concludes.

2. Colonial Medical Campaigns

French, British, and Belgian colonial governments implemented a wide variety of medical campaigns beginning in the early 20th century. The introduction of these efforts coincided with

greater European penetration into rural areas and to large outbreaks of human African trypanosomiasis, also known as sleeping sickness. The largest and most pervasive medical campaigns organized by the French focused on the treatment and prevention of sleeping sickness. However, the campaigns also targeted other diseases including yaws (a form of syphilis), malaria, leprosy, and yellow fever (Headrick, 1994, 2014; Pepin, 2011).

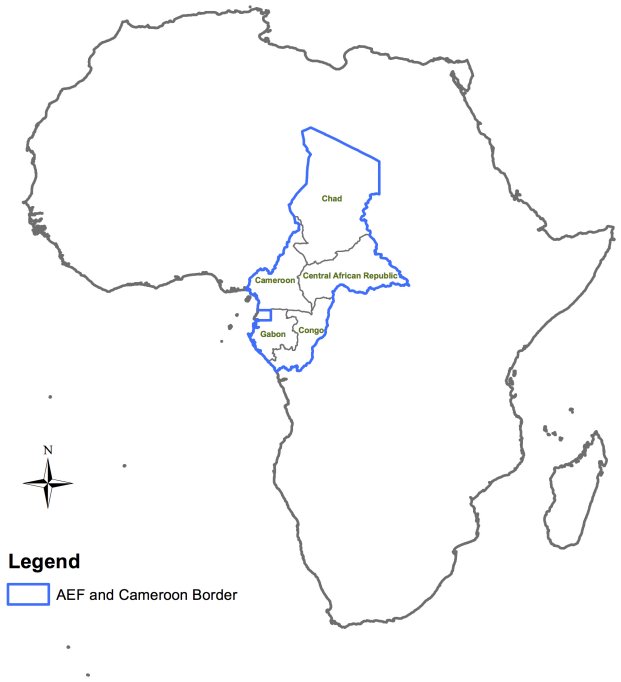
Sleeping sickness is a lethal a parasitic disease transmitted by the bite of a tsetse fly, which is only present in Africa. An individual in the first stage of the disease experiences joint pain, headaches, and fever. The disease can cause drowsiness and swelling in the lymph nodes. Once the disease infects the nervous system (the second stage of the disease), the individual experiences extreme lethargy and eventually dies. There are two types of human sleeping sickness. The more acute and rapid acting form of the disease, *Trypanosoma brucei rhodesiense*, is found in Eastern and Southern Africa. Most sleeping sickness cases in humans are from the chronic form of the disease, *Tryponosoma brucei gambiense*, which is found in Western and Central Africa. There is also a form of sleeping sickness that affects domesticated animals *Trypanosoma brucei brucei*.[3]. The sleeping sickness epidemics motivated a large European response during the colonial era. This was partially due to humanitarian concerns but also due to concerns about labor supply, particularly in the sparsely populated equatorial zone. Scientific and nationalistic motivations were also important, as the colonial governments competed over developing advancements in medicine (Headrick, 1994, 2014).

In French colonies, the military organized campaigns through a system of mobile medical teams. In Cameroon, the mobile medical teams were first organized in 1921. AEF organized mobile teams starting in 1927. See Figure 1 for a map of Cameroon and the former AEF countries. The mobile teams generally consisted of one French military doctor, several African nurses, two white corporals, several African soldiers and a large number of porters to carry equipment. The teams faced the challenging task of visiting villages at a time of minimal road infrastructure. During a village visit, villagers were forced, often at gunpoint, to submit to a physical examination. The examinations included neck palpitations to check for swelling of the lymph nodes, blood tests to check for trypanosomes in the blood, and spinal taps. Doctors would then administer treatments based on the results of the examination (Headrick, 1994, 2014).

The campaigns initially focused exclusively on the treatment of sleeping sickness. One of the

[3]Sleeping sickness in animals is also known as *nagana*

Figure 1: Map of Cameroon and former French Equatorial Africa



earliest forms of treatment for sleeping sickness was the drug *atoxyl*, an arsenic based drug. While the name atoxyl literally means non-toxic, the drug had a chemotherapeutic index close to one. This means that the dose of treatment required to rid the body of the trypanosomes was almost equal to the dose that would be lethal to the patient. The drug caused partial or total blindness in up to 20% of patients (Headrick, 2014). Patients were often administered the drug regardless of whether they were known to have sleeping sickness. It was also poorly understood that the drug was only effective in treating the disease during the first stage but had no benefits in the second stage. The coverage of the campaigns was impressive. For example, in Cameroon in 1928, the mobile medical teams examined 663,971 people, of whom 17% were identified as having sleeping sickness (Le Gouvernement Fraçais, 1929).

Subsequent medications for sleeping sickness, such as Lomidine, were less toxic, but often had serious side effects. Lomidine worked as a prophylactic, which means it prevented individuals from getting sleeping sickness, rather than treating those who already had sleeping sickness. During the campaigns, all individuals in a village were required to receive Lomidine injections. The Lomidine injection needed to be administered every six months in order for it to effectively prevent sleeping sickness in an individual. Even though Lomidine was possibly effective at

preventing the spread of sleeping sickness, it was also associated with significant side effects. The injections themselves were painful and caused dizziness and low blood pressure. Entire villages were required to rest under the supervision of the medical team after receiving the injections. Lomidine injections were also associated with several serious accidents, including the development of gangrene at the injection site and death (Lachenal, 2014).

Historians and anthropologists have linked the sleeping sickness campaigns to mistrust in modern medicine, as individuals were often forced to participate in the campaigns and the treatments had harsh side effects. Furthermore, the efficacy of the drugs used in the campaigns was dubious. Anecdotally, the experience of these campaigns has affected present day views of medicine. Feldman-Savage (2000) explains resistance to a tetanus campaign in Cameroon in 1990 by noting that "[the modern medical campaigns]...awakened negative collective memories of French colonial efforts to wipe out sleeping sickness".

Additionally, epidemiologists have examined the effects of the unsanitary practices used during the campaigns on the spread of contagious disease. While the campaigns followed standard contemporaneous medical procedures, they may have contributed to the proliferation of certain blood-born diseases from the reuse of unsanitary needles (Pepin, 2011). For example, medical researchers have documented a link between exposure to colonial medical campaigns and Hepatitis C infection rates in Cameroon, which today has one of the highest Hepatitis C infection rates in the world (Nerrienet et al., 2005). Epidemiologists often use Hepatitis C rates to examine *iatrogenic* transmissions of diseases (illness related to medical practice or treatment) because Hepatits C is generally non-lethal and difficult to spread through sex. For example, campaigns against schistosomiasis in Egypt have been associated with the iatrogenic spread of Hepatitis C (Frank et al., 2000). Pepin (2011) suggests that in AEF, the medical campaigns may have contributed to the initial spread of HIV prior to its initial identification, as it gave the virus access to large swaths of population that it would not have otherwise had access too.

3. Description of Data

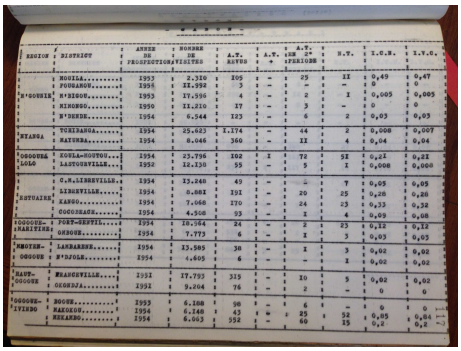
3.1. Historical Data

The historical data for this paper comes primarily from the *Service Historique de la Defense*, military archives in France. The colonial governments of Cameroon, Gabon, Republic of Congo, Chad, and

Central African Republic submitted annual reports to France on the health activities undertaken that year within the colony. An aggregated report for the whole of AEF was also produced on annual basis.[4] These records include administrative, medical, demographic, geographic, and climate information for each colony. Importantly, the reports include the places visited by medical teams and the types of treatments administered at a granular geographic level.

In January 2013, we collected these records from the military archive to construct a panel data set for Cameroon and former AEF countries. For the AEF countries we digitize data for 1927 to 1956. For Cameroon, the data is at an ethnicity-district level for the years 1921 to 1956. See Figure 2a for an example of data from Gabon and 2b for an example of the archival data for Cameroon. This information is at a sub-district level. The tables include detailed information on estimated number of people in an area, the number of people visited, the number of newly sick individuals, number of previously sick individuals, the number of lumbar punctures administered, and the number of previously sick individuals who had recovered. Often, the number of injections of various types of drugs were also reported. The reports also included narrative descriptions of the activities undertaken by the health teams. Many of the reports include maps of where the teams visited and the geographic distribution of the incidence of various diseases. Figure 3 is an example of a map documenting areas visited in 1941 in Cameroon and Figure 4 is an example of a Cameroon map documenting incidence of sleeping sickness by ethnic group in 1934.

Figure 2: Examples of Reports



(a) Example of Archival Data from Gabon (1954)

PROSPECTION EN 1934

CIRCONSCRIPTIONS	SUBDIVISIONS	TRIBUS	INDIGÈNES Recensés	INDIGÈNES Visités	Nouveaux malades	Anciens malades positifs	Total des porteurs de germes	Anciens malades contrôlés par ponction lombaire	Anciens malades guéris
Yaoundé	Yaoundé	Mbida-Mbanés	8.367	7.337	17	1	18	231	162
		Tsingas	4.117	3.716	9	2	11	371	290
		Mvélés-Est.	6.040	5.514	20	8	28	1.586	1.412
		Mvélés-Ouest.	19.909	17.737	35	26	61	3.877	2.499
		Étons-Ouest	45.020	40.982	56	5	61	1.388	1.233
		Étons-Est.	81.815	73.490	43	2	45	3.129	2.818
		Banés	35.885	31.839	247	78	325	809	503
		Environs de Yaoundé: Banés	19.490	17.442	208	75	283	701	445
		Environs de Yaoundé: Est	16.357	14.916	121	79	200	2.038	1.599
		Environs de Yaoundé: Ouest	32.067	30.124	152	29	181	334	161
		Ville							
	Nanga-Eboko	Yessoums et Yekabas.	11.534	9.019	18	6	24	810	711
	Akonolinga	Yebekolo	21.142	16.339	36	12	48	2.382	1.774
		Omvang	4.388	3.874	6	11	17	607	507
		Yembama	5.638	4.888	10	12	22	890	720

(b) Example of Archival Data from Cameroon (1934)

[4]Similarly, the countries that comprised French West Africa (Mauritania, Senegal, Mali, French Guinea, Ivory Coast, Burkina Faso, Benin, and Niger) submitted annual reports on their health activities. We focus on AEF and Cameroon because the historical literature on medical campaigns has focused on these areas. Cameroon was not officially part of AEF, but was administered similarly. It had a special status because it was taken from the Germans after World War I, after which the country was divided between the French and the British.

By combining the data from the tables and maps with information on the incidence of sleeping sickness and number of medical visits, we are able to create detailed measures of when and where the campaigns went and what they did during various visits. We create two main measures of exposure to the colonial medical campaigns: (1) total number of visits to an area and (2) share of people in an area exposed to the campaigns. We use these as our two main measures of exposure because they are available in every report and are most likely to be comparable across countries and reports. Figure 5 shows the variation in number of visits to ethnic groups for Cameroon and sub-districts for former AEF countries between 1921 and 1956. The number of visits varies between 0 and over 20. Northern Chad was not visited by the mobile teams, likely because it is not suitable for the tsetse fly and therefore did not have sleeping sickness (see Figure A1a).

Figure 3: Sleeping Sickness Campaign Map for Cameroon - Areas visited in 1941

3.2. *Modern Data*

We combine the historical data on colonial medical campaign visits with DHS data for our countries of interest. The datasets in our analysis include DHS data for men, women, and children for Cameroon from 2004 and 2011, Gabon for 2012, Congo for 2009 and 2011, Chad

Figure 4: Sleeping Sickness Prevalence by Ethnic Group in Cameroon (1934)

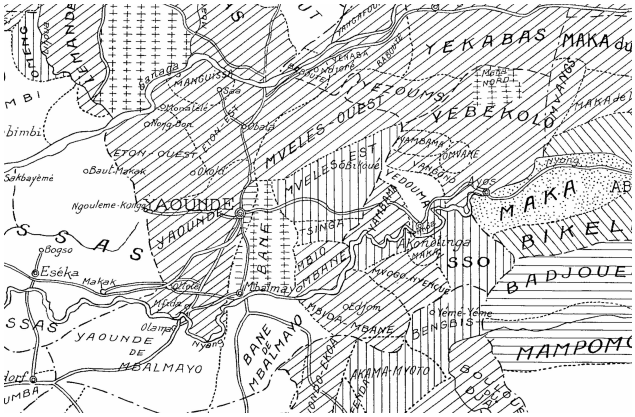
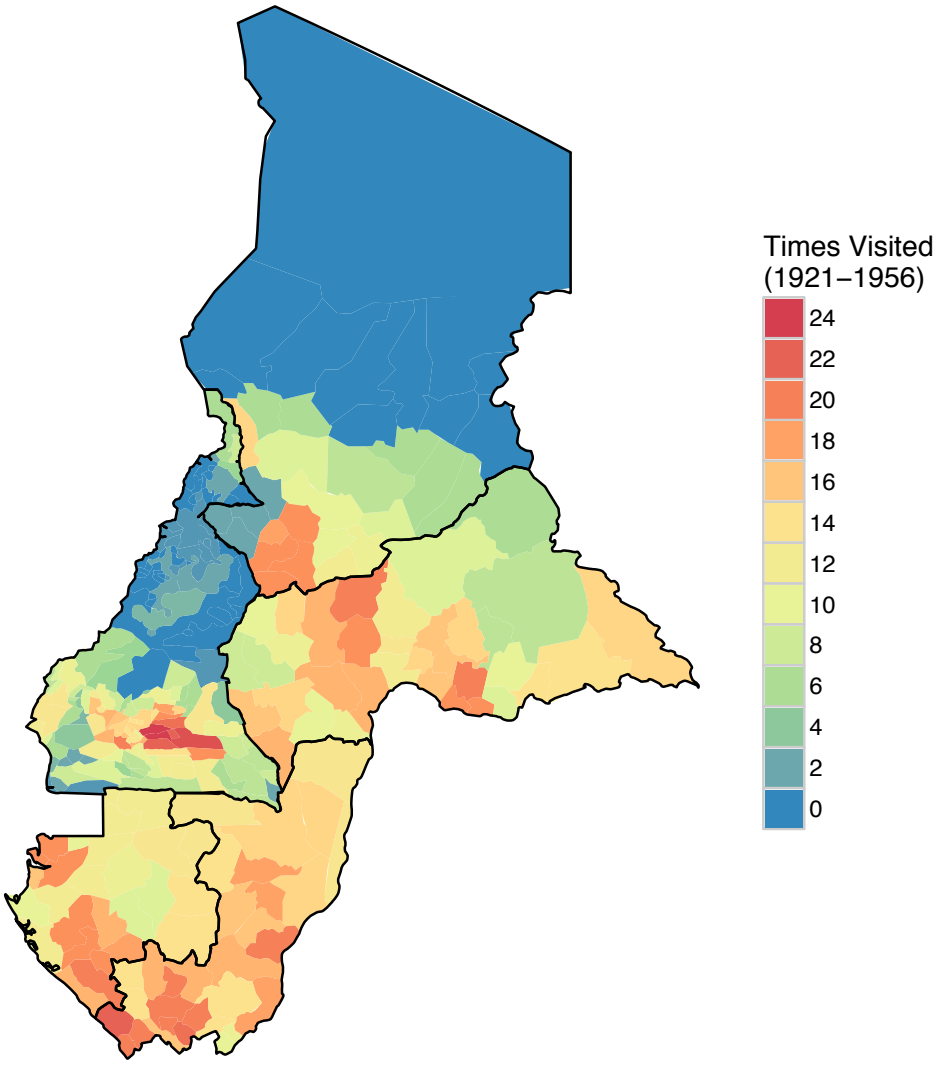


Figure 5: Sleeping Sickness Visits Between 1921-1950



for 1996, 2004, and 2014, and Central African Republic for 1994. We also combine GIS data on climate, geography, and disease suitability and colonial data and pre-colonial data to control for potential covariates that could affect both exposure to campaigns and trust in medicine today.

The DHS does not include questions on trust in medicine. However, survey participants are asked whether they are willing to take a blood test for anemia and/or HIV. We use blood test refusal as a proxy for mistrust in modern medicine. This has the benefit of being a revealed preference measure of trust, rather than a self-reported measure. Importantly, these blood tests are non-invasive. For the anemia tests, they simply involve a blood prick and results are delivered within minutes. If an individual is identified as anemic, they are told by the survey enumerator that they are anemic and given information on how to get treatment. Extensions of our main analysis use geolocated Round 5 and Round 6 data from the Afrobarometer for Cameroon and Gabon, the only countries in our sample for which Afrobarometer data is available.

4. Colonial Medical Campaigns and Trust in Medicine

We can examine the correlation between exposure to colonial medical campaigns and trust in modern medicine by estimating the following equations:

$$y_{irct} = \alpha + \gamma_1 TimesVisited_r + \mathbf{X}_{ict}^{'}\mathbf{B} + \mathbf{X}_{r}^{'}\mathbf{\Gamma} + \delta_{ct} + \varepsilon_{irct} \quad (1)$$

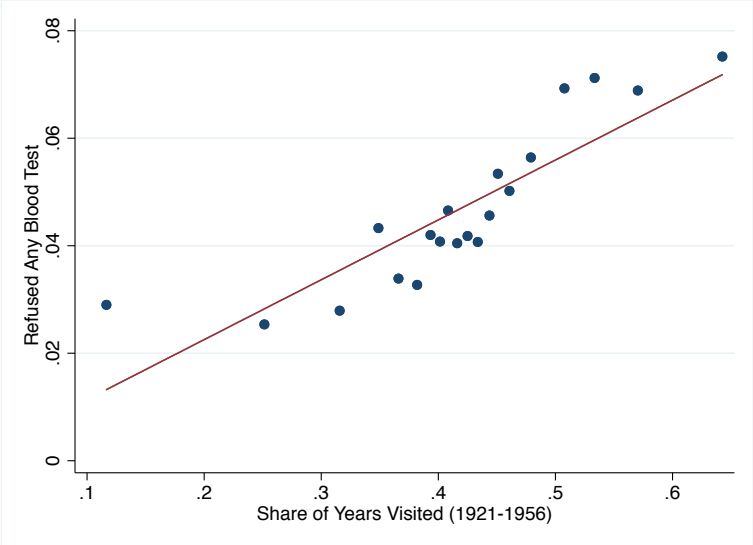
$$y_{irct} = \alpha + \gamma_2 TotalTreatment_r / Population_r + \mathbf{X}_{ict}^{'}\mathbf{B} + \mathbf{X}_{r}^{'}\mathbf{\Gamma} + \delta_{ct} + \varepsilon_{irct} \quad (2)$$

where y_{irct} is the outcome of interest for individual i residing in colonial medical report region r for DHS country c administered in year t. For Cameroon r is an ethnicity-district, for Gabon and CAR r is a colonial sub-district, and for Chad and Congo r is at the district level, due to the aggregation in the DHS reporting of data. $TimesVisited_r$ is the share of years an region r was visited between 1921 and 1956 and $TotalTreatment_r / Population_r$ is the total treatment between 1921 and 1956 for sleeping sickness received by region r as a share of the population at the time of treatment. We include $\mathbf{X}_i^{'}$, a vector of individual-level covariates and $\mathbf{X}_r^{'}$, a vector of region-level covariates. The standard errors are clustered at the region level r. All regressions include survey-year fixed effects, δ_{ct}.

4.1. OLS Estimates

Figure 6 shows the visual relationship between share of years visited and refusal to consent to a blood test. The simple binscatter suggests a strong positive relationship between exposure to the medical campaigns and refusal to consent to the blood test. For the binscatters of the data by country see Figure 7.

Figure 6: Share of Years Visited and Blood Test Refusal



We present the OLS estimates for the effects of $TimesVisited_r$ on refusal to do a blood test in Panel A of Table 1. $TimesVisited_r$ is calculated as the number of years an ethnic group or region was visited between 1921 and 1956 divided by 35. Blood test refused is an indicator variable equal to 1 if the individual refused to consent to a blood test. Because the DHS did not collect blood tests in CAR, CAR is excluded from this analysis.

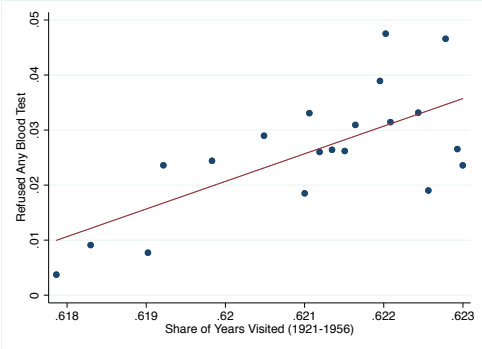
Column (1) indicates that increasing the share of visits from no visits to visited every year increases blood test refusal by 13.3 percentage points. This is relative to a baseline refusal of 4.8% for the sample as a whole. This suggests a large and significant correlation between historical exposure to medical campaigns and trust in medicine today. Column (1) includes controls for geography and climate, including: temperature, precipitation, land suitability and elevation. Columns (2) to (5) sequentially add additional controls for: disease suitability, colonial presence, pre-colonial ethnic group features, and contemporary demographics. Disease suitability controls include mean malaria ecology index and tsetse fly suitability. Colonial controls include total number of slaves taken from each ethnic group during the Atlantic slave trade and the number of

Table 1: OLS Estimates: Colonial Medical Campaign Visits and Trust

	Panel A: Share of Years Visited				
	Dep. Var.: Blood Test Refused				
	(1)	(2)	(3)	(4)	(5)
Share of Years Visited (1921-1956)	0.133***	0.126***	0.128***	0.153***	0.111***
	(0.034)	(0.032)	(0.032)	(0.022)	(0.026)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
Observations	67,262	67,262	67,262	32,833	67,209
Clusters	134	134	134	84	134
Mean Dep. Var.	0.048	0.048	0.048	0.067	0.048
	Panel B: Total Treated/Population				
	Dep. Var.: Blood Test Refused				
	(1)	(2)	(3)	(4)	(5)
Total Treated/Population	0.082**	0.077**	0.089**	0.150***	0.078**
	(0.039)	(0.038)	(0.037)	(0.046)	(0.031)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
Observations	67,262	67,262	67,262	32,833	67,209
Clusters	134	134	134	84	134
Mean Dep. Var.	0.048	0.048	0.048	0.067	0.048

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), Congo (2009 and 2011) and Chad (1996, 2004, 2014). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon, and at the district level for Congo and Chad. *Blood Test Refused* is an indicator variable for refusing consent to taking a blood test (either for HIV testing or hemoglobin levels testing). *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. *Total Treated/Population* measures the total number of individuals treated for sleeping sickness treatment as a share of the reported population in that region at the time between 1921 and 1956. All regressions control for age, age squared, gender, urban-rural status, and include survey round fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each main ethnic group in a region. *Contemporary Controls* include educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

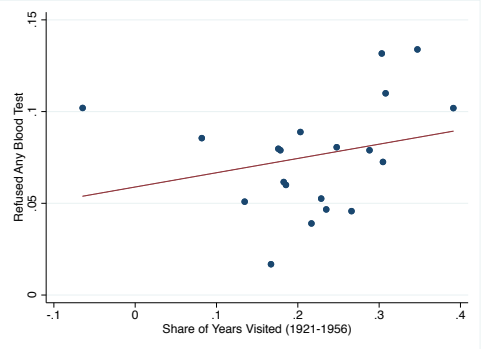
Figure 7: Share of Years Visited and Blood Test Refusal By Country



(a) Congo

(b) Cameroon

(c) Gabon



(d) Chad

missions in each ethnic group. Pre-colonial controls include level of centralization, use of plough, whether indigenous slavery was practiced, and whether agriculture was practiced for each ethnic group. Finally, contemporary controls include educational attainment fixed effects and wealth index fixed effects. Note that column (4) has a smaller sample size. When we include pre-colonial controls the sample size falls because not all Murdock ethnic groups have pre-colonial data. The point estimate remains large, significant, and consistent across the various specifications.

Importantly, these results are robust to examining the refusal of hemoglobin test only or the HIV test only, suggesting that the results are not driven by an aversion to knowing HIV status nor by the slightly more invasive nature of the HIV test relative to the anemia test. See Appendix Tables A1-A2 for the results for the anemia test alone and the HIV test alone.

Panel B of Table 1 estimates equation (2), which uses an alternative measure of exposure to colonial medical campaigns: percentage of population exposed. $TotalTreatment_r / Population_r$ is the share of the population of an ethnic group or region visited in each year between 1921 and 1956. Column (1) indicates that increasing the share of the population exposed to the medical campaigns from 0 to 1 increases the likelihood of refusing the blood test by 8.2 percentage points.

Table 2: OLS Estimates: Controls for Health Access

	Dep. Var.: Blood Test Refused			
	(1)	(2)	(3)	(4)
Share of Years Visited (1921-1956)	0.114***	0.120***	0.114***	0.128***
	(0.025)	(0.027)	(0.025)	(0.027)
% Say Distance to Health Center is a Problem	-0.011			-0.019*
	(0.009)			(0.012)
% Know Where to Get HIV Test		0.003		0.001
		(0.001)		(0.016)
% of Women that Delivered Child in Hospital			-0.006	-0.009
			(0.005)	(0.011)
Geography and Climate Controls	Y	Y	Y	Y
Disease Suitability Controls	Y	Y	Y	Y
Colonial Controls	Y	Y	Y	Y
Contemporary Controls	Y	Y	Y	Y
Observations	45,389	43,632	59,757	34,296
Clusters	127	124	134	117
Mean Dep. Var.	0.059	0.047	0.051	0.052

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), Congo (2009 and 2011) and Chad (1996, 2004, 2014). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon, and at the district level for Congo and Chad. *Blood Test Refused* is an indicator variable for refusing consent to taking a blood test (either for HIV testing or hemoglobin levels testing). *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. *% Say Distance to Health Center is a Problem* is the share of people in the DHS cluster that say that distance to health centers is a problem. *% Know Where to Get HIV Test* is the share of people in the DHS cluster that answer that they do know of a place where one can get an HIV test. *% of Women that Delivered Child in Hospital* is the share of women in the DHS cluster that say that they delivered at least one child in a hospital. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Contemporary Controls* include educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

One potential concern is that the results are driven by differential access to health facilities. While the DHS does not provide information on the health infrastructure at the village level, it does include a few questions that can proxy for ease of access to health care. These measures are: the percentage of people in each cluster who say distance to health center is a problem, the percentage of people who report they know where to get an HIV test, and the percentage of women in each cluster that have delivered any of their children in a hospital. Columns (1)-(3) of Table 2 incorporates each of these measures of access to healthcare at the cluster level as a control. The coefficient on share of years visited remains stable, large, and significant, while the coefficients on access are relatively small and not significant. Column (4) includes all of the healthcare access controls simultaneously. The percentage of people who say distance to health center is a problem is marginally significant, but the main coefficient of interest is unchanged.

4.2. Instrumental Variable Estimates

The results presented in Tables 1 suggest that there is a positive correlation between exposure to medical campaigns and lack of trust in modern medicine today. However, this does not identify the causal effect of medical campaign exposure on trust. It is possible that there is an omitted variable that both determines exposure to campaigns and trust in medicine. To address this concern, we present results using an instrumental variables approach. An appropriate instrument will predict exposure to colonial medical campaigns but will not affect trust in medicine through any other channel than through the campaigns.

An instrument we considered is the tsetse fly suitability index created by Alsan (2015). However, we found that across our areas of interest, there is not much variation in tsetse fly suitability. In fact, most places are highly suitable for the tsetse fly. See Appendix Figure A1a for the spatial variation in tsetse fly suitability. Given that actual sleeping sickness prevalence may affect present day trust in medicine, we include the tsetse fly suitability index as a control variable in our specifications.

Using historical accounts of what factors people thought determined sleeping sickness, we propose using the relative soil suitability for cassava versus traditional crops (e.g. millet and sorghum). Historians had noted that there was a positive correlation between growing cassava and observed sleeping sickness. Cassava yields 4 times the number of calories per acre and 13 times the weight per acre as millet or sorghum. Thus, to obtain a fixed number of calories, farmers

need to clear less land. However, clearing less land means that there is more tsetse fly harboring bush and therefore potentially more sleeping sickness (Headrick, 1994).

To avoid concerns that soil suitability for cassava relative to millet (or sorghum) directly affects trust or affects trust through actual incidence of sleeping sickness rather than through the medical campaigns, we also present an alternative instrument where we interact relative suitability with distance to colonial district capital. Distance to colonial district capital is likely correlated with how accessible a particular area was to the mobile medical teams. Additionally, district capitals were often used as headquarters for the mobile teams. However, for this alternative instrument we can only present the results for Cameroon due to data aggregation to the district level in the DHS and inconsistent information on the mobile medical team headquarters for other countries. Therefore, we also present a falsification test for both instruments, suitability for cassava relative to millet and suitability for cassava relative to millet interacted with distance to district capital. We show that the instruments only predict blood test refusals in places that had medical campaigns in Section 4.3. This result suggests that relative suitability for cassava does not directly affect trust in medicine.

Panel A of Table 3 presents the first stage estimates for the first instrument of relative suitability for cassava on the share of years visited by colonial medical teams. The soil suitability for cassava relative to millet appears to strongly predict visits by colonial medical teams. The F-Stat for the instrument is close to or above ten for most of the specifications. Panel B presents the second stage least squares results using the predicted values for shares of years visited. An increase in the share of years visited from 0 to 1 increases the probability of refusing the blood test by 15.4 percentage points in Column (5). This is an increase from the OLS estimate of approximately 11.1 percentage points from column (5) in Table 1. This suggests that the OLS results are biased downward, consistent with colonial medical teams choosing to visit places they viewed as more trusting or avoiding the places that were the least trusting.

Panel A of Table 4 presents the first stage estimates for the alternative instrument - using the interaction between the soil suitability for cassava relative to traditional crops and distance to the nearest colonial district capital - on the share of years visited by colonial medical teams. This alternative instrument appears to predict visits by colonial medical teams in Cameroon. An increase in the share of years visited from 0 to 1 increases the probability of refusing the blood test by 29.8 percentage points in Column (5) for Cameroon. The corresponding OLS estimate for

Table 3: First and Second Stage IV Estimates - AEF and Cameroon

	Panel A: First-Stage Estimates				
	Dep. Var.: *Share of Years Visited* (1921-1956)				
	(1)	(2)	(3)	(4)	(5)
Relative Suitability: Cassava vs. Millet	0.0403***	0.0503***	0.0536***	0.123***	0.0525***
	(0.014)	(0.016)	(0.016)	(0.022)	(0.016)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
F-Stat of Excluded Instrument	8.87	9.61	10.67	31.90	10.67
Observations	67,099	67,099	67,099	32,670	67,046
Clusters	134	134	134	84	134
Mean Dep. Var.	0.44	0.44	0.44	0.43	0.44
	Panel B: Second-Stage 2SLS Estimates				
	Dep. Var.: *Blood Test Refused*				
	(1)	(2)	(3)	(4)	(5)
Share of Years Visited (1921-1950)	0.217**	0.219**	0.188**	0.128***	0.154**
	(0.086)	(0.094)	(0.086)	(0.049)	(0.075)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
Observations	67,099	67,099	67,099	32,670	67,046
Clusters	134	134	134	84	134
Mean Dep. Var.	0.048	0.048	0.048	0.068	0.048

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), Congo (2009 and 2011) and Chad (1996, 2004, 2014). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon, and at the district level for Congo and Chad. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. *Relative Suitability: Cassava vs. Millet* measures the difference in suitability vs. cassava from the FAO for a medical report region. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each ethnic group. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each ethnic group during the atlantic slave trade and number of missions in each region. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each region. *Contemporary Controls* includes total years of education and wealth factor score for each individual. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Cameroon is approximately 10.8 percentage points. Again, the OLS results are biased downward.

4.3. Falsification Test

One concern with the results from Section 4.2 is that the proposed instrumental variable does not satisfy the exclusion restriction. Namely, the concern is that soil suitability for cassava relative to millet might affect trust in medicine through channels other than exposure to the colonial medical campaigns. This is less of a concern with the alternative instrument, where we interact this relative suitability with distance to district capitals. Given potential concerns about violation of the exclusion restriction, we use the unique history of Cameroon to provide evidence that the soil suitability for cassava relative to millet does not directly affect trust in medicine.

In 1884 Cameroon became a German colony. In World War I (WWI) the British invaded Cameroon from Nigeria and the German forces in Cameroon surrendered in 1916. Cameroon was subsequently divided between France and Britain after WWI under a 1919 League of Nations mandate. The British kept a strip of Cameroon bordering Nigeria and generally practiced "indirect rule" within their portion of Cameroon. Their rule of British Cameroon has been characterized as "one of benign neglect". Unlike the French, they did not pursue medical campaigns within Cameroon. Shortly after French Cameroon gained independence from France in 1960, the Southern part of British Cameroon voted in a 1961 referendum to join Cameroon. The northern strip voted to join Nigeria.

This history provides a nice falsification test for the instrument. The instrument should only predict blood test refusal in those areas that also were exposed to medical campaigns. Thus, the instrumental variable should have no predictive power for blood test refusals in former British Cameroon. We can test this by estimating the reduced form effect of the instrument on blood test refusals for former British and French Cameroon. Table 5 presents these results. For British Cameroon, there is no relationship between the instrument and refusing the blood test. Relative suitability for cassava does not predict blood test refusals in places that did not have the colonial medical campaigns. However, for French Cameroon, there is a positive and significant relationship between the instrument and blood test refusal. This suggests that the instrument is valid and the exclusion restriction holds: the instrument does not directly affect trust in medicine.

Table 4: First and Second Stage for Alternative Instrument - Cameroon Only

	Panel A: First-Stage Estimates				
	Dep. Var.: *Share of Years Visited* (1921-1956)				
	(1)	(2)	(3)	(4)	(5)
Relative Suitability: Cassava vs. Millet					
x **Dist. Colonial Capitals**	0.381***	0.439***	0.438***	0.300**	0.409***
	(0.111)	(0.123)	(0.121)	(0.128)	(0.114)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporaneous Controls	N	N	N	N	Y
F-Stat of Excluded Instrument	11.51	12.44	12.84	5.41	12.66
Observations	29,184	29,184	29,184	18,779	29,184
Clusters	99	99	99	68	99
Mean Dep. Var.	0.221	0.221	0.221	0.307	0.221
	Panel B: Second-Stage 2SLS Estimates				
	Dep. Var.: *Blood Test Refused*				
	(1)	(2)	(3)	(4)	(5)
Share of Years Visited (1921-1956)	0.424***	0.397***	0.399***	0.675***	0.298***
	(0.103)	(0.092)	(0.092)	(0.219)	(0.073)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporaneous Controls	N	N	N	N	Y
Observations	29,184	29,184	29,184	18,779	29,184
Clusters	99	99	99	68	99
Mean Dep. Var.	0.0654	0.0654	0.0654	0.0747	0.0654

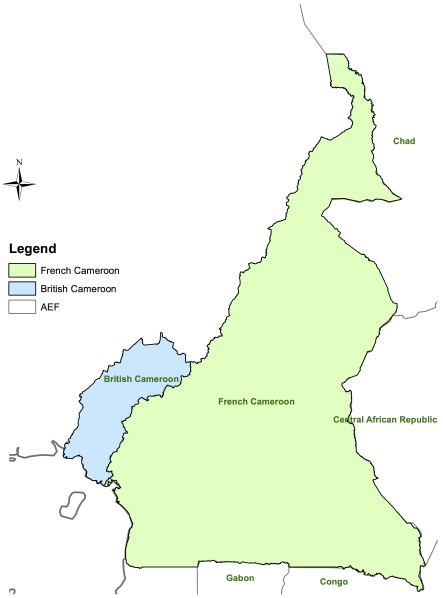
Notes: Data is from the 2004 and 2011 Cameroon DHS surveys. Standard errors are clustered at the ethnic group level. All regressions control for age, age squared and gender and include survey round fixed effects. *Blood Test Refused* is an indicator variable for refusing consent to taking a blood test (either for HIV testing or hemoglobin levels testing). *Share of Years Visited* measures the share of years the mobile medical teams visited an ethnic group for sleeping sickness treatment between 1921 and 1956. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each ethnic group. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each ethnic group during the atlantic slave trade and number of missions in each ethnic group. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each ethnic group. *Contemporaneous Controls* includes whether a place of residence is urban or rural, and the total years of education and wealth factor score for each individual. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 5: Reduced Form Estimates for Former British and Former French Cameroon

	Panel A: Falsification Test for Relative Suitability Instrument					
	Dependent Variable: *Blood Test Refused*					
	Former British Cameroon			Former French Cameroon		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative Suitability: Cassava vs. Millet	-0.0020	0.0002	0.0008	0.0125**	0.0118**	0.0090*
	(0.011)	(0.010)	(0.0098)	(0.0054)	(0.0054)	(0.0052)
Geography and Climate Controls	Y	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	N	Y	Y
Colonial Controls	N	Y	Y	N	Y	Y
Contemporary Controls	N	N	Y	N	N	Y
Observations	4,875	4,875	4,875	21,440	21,440	21,440
Clusters	132	132	132	452	452	452
Mean Dep. Var.	0.0285	0.0285	0.0285	0.0696	0.0696	0.0696
	Panel B: Falsification Test for Relative Suitability Interacted with Distance to Colonial Capital Instrument					
	Dep. Var.: *Blood Test Refused*					
	Former British Cameroon			Former French Cameroon		
	(1)	(2)	(3)	(4)	(5)	(6)
Relative Suitability: Cassava vs. Millet x **Dist. Colonial Capitals**	0.0136	-0.0127	-0.0196	0.138***	0.140***	0.107***
	(0.064)	(0.058)	(0.058)	(0.025)	(0.025)	(0.025)
Geography and Climate Controls	Y	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	N	Y	Y
Colonial Controls	N	Y	Y	N	Y	Y
Contemporary Controls	N	N	Y	N	N	Y
Observations	4,875	4,875	4,875	21,440	21,440	21,440
Clusters	132	132	132	452	452	452
Mean Dep. Var.	0.0285	0.0285	0.0285	0.0696	0.0696	0.0696

Notes: Data is from the 2004 and 2011 Cameroon DHS surveys. Standard errors are clustered at the dhs cluster level. All regressions control for age, age squared, gender, whether a place of residence is urban or rural, and include survey round fixed effects. *Blood Test Refused* is an indicator variable for refusing consent to taking a blood test (either for HIV testing or hemoglobin levels testing). *Relative Suitability: Cassava vs. Millet* is from the FAO and measures the mean difference in suitability for cassava and millet, for a 50 km buffer around each DHS cluster. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each ethnic group. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each ethnic group during the atlantic slave trade and number of missions in each ethnic group. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each ethnic group. *Contemporary Controls* includes educational attainment fixed effects and wealth index fixed effects.
* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Figure 8: Former French Cameroon and British Cameroon



4.4. Other Measures of Trust

To understand if the observed effects on trust are specific to medicine or are more generalizable to other institutions and people, we use geolocated data for Cameroon and Gabon from the Afrobarometer.[5] In Round 5, the Afrobarometer asks how much the respondent trusts: neighbors, parents, people they know, and most people. In Round 6, the trust questions are more focused on institutions; for example, it asks about parliament, local government, the ruling party, and traditional leaders, among others. This data allows us to examine whether the observed effect of exposure to the medical campaigns on trust in medicine extends to other people and institutions.

Table 6 presents the AES coefficients across the various trust questions. Across both rounds of the Afrobarometer, the coefficient on share of years visited is negligible and insignificant. This suggests that there is no effect of the colonial medical campaigns on trust in the others individuals or institutions. Figure 9 plots the coefficients for each question alongside the estimated AES coefficient. Again, the results suggest that exposure to historical medical campaigns is uncorrelated with other measures of trust.

The Afrobarometer records refusal rates across both rounds 5 and 6. This allows us to see if our measure of refusal to consent to a blood test is more general to refusal to participate

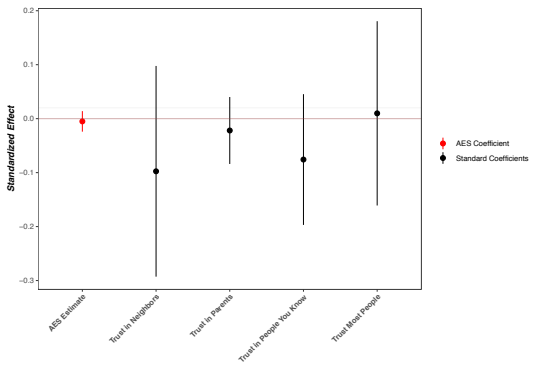
[5]The Afrobarometer only provides names of villages, rather than their coordinates. The corresponding geolocations of villages were provided by AidData.org.

Table 6: Other Measures of Trust and Share of Years Visited

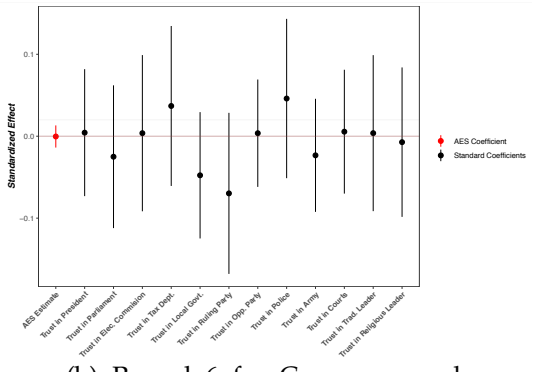
	Afrobarometer Trust Questions *(AES Coefficients)*			
	Round 5		*Round 6*	
	(1)	(2)	(3)	(4)
Share of Years Visited (1921-1956)	-0.0061	-0.0051	0.0005	-0.0003
	(0.0093)	(0.0097)	(0.0068)	(0.0069)
Geography and Climate Controls	Y	Y	Y	Y
Disease Suitability Controls	Y	Y	Y	Y
Colonial Controls	Y	Y	Y	Y
Contemporary Controls	N	Y	N	Y
Observations	731	731	1,769	1,769
Clusters	33	33	64	64

Notes: Data is from the Afrobarometer for Cameroon (Round 5 and Round 6) and Gabon (Round 6). Standard errors are clustered at the ethnic group level for Cameroon and at the colonial Sub-District level for Gabon. *Trust Questions* for Round 5 are "How much do you trust each of the following": (1) neighbors, (2) parents, (3) people you know, and (4) most people. *Trust Questions* for Round 5 are "How much do you trust each of the following": (1) president, (2) parliament, (3) electoral commission, (4) tax department, (5) local government, (6) ruling party, (7) opposition party, (8) police, (9) army, (10) courts, (11) traditional leaders, and (12) religious leaders. All trust questions range from 0-3 (0=Not at all, 1=Just a little, 2=Somewhat, 3=A lot) except for *Do you trust most people*, which ranges from 0-1 (0=Do not trust most people, 1=Trust most people).*Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. Columns (1)-(3) include child age fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, and centroid longitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Contemporary Controls* includes educational attainment fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Figure 9: Trust Questions from Afrobarometer and Share of Years Visited



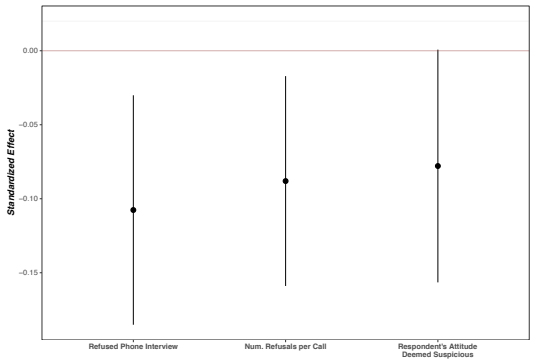
(a) Round 5 for Cameroon



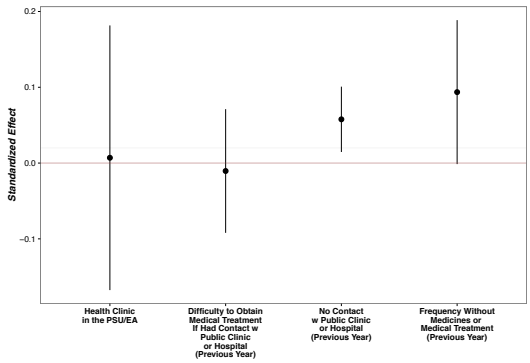
(b) Round 6 for Cameroon and Gabon

in surveys or research. Figure 10a plots the refusal data. Before each successful interview, an enumerator records if they experienced a refusal to participate, and if so, the number of refusals experienced per each successful interview. Additionally, the enumerator also assesses the respondent's attitude conditional on consent to participate in the survey. In fact, individuals from areas that were visited more by medical campaigns are slightly less likely to refuse to be interviewed and are less likely to be deemed as acting suspicious during the interview. These results corroborate the finding that the exposure to the medical campaigns affects trust in medicine but not more generalized measures of trust.

Figure 10: Refusals and Health Access from Afrobarometer and Share of Years Visited



(a) Refusals to be Interviewed and Suspicious During Interview



(b) Access to Health Center and Interactions with Health System

The Afrobarometer also allows us to do an additional check on the results from Table 2 on whether differential health access could be driving the observed results. The survey asks several questions about health care utilization and ease of access. First, it asks in the past year whether the respondent has had contact with a public clinic or hospital. Conditional on having had contact, it asks how difficult it was to access the health center. The survey also asks how often the respondent or anyone in the respondent's family have gone without medicine or treatment. Finally, the survey also records whether there is a health center located in the respondent's enumeration area. These coefficients are plotted in Figure 10b. Importantly, there is no difference in likelihood of having a health center in the enumeration area, nor, conditional upon trying to access medical care, is there any difference in difficulty of obtaining medical care. However, individuals in places that were more exposed to the campaigns are more likely to have not had contact with the health system in the past year and are more likely to have gone without treatment in the past year. These results are consistent with the DHS results, as they suggest that, despite similar ability to access health

care, individuals are less likely to seek out medical treatment the greater the historical exposure to the medical campaigns.

4.5. Channels

The effect of exposure to medical campaigns may be from internal norms, passed through generations, or through the external environment. One strategy to disentangle these two potential channels is to examine if it is an individual's ethnic group's exposure that predicts likelihood of refusing a blood test, or if it is the average exposure of the ethnic groups' of others where an individual lives that matters. Of course, this exercise focuses on individuals that have moved from their ethnic homeland in order to get variation in an individual ethnic group's exposure relative to the average exposure of those in the same cluster.

We undertake this exercise in Table 7 for Cameroon only because the historical data for Cameroon was reported at the ethnic group level and the 2004 DHS for Cameroon reports an individual's ethnicity (this exercise is similar to the one performed in Nunn and Wantchekon (2011)). Column (1) presents the results of an individual's own ethnicity's exposure to the medical campaigns on trust. An individual's ethnic group's exposure to the campaigns leads to an 8.5 percentage point increase in refusals. In Columns (2)-(5) we add a measure of the average exposure of the ethnic groups of others in the same DHS cluster as you and various controls. While this measure of others' exposure is positive, most of the effect of exposure to colonial medical campaigns seems to come from the exposure of an individual's own ethnic group. This suggest that the primary channel of the effect is internal, driven by the average experience of an individual's ethnic group, rather than external, driven by the effect of the average experience of ethnic groups where an individual resides.

5. Examining Health Outcomes

5.1. Anemia and HIV Outcomes

One crucial question from the results presented so far is whether lower trust in medicine due to the colonial medicine campaigns is also associated with worse health outcomes. Worse health outcomes today due to the campaign could arise through two channels: (i) directly due to the campaigns because they have been linked with the spread of contagious diseases as highlighted

Table 7: Ethnic Group Versus Location Based Measure of Exposure to Colonial Medical Campaigns

	Blood Test Refused				
	(1)	(2)	(3)	(4)	(5)
Ethnicity-Based Measure of Share of Years Visited (1921-1956)	0.085**	0.082**	0.084**	0.088**	0.071**
	(0.038)	(0.039)	(0.0367)	(0.036)	(0.034)
Average Share of Years Visited (1921-1956) **Among Other Ethnicities in Same Location**	–	0.045	0.046	0.054	0.035
		(0.040)	(0.039)	(0.040)	(0.039)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	Y	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Contemporary Controls	N	N	N	N	Y
Observations	8,149	7,103	7,103	7,103	7,103
DHS Ethnicities	26	26	26	26	26
Mean Dep. Var.	0.105	0.110	0.110	0.110	0.110

Notes: Data is from the 2004 Cameroon DHS surveys. Standard errors are clustered at the DHS ethnic group level. All regressions control for age, age squared, and gender and include survey round fixed effects. *Blood Test Refused* is an indicator variable for refusing consent to taking a blood test (either for HIV testing or hemoglobin levels testing). *Ethnicity-Based Measure of Share of Years Visited* measures the share of years the mobile medical teams visited an individual's reported DHS ethnic group for sleeping sickness treatment between 1921 and 1956. *Average Share of Years Visited Among Other Ethnicities in Same Location* measures the share of years the mobile medical teams visited other individuals' reported DHS ethnic groups within an individual's DHS cluster for sleeping sickness treatment between 1921 and 1956, excluding an individual's own reported DHS ethnic group. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each ethnic group. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each ethnic group during the atlantic slave trade and number of missions in each ethnic group. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each ethnic group. *Contemporary Controls* includes whether a place of residence is urban or rural, educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

in Section 2; (ii) indirectly through lower trust leading to lower utilization of health care and avoidance of preventative measures.

While it is difficult to distinguish between these two channels, we first establish that the colonial medicine campaigns are associated with worse health outcomes for the two main outcomes measured with the blood test. Demonstrating worse outcomes for these two measures is also key as one reason individuals in areas exposed to the campaigns could be refusing the test is that they have much better health levels and do not need the information. This is unlikely to be the case, as most respondents have low income and education levels and have poor access to health care.

Table 8 presents estimates between the colonial medicine campaigns and health outcomes today for the sample as a whole in Panel A and for Cameroon alone in Panel B. The evidence suggest that areas more exposed to the campaign have significantly lower hemoglobin levels (a marker for anemia). The coefficient on HIV rates is positive but not significant. In Cameroon, individuals both have significantly lower hemoglobin levels and significantly higher levels of HIV. Thus, of those who choose to consent to the blood test, individuals from areas more exposed to the colonial medical campaigns have higher levels of anemia and potentially higher levels of HIV. While these results must be interpreted with caution, as we have just shown selection in to the sample of people who consent to the blood test, they suggest that individuals from more exposed areas have worse anemia and HIV outcomes.

5.2. Child Health and Response to Health Policies

We also examine more general health outcomes in Table 9. We look at vaccination rates for children and child mortality. The DHS asks about all childhood vaccinations, for a total of 10 possible vaccinations. We construct an index of number of completed vaccinations. We find evidence that in areas that were more exposed to the colonial medical campaigns, children are less likely to be vaccinated across all of the vaccinations reported in the DHS. Additionally, women from areas that were more exposed to the campaigns report having more children that have died.

Thus far we have demonstrated that those areas more exposed to the colonial medical campaigns across Central Africa are more likely to refuse a free blood test and that exposure to the historical medical campaigns is also correlated with present day health outcomes. However, our analysis so far for health outcomes has not allowed us to disentangle "supply side" effects from

Table 8: OLS Estimates - Hemoglobin Levels and HIV Incidence

	Panel A: Full Sample			
	Hemoglobin Levels (g/cl)		HIV Positive	
	(1)	(2)	(3)	(4)
Share of Years Visited (1921-1956)	-2.258*	–	0.0106	–
	(1.632)		(0.0159)	
Total Treated / Population	–	-2.993	–	0.0038
		(2.588)		(0.0101)
Geography and Climate Controls	Y	Y	Y	Y
Disease Suitability Controls	Y	Y	Y	Y
Colonial Controls	Y	Y	Y	Y
Contemporary Controls	Y	Y	Y	Y
Observations	22,361	22,361	37,627	37,627
Clusters	110	110	122	122
Mean Dep. Var.	125.6	125.6	0.043	0.043
	Panel B: Cameroon Only			
	Hemoglobin Levels (g/cl)		HIV Positive	
	(1)	(2)	(3)	(4)
Share of Years Visited (1921-1956)	-5.585***	–	0.0126	–
	(1.632)		(0.0159)	
Total Treated / Population	–	-3.697**	–	0.0196**
		(1.839)		(0.0098)
Geography and Climate Controls	Y	Y	Y	Y
Disease Suitability Controls	Y	Y	Y	Y
Colonial Controls	Y	Y	Y	Y
Contemporary Controls	Y	Y	Y	Y
Observations	15,230	15,230	20,058	20,058
Clusters	99	99	99	99
Mean Dep. Var.	127.1	127.1	0.046	0.046

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), Congo (2009 and 2011) and Chad (1996, 2004, 2014). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon, and at the district level for Congo and Chad. *Hemoglobin Levels (g/cl)* is the reported hemoglobin level in grams per centi-liters. *HIV Positive* is an indicator variable for whether or not the HIV blood test was positive. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each ethnic group during the atlantic slave trade and number of missions in each ethnic group. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each ethnic group. *Contemporary Controls* includes educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 9: Child Health Outcomes

	Dependent Variable:					
	Vaccination Index			*Child Mortality*		
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Years Visited (1921-1956)	-0.945*	-0.714	-1.194**	0.100	0.084	0.172**
	(0.552)	(0.524)	(0.503)	(0.088)	(0.083)	(0.072)
Geography and Climate Controls	Y	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	N	Y	Y
Colonial Controls	N	Y	Y	N	Y	Y
Contemporary Controls	N	N	Y	N	N	Y
Observations	51,661	51,661	51,661	60,862	60,862	56,447
Clusters	188	188	188	188	188	188
Mean Dep. Var.	5.926	5.926	5.926	0.572	0.572	0.572

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), Congo (2009 and 2011), Central African Republic (1994) and Chad (1996, 2004, 2014). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon and CAR, and at the district level for Congo and Chad. *Vaccination Index* is the number of vaccines reported for children in the DHS out of the 10 possible vaccines. *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. Columns (1)-(3) include child age fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each main ethnic group in a region. *Contemporary Controls* includes educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

"demand effects". This is particularly problematic if we think that there is variation across space in access to healthcare and that this variation is affected by trust. While in our analysis of trust in medicine, we know all individuals who participated in the DHS were offered the blood test, for our analysis of health outcomes, there may be important variation in access to health services that affects our outcomes of interest.

To address this concern, we examine heterogeneity in response to a universal measles campaign in Cameroon. During a universal campaign, parents of all children of a particular age were offered a measles vaccination for those children. Cameroon has undertaken many measles campaigns and yet still continues to have lower than herd immunity levels of measles vaccinations. We examine a measles campaign that took place in Cameroon between 2002 and 2003, targeting all children of age for the first measles vaccination (children of approximately 12 to 15 months of age). We focus on this campaign because it aimed for universal coverage and it took place before the 2004 DHS wave in Cameroon. To identify a causal effect of exposure to colonial medical campaigns on willingness to get a child vaccinated for measles, we use a difference-in-differences strategy. Effectively, we compare younger cohorts who were eligible for the measles campaign to

older cohorts who were not eligible for the measles campaign in regions that were more or less exposed to the colonial medical campaigns. Those eligible for the campaign are children between the ages of 6 months and 1.5 years.

Table 10: Response to Measles Vaccination Campaign in Cameroon

	Vaccinated: Measles				
	(1)	(2)	(3)	(4)	(5)
Share of Years Visited (1921-1956)					
x **Infant at time of Measles Campaign**	-0.261***	-0.263***	-0.264***	-0.243**	-0.262***
	(0.064)	(0.064)	(0.064)	(0.111)	(0.063)
Region and Cohort Fixed Effects	Y	Y	Y	Y	Y
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
Observations	5,923	5,923	5,923	3,579	5,923
Clusters	81	81	81	57	81
Mean Dep. Var.	0.70	0.70	0.70	0.75	0.70

Notes: Data is from the 2004 DHS for Cameroon. Standard errors are clustered at the ethnic group level. All regressions include child age fixed effects and region fixed effects. *Vaccinated: Measles* is an indicator variable equal to 1 if a child has had a measles vaccination. *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. *Infant at time of Campaign* is an indicator for 1 if the child was an infant at the time when the national measles campaign. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each main ethnic group in a region. *Contemporary Controls* includes educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 10 presents the results for how exposure to the historical campaigns affects response to the present day measles campaign. We find that in areas that were more exposed to the medical campaigns, children who were eligible to have received a measles vaccination are much less likely to have been vaccinated for measles in 2004. Going from 0 to all years visited by medical campaigns reduces likelihood of having a child vaccinated during the campaign by 26.1 percentage points relative to a mean of 70% coverage. This suggests that the historical medical campaigns have important implications for health policy today, as they continue to affect responses to present day health efforts.

6. Conclusion

This paper examines the historical roots of present day underutilization of health services in Central Africa. We present evidence that historical interactions with medicine may explaining the puzzling phenomenon of low utilization rates of health services, even at very low price points. We focus on medical campaigns aimed at controlling the growing epidemic of sleeping sickness conducted by the French military in Cameroon former AEF countries between the 1920s and 1950s. The mobile medical campaigns forced villagers to receive the treatments and prophylaxis for sleeping sickness. The medications had significant side effects that resulted in resistance to the campaigns.

To examine the effects of the campaigns, we first collect and digitize annual data from archival sources on colonial medical campaigns. We construct a panel data set of exposure to these medical campaigns at a granular geographic level. We thus construct a novel data set of important historical data for understanding the medical and public health history of several sub-Saharan African countries.

We use an instrumental variables strategy to show that historical exposure to the medical campaigns affects our revealed preference measure of trust in medicine – willingness to consent to a blood test. These results are large, significant, and robust to variety of controls, including proxies of access to health services. We use the unique history of Cameroon to demonstrate that our instrument only has predictive power in areas of Cameroon that were exposed to the colonial medical campaigns.

Given that the health campaigns affect trust in medicine, we also explore whether the effect on trust is more generalizable to other individuals and institutions using Afrobarometer data. We find no evidence that the medical campaigns affect other measures of trust. We also present evidence that the effect is predominantly driven by an individual's ethnic group's historical exposure to the campaigns, rather than the exposure of the groups of others around an individual.

Finally, we explore the implications of these campaigns for health outcomes. Those areas that were more exposed to the campaigns have worse health outcomes today. Children have fewer vaccinations and mothers report having more children that have died. Additionally, we examine the results from the blood tests that were collected. Affected areas have higher levels of anemia and higher levels of HIV. To address concerns about differential supply of health care, we look at

response to a universal measles campaign in Cameroon. We find that children are less likely to be vaccinated for measles in more exposed areas.

The results provide strong evidence that the colonial medical campaigns have caused lower levels of trust in medicine. This has important implications for the health of individuals and for their response to health policies in these countries. These results highlight the significant cost of the legacy of medical campaigns and that building demand for health services may require rebuilding trust in medicine. Finally, the results suggest the importance of understanding historical events for designing development interventions.

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Web Appendix for

Mistrust in Medicine: The Legacy of Colonial Medical Campaigns in Central Africa

Sara Lowes

Bocconi University

Eduardo Montero

Harvard University

4 October 2017

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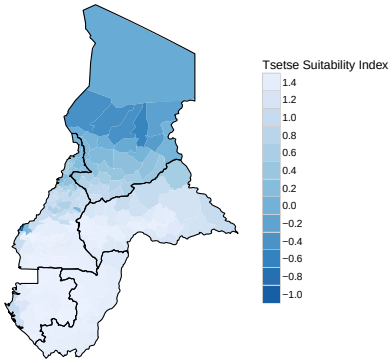
Contents

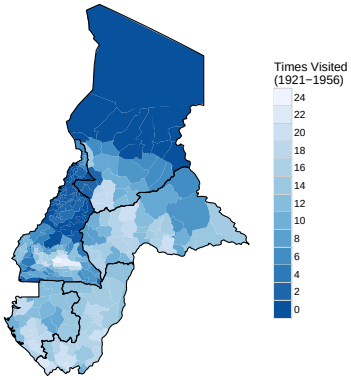
Appendix A. Additional Tables and Figures

A.1. Figures

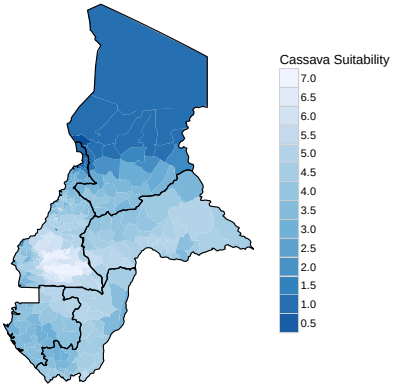
Figure A1: Maps of Variables for Instrument and Colonial Medical Campaign Visits in Cameroon and Former French Equatorial Africa



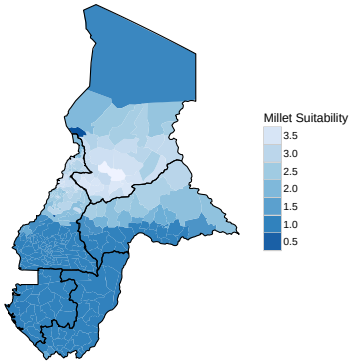
(a) Tse Tse fly Suitability



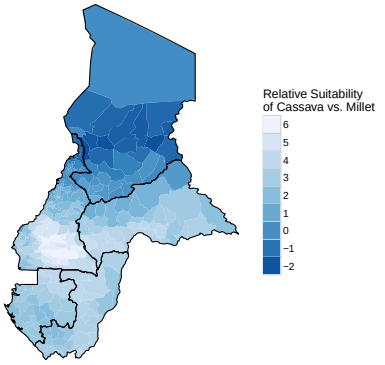
(b) Times Visited



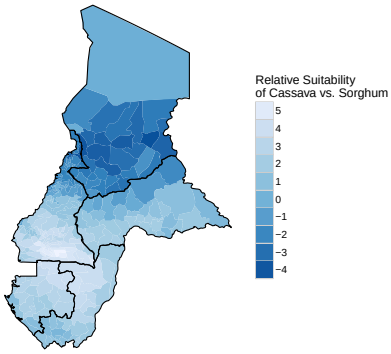
(c) Suitability for Cassava



(d) Suitability for Millet



(e) Suitability for Cassava Relative to Millet



(f) Suitability for Cassava Relative to Sorghum

A.2. Tables

Table A1: OLS Estimates - Hemoglobin Test Only - Blood Test Refusal

	Dep. Var.: Hemoglobin Blood Test Refused				
	(1)	(2)	(3)	(4)	(5)
Share of Years Visited (1921-1956)	0.126***	0.112***	0.109***	0.145***	0.094***
	(0.033)	(0.029)	(0.026)	(0.019)	(0.023)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
Observations	32,564	32,564	32,564	16,407	32,564
Clusters	138	138	138	88	138
Mean Dep. Var.	0.0479	0.0479	0.0479	0.0633	0.0479

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), and Congo (2011). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon, and at the district level for Congo. *Hemoglobin Blood Test Refused* is an indicator variable for refusing consent to taking a blood test to test hemoglobin levels. *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each main ethnic group in a region. *Contemporary Controls* includes educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table A2: OLS Estimates - HIV Test Only - Blood Test Refusal

	Dep. Var.: HIV Blood Test Refused				
	(1)	(2)	(3)	(4)	(5)
Share of Years Visited (1921-1956)	0.132***	0.127***	0.131***	0.159***	0.110***
	(0.035)	(0.032)	(0.032)	(0.030)	(0.027)
Geography and Climate Controls	Y	Y	Y	Y	Y
Disease Suitability Controls	N	Y	Y	Y	Y
Colonial Controls	N	N	Y	Y	Y
Pre-Colonial Controls	N	N	N	Y	N
Contemporary Controls	N	N	N	N	Y
Observations	53,597	53,597	53,597	27,340	53,544
Clusters	138	138	138	88	138
Mean Dep. Var.	0.0442	0.0442	0.0442	0.0606	0.0441

Notes: Data is from the DHS for Cameroon (2004 and 2011), Gabon (2012), Congo (2009 and 2011) and Chad (2014). Standard errors are clustered at the ethnic group level for Cameroon, at the colonial Sub-District level for Gabon, and at the district level for Congo and Chad. *HIV Blood Test Refused* is an indicator variable for refusing consent to taking a blood test to test for HIV. *Share of Years Visited* measures the share of years the mobile medical teams visited a region for sleeping sickness treatment between 1921 and 1956. All regressions control for age, age squared, gender, urban-rural status and include survey round fixed effects. *Geography and Climate Controls* includes mean temperature, mean precipitation, mean land suitability, the mean surface area, centroid latitude, centered longitude and mean altitude of each cluster. *Disease Suitability Controls* includes mean malaria ecology index and tse tse fly suitability. *Colonial Controls* includes total number of slaves taken from each main ethnic group in a region during the atlantic slave trade and number of missions in each main ethnic group in a region. *Pre-Colonial Controls* includes level of centralization, use of plow, whether indigenous slavery was practiced, and whether agriculture was practiced for each main ethnic group in a region. *Contemporary Controls* includes educational attainment fixed effects and wealth index fixed effects. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$