Supernatural Beliefs about Illness and Modern Medicine Use: Evidence from the DRC*

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Abstract

In many societies around the world, people attribute illness to supernatural forces, including deities, spirits, and malevolent agents. Using observational data from sub-Saharan Africa and an original large-scale survey in the Democratic Republic of Congo (DRC), I document the near-universality of supernatural beliefs about illness – 94% of respondents hold at least one such belief – and their relevance for health behavior: They are linked to lower use of and beliefs in the effectiveness of modern medicine, and higher stigma toward those with illness. Then, I conduct a field experiment in the DRC to test whether these beliefs can change. I randomize showing an informational video about the biomedical cause and treatment of epilepsy, a prevalent disease commonly associated with supernatural forces. The intervention shifts respondents' beliefs away from supernatural causes and toward modern medicine's effectiveness, not only for epilepsy but for other conditions. Moreover, the intervention reduces stigma toward those with the disease and increases take-up of free hospital consultations for epilepsy by 50%.

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1 Introduction

Humans need an explanation for their suffering (Kleinman, 1988). Throughout history, societies have attributed illness to supernatural forces to satisfy this need. Indeed, all but one out of 186 independent preindustrial societies predominantly used supernatural explanations for illness (Murdock and White, 1969). Supernatural explanations are attributions of illness to nonscientific causes such as divine intervention, spirits, or fate.[1] Sub-Saharan Africa displays a rich landscape of supernatural beliefs, including concepts predating Abrahamic religions such as evil spirits, the evil eye, curses, and malicious humans with ancestral powers, which Westerners might call "witchcraft". Such beliefs may play an important role for health practices in Sub-Saharan Africa, as suggested by anthropological accounts (Foster, 1976, Olupona, 2014). More generally, supernal attributions of illness could impact take-up of modern medicine if they cast doubt on modern medicine's ability to treat diseases believed to be caused by spirits or curses. Understanding how beliefs about illness affect health behavior is particularly relevant for low- and middle-income countries with a high burden of disease, low use of modern medicine, and high prevalence of indigenous religious beliefs. Yet, we have relatively little empirical evidence on the prevalence of supernatural beliefs about illness and their consequences for medical decision-making.

In this paper, I document supernatural beliefs about the cause of illness and their consequences for medical decision-making in sub-Saharan Africa, with a focus on the Democratic Republic of Congo (DRC). I ask three questions: (1) Are supernatural beliefs about illness common? (2) Are they relevant for health behavior? And, (3) is it possible to shift beliefs and increase take-up of modern medicine?

I start by examining whether supernatural beliefs about illness are common and relevant for health behavior in sub-Saharan Africa. In this region, an average of 46% of the population holds indigenous supernatural beliefs, as reported by surveys conducted across 19 countries by the Pew Research Center. I find that these beliefs indeed positively correlate with the use of traditional healers, suggesting that they could be relevant for health behavior. Furthermore, I give motivating evidence that supernatural illness beliefs may lead to stigmatization of the afflicted, that is, negative attitudes and discrimination toward those with illness. Such stigmatization could adversely affect the mental health of the afflicted and hinder take-up of treatment because of concerns about

[1] The anthropology and psychology literature defines "supernatural" phenomena as ones that defy or exist beyond the boundaries and laws of the natural world (Legare et al., 2012, Murdock, 1980). Alternative terms are "religious belief" or "traditional belief", referring to beliefs stemming from traditional African religion.

disclosing the disease (Turan et al., 2017, Ridley et al., 2020). Using the Demographic and Health Surveys data, I find that supernatural beliefs regarding HIV/AIDS indeed negatively correlate with the attitude that individuals with HIV/AIDS should feel "ashamed of themselves".

Motivated by these patterns, in the second part of the paper, I zoom in on one setting in sub-Saharan Africa. I designed a large-scale survey in Kananga in the DRC, an urban setting with high levels of poverty but also with access to modern medicine for primary care. I surveyed a representative sample of 800 respondents and elicited beliefs about 13 common adulthood illnesses.

Using my original data, I find that supernatural beliefs about the cause of illness (e.g., "witchcraft", evil spirits, or curses) are common: 94% of respondents attribute at least one illness to supernatural forces. Some illnesses are more likely to be attributed to supernatural forces than others: 93% of respondents attribute epilepsy to supernatural forces, while only 6% do so for malaria. In addition, people use different explanations for different cases of even the same illness. The variation suggests that supernatural and natural beliefs coexist and could be malleable.

What drives these patterns? Some individuals are more likely to embrace supernatural explanations, but the propensity does not correlate with education, age, or wealth. Examining predictors of beliefs across illnesses, I find a strong negative relationship between individuals' espousing supernatural beliefs about illness and their having used modern medicine in the past and believing in the efficacy of modern medicine. These negative relationships hold even across illnesses for a given individual. Indeed, local medical professionals noted that patients may not seek treatment for a disease believed to be of supernatural origin at the hospital as modern medicine is deemed ineffective in treating such a disease. The correlations also suggest that supernatural beliefs may change with more exposure to modern medical care. Thus, a medicine-based intervention that targets one exemplifying illness could shift beliefs across illnesses, which motivated the experiment below.

Finally, my own survey data confirms the motivational patterns on stigma. The belief that people with epilepsy are witches empirically predicts stigma toward those with epilepsy, a noncommunicable disease occurring across age groups and gender. Such stigma not only may affect whether the afflicted seek medical treatment but also may have direct implications including an increased risk of complications during seizures such as burning or drowning and neglect – even of children (Jilek-Aall, 1999, Molina, 2006, Cimpric, 2010).

In the third part of the paper, I ask whether it is possible to shift beliefs and increase take-up of modern medical treatment, which I answer through a randomized controlled trial in the DRC. The

treatment constituted an informational video on the biomedical causes and treatment of epilepsy.[2] I partnered with local medical professionals from the provincial Ministry of Health in Kananga to design the intervention. The video combined various elements to mimick information provided by a doctor's office: details on (1) the occurrence of epilepsy in the brain and the condition's biomedical causes, (2) the availability of modern medical treatment for epilepsy in Kananga and its effectiveness, (3) the ineffectiveness of traditional medicine in treating epilepsy, and (4) the nonassociation of epilepsy with supernatural forces. The content was delivered by the local medical professionals. The video also included a woman giving a testimonial.

I focused on epilepsy as it is the disease most often attributed to supernatural causes and a prevalent disease in Kananga, as in other less developed countries.[3] In my sample, 96% of respondents have seen a seizure before, with an average of 8.6 attacks witnessed, and 10.5% of the respondents have a parent, sibling, or child with epilepsy. Moreover, the majority of respondents (63.3%) believe that modern medicine could never treat epilepsy, and only 10% know that modern treatment exists in Kananga, providing an opportunity for intervention.

To assess the intervention's causal effect, I used the representative sample of 800 respondents in Kananga and randomized respondents at the individual level to watch either the treatment video or a placebo control video on children's games, delivered by the same individuals. In a first visit, the enumerator showed the video on a tablet and conducted an immediate "midline" survey. Then, the enumerator conducted an endline survey approximately one week later in a second visit.

I find that the intervention shifted beliefs about epilepsy from supernatural toward medical. The intervention reduced the treated respondents' belief that epilepsy may be of supernatural causes, increased their belief that modern medicine is effective in treating epilepsy, and decreased their belief that traditional medicine is effective in treating epilepsy in the endline survey. For example, treated respondents were 20.8 percentage points less likely to believe that epilepsy could have supernatural causes than the control respondents. The treatment effect on supernatural beliefs is driven by those who did not know that epilepsy medication exists in Kananga, which is consistent with the strong negative correlation between supernatural explanations and beliefs about modern medicine

[2]Epilepsy is a chronic noncommunicable neurological disorder characterized by recurrent, unprovoked seizures of unknown causes or attributable to factors including genetic predisposition, brain injury, or infection. It affects individuals of all ages and backgrounds. Treatment exists with an efficacy of 70% in developed countries.

[3]Developing countries face a higher prevalence of epilepsy because of a higher risk of infectious diseases and birth- and pregnancy-related complications, which can injure the brain (of the infant). Sub-Saharan Africa has an average epilepsy prevalence of 9.39 per 1,000, in contrast to the U.S. rate of 0.45 per 1,000. Individuals with epilepsy in sub-Saharan Africa face a mortality rate up to ten times higher than the population average, with deaths often stemming from loss of consciousness in unfortunate circumstances (Ba-Diop et al., 2014).

discussed above.

Moreover, the intervention spilled over to beliefs about other illnesses. The intervention shifted beliefs about the causes and the treatment efficacy of modern and traditional medicine across illnesses. Excluding epilepsy and considering the variation across individuals for a given illness, I find that treated respondents were 9.0 percentage points less likely to believe that an illness could be of supernatural origin and 6.0 percentage points more likely to believe that modern medicine is effective in treating an illness. These results sheds light on how people think about illness and how a disease-specific intervention can affect illness beliefs more broadly.

Importantly, my low-cost intervention increased the take-up of free hospital consultations for seizures, which helps mitigate concerns about experimenter demand effects. Respondents received a voucher for a consultation for seizures that they could use themselves or could give to any other adult. In the treatment group, 10.9% of vouchers were redeemed – an increase of 45% compared to the control group mean of 7.5%. The voucher was used by a third party in 95% of the cases.

Finally, the intervention reduced stigma toward people with epilepsy. It significantly reduced attitudes that one's children should not play with children who have epilepsy and that one should avoid people with epilepsy during a seizure. The intervention also significantly increased respondents' willingness to engage with people with epilepsy in an incentivized measure. Specifically, I elicited respondents' interest in interviewing for a job for an NGO project working with people with epilepsy – a high-stake decision in an environment with high unemployment.

In summary, supernatural attributions of illness are common across sub-Saharan Africa and they have important implications for health behavior, as they can affect beliefs about the efficacy of modern medicine, take-up of modern treatments by 50%, and stigma toward those with the disease. However, I show that beliefs about disease can adapt, as they have throughout history. An intervention providing information on the biomedical causes and treatment of epilepsy shifted beliefs from supernatural toward medical for epilepsy and other illnesses, increased take-up of modern medicine, and reduced stigma toward those with the disease. My light-touch intervention may have worked by accelerating learning about disease and modern medicine, which presents a complex problem in an environment with a high disease burden and limited access to high-quality care. Altogether, I demonstrate the value of taking the local population's concept of disease into account in the shaping of health policy.

The paper contributes to several strands of the literature. First, the paper advances the literature on health by documenting fundamental beliefs about the nature of disease and their implications

for health-related outcomes. The literature has extensively examined the determinants of low use of modern medicine such as costs, credit and savings constraints, information, trust, and behavioral biases on the demand side and the availability and quality of care and pharmaceuticals on the supply side.[4] While supernatural beliefs about illness and their role in health behavior has been an important subject in the medical anthropology literature (e.g., Kleinman, 1988), the literature in economics has discussed the topic mostly anecdotally.[5] Lowes and Montero (2019), Ashraf et al. (2017), and Bennett et al. (2018) are exceptions, examining health through the lens of local beliefs and practices.[6] Furthermore, I show that beliefs about the origin of disease can cause stigma, expanding the literature on stigmatization of illness and its effects on healthcare-seeking (Ramos-Toro, 2023, Ridley et al., 2020).

Second, this paper furthers the literature on culture and religion and their relevance for policy by exploring their impact on health.[7] The literature has primarily examined causes and consequences of religious participation, religious practices and behavior, and affiliation with specific institutionalized religions.[8] My original data collection allows me to measure individuals' actual supernatural beliefs and to examine them from a cognitive perspective, revealing that the human mind is capable of entertaining both supernatural and natural explanations for the same type of event. Coupled with the experimental evidence on how these explanations can adapt, these findings shed light on the evolution of religious beliefs in response to scientific advances and thus ultimately the secularization hypothesis (Berkes et al., 2023, Inglehart and Norris, 2004). I contribute to the emerging literature on traditional religion in sub-Saharan Africa (Gershman, 2020, Gershman, 2022) and its impact on prosociality and trust (Le Rossignol et al., 2023, Gershman, 2016), violence (Nunn and Sanchez

[4]For overviews, see Dupas (2011b) and Dupas and Miguel (2017). Regarding the demand side, see, for example, Dupas (2009), Dupas and Robinson (2013), Banerjee et al. (2010), Thornton (2008), Tarozzi et al. (2014), Banerjee et al. (2015), Chandra et al. (2019), Alsan and Wanamaker (2017), Alsan et al. (2019) Alsan et al. (2024), Lowes and Montero (2021), and Oster (2012). Regarding the supply side, see, for example, Christensen et al. (2021), Nyqvist et al. (2019), Banerjee et al. (2004), Das et al. (2008), Das and Hammer (2014), Okeke (2023), Björkman Nyqvist et al. (2022), Dupas (2011a), Kremer and Miguel (2007), and de Walque (2007).

[5]For example, in the context of *bhopa* diseases described in Banerjee and Duflo (2011).

[6]Lowes and Montero (2019) examine predictors of traditional medicine use in former French Central Africa and find that a belief in supernatural causes of HIV/AIDS positively correlates with traditional medicine use. Ashraf et al. (2017) demonstrate that traditional beliefs about the cause of childbirth complications attenuate learning about childbirth risks in Zambia. Furthermore, Bennett et al. (2018) find that displaying bacteria under a microscope enhances the credibility of hygiene information and promotes better hygienic practices in Pakistan, where illness is attributed to an imbalance between bodily humors. Building upon these findings, I delve into beliefs about disease in sub-Saharan Africa, offering conceptual insights into the relationship between beliefs about disease causation and those about modern medicine and generating insights on diseases without readily identifiable causes.

[7]For example, see Spolaore and Wacziarg (2013), Becker and Woessmann (2009), Nunn and Wantchekon (2011), Nunn (2008), Moscona et al. (2020), Alesina et al. (2013), Lowes (2022), Bazzi et al. (2020), Bau (2021), Lowes and Montero (2021), and Ashraf et al. (2020).

[8]For an overview of the literature on the economics of religion, see Iannaccone (1998) and Iyer (2016).

de la Sierra, 2017, Miguel, 2005),[9] and investment decisions (Butinda et al., 2023).

Finally, I contribute to the literature on mental models and beliefs in behavioral economics. I show that causal beliefs influence behavior and individuals may turn to the supernatural to form these beliefs, potentially resulting in inefficiencies and negative externalities.[10] I build on a large literature on information provision experiments.[11]

2 Motivation and Background: Empirical Patterns in Sub-Saharan Africa

In this section, I examine supernatural beliefs about illness and their association with health outcomes in sub-Saharan Africa. Using data from Gallup World Poll, Pew Religion and Public Life survey, and Demographic and Health Surveys, I identify empirical patterns across a large set of countries. I then exploit the introduction and rollout of HIV treatment in the region to provide motivational evidence on whether access to modern medicine influences supernatural illness beliefs.

The landscape of supernatural beliefs. The global landscape of supernatural beliefs is diverse. Religious beliefs range from beliefs in powerful, morally concerned "big gods" to ancestral spirits, nature spirits, and other supernatural entities ("small gods").[12] Such beliefs can evolve over time and become mixed, leading to syncretism.[13]

The nature and content of beliefs differ, and these differences can have different effects on societies and individuals. For example, beliefs centered on a powerful, morally concerned deity, often referred to as a "big God", who actively intervenes in human affairs with rewards and punishments, tend to foster prosocial behavior and enhance social cohesion (Norenzayan, 2013). While beliefs in harm through supernatural forces exist across societies, beliefs that real humans can hold powers and use them for harm ("witches") can have different consequences (Singh, 2021).

I focus on indigenous, pre-Abrahamic supernatural beliefs in sub-Saharan Africa. As my data collection reveals, these beliefs constitute the prevailing explanatory framework for illness in my

[9] Oster (2004) examines similar phenomena in medieval Europe.

[10] For example, see Alsan et al., 2024, Schwartzstein and Sunderam, 2021, Mullainathan et al., 2008, Barron and Fries, 2023, Hanna et al., 2014, Bordalo et al., 2022, and Bursztyn and Yang, 2022.

[11] See Haaland et al. (2023) for an overview of information provision experiments.

[12] Supernatural beliefs have developed independently across societies. One hypothesis is that human minds' ease of separating the mind from the body and physical from spiritual existence makes humans naturally susceptible to belief in supernatural agents such as ghosts and witches. For example, many believe that the body can be buried while the mind or the spirit goes to a spiritual world upon death (e.g., Willard and Norenzayan, 2013, Henrich, 2021).

[13] For example, the Catholic church originally incorporated numerous pagan beliefs and practices, which persisted during the medieval period and gradually receded, with their decline accelerated in particular by the Protestant Reformation (Thomas, 1971).

setting in the DRC and other regions of sub-Saharan Africa. Such beliefs – some of them referred to as "witchcraft" by Westerners and the literature – encompass ancestral reverence and beliefs in spirits, fetishism, curses, spells, and humans with supernatural powers.

Similar beliefs exist across the world and often coexist in syncretism with other religions such as Christianity. Using contemporary data, Gershman (2022) reports that 43% of respondents across 95 countries worldwide believe in the evil eye or the ability of certain individuals to cast harmful spells.[14] Europe is the exception in terms of the prevalence of beliefs in witchcraft and the evil eye, as shown in Appendix Figure A.1. In sub-Saharan Africa, almost half (45.6%) of respondents believe in witchcraft, according to Pew data from 2009.[15] This number masks significant regional heterogeneity, ranging from a high of 92% in Madagascar to a low of 18% in Ethiopia,[16] with 65.9% in the DRC, as shown in Figure 1a.

I. How common are supernatural beliefs about the cause of illness?

Fact I.1: Historically, supernatural explanations of illness were very common across the world – more common, in fact, than natural explanations.

Historically, supernatural explanations for illness prevailed over natural ones.[17] As classified by Murdock (1980) in the Standard Cross-Cultural Sample,[18] supernatural explanations dominated natural explanations in all but one of 186 independent preindustrial societies.[19] During this period, biomedical explanations were not yet established. However, concepts such as accidents, violence, old age, or a rudimentary understanding of agents akin to microbes were largely absent from these explanatory frameworks.[20] These statistics highlight that, in the past, societies worldwide held similar supernatural belief systems. For this reason, this paper offers insight into how scientific

[14] While survey questions across countries cannot fully capture the diversity of local spiritual practices and interpretations, researchers have used them to gauge prevalence across countries.

[15] The survey question is "Do you believe in witchcraft?" However, there is a lack of clarity regarding its translation into the local language.

[16] Ethiopia has a longer history of Christianity than most of the rest of the region.

[17] I use the definitions of supernatural and natural phenomena from the psychology literature, defining "*natural* as (in principle) observable and empirically verifiable phenomena of the physical or material world" (Legare et al., 2012, p.780) and "*supernatural* as phenomena that violate, operate outside of, or are distinct from the realm of the natural world or known natural law" (Legare et al., 2012, p.780).

[18] The Standard Cross-Cultural Sample, curated by anthropologist George Peter Murdock and Douglas R. White, is a comprehensive dataset on 186 preindustrial societies, selected to offer a balanced representation of geographical regions and societal types, thereby minimizing historical and cultural dependencies. The data cover Hebrew, Japanese, Javanese, Aztec, Vietnamese, Siamese, Roman, Turk, Inca, and Mapuche societies.

[19] The exception is preindustrial Japanese society, which predominantly attributed illness to origins resembling infection.

[20] For example, 26 out of the 186 societies employed no natural explanations for illness. Furthermore, in 157 societies, "deterioration" meaning death from old age or body dysfunction was not a recognized cause at all. In 117 societies, supernatural causes were the predominantly recognized explanation for death.

explanations for disease came to dominate supernatural ones in other parts of the world.

Fact I.2: Supernatural explanations remain common today across sub-Saharan Africa. Qualitative evidence suggests that supernatural beliefs about illness still exist in many parts of the world today. For example, Banerjee and Duflo (2011) describe *bhopa* diseases in India. In many societies in sub-Saharan Africa, diseases are often attributed to invisible forces, which are frequently linked with "witchcraft", according to anthropologists (Ashforth, 2002, Wood and Lambert, 2008, Evans-Pritchard, 1976).[21]

I empirically investigate the prevalence of supernatural beliefs regarding illness in sub-Saharan Africa using data from the DHS and Gallup. Both surveys include a variable on whether individuals believe one can contract the AIDS virus (HIV) through witchcraft or other supernatural means.[22] On average, 17.2% of respondents in sub-Saharan Africa according to the DHS data and 14.8% according to the Gallup data hold a supernatural belief regarding contraction of HIV/AIDS, as shown in Appendix Figure A.2. The overall average hides significant heterogeneity. The lowest country mean is 3% in Rwanda, while the highest is 62% in the Republic of Congo. In the DRC, 35% of respondents hold such beliefs.

II. Are supernatural beliefs about illness relevant for health behavior?

Fact II.1: Supernatural beliefs positively correlate with healer use in sub-Saharan Africa.

In many societies, religious and health beliefs are interconnected (Rivers, 1979, Glick, 1967).[23] As one consequence, individuals may seek traditional healers when they believe the cause of the affliction to be of supernatural nature, as they consider modern medicine ineffective in treating such afflictions (Plummer et al., 2006). Indeed, the use of traditional healers is common in sub-Saharan Africa, as Figure 1b illustrates.[24] In the Pew data, almost half of the respondents use traditional healers (42%); country figures range from 12% in Rwanda to 75% in Senegal, with 42% in the DRC.

Now, given the established prevalence of such beliefs, an important question rises: Is there a relationship between indigenous religious beliefs and healer use? Appendix Figure A.4 gives evidence

[21] Witchcraft-related explanations serve to address the fundamental question "Why are we suffering?" (Rödlach, 2006). According to Preston-Whyte (2008), such explanations can shed light on seemingly random coincidences, such as why some individuals fall ill and die while others continue to live.

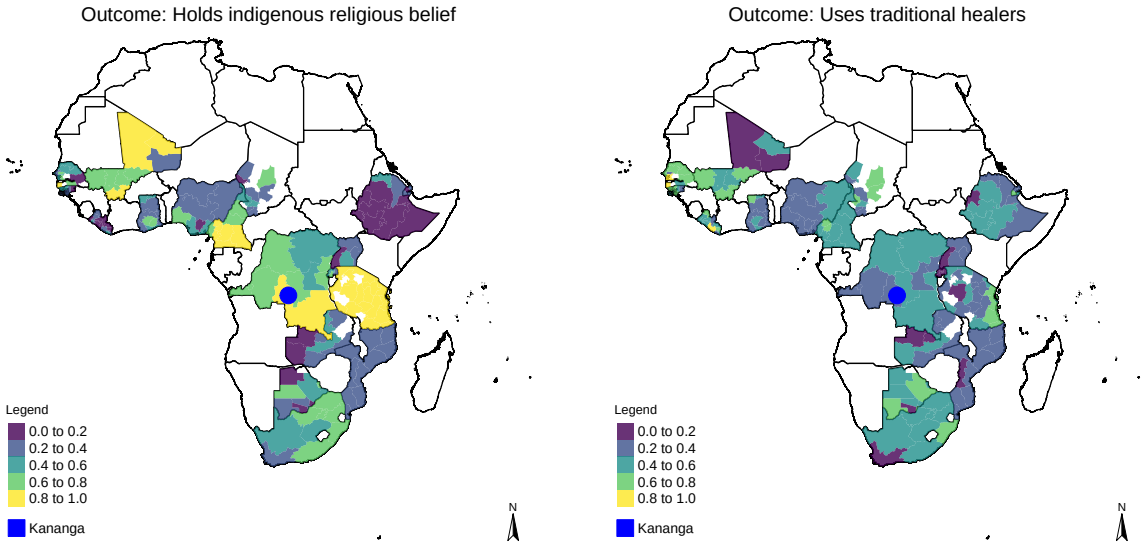
[22] The DHS survey question is "Can people get AIDS virus/HIV because of witchcraft or other supernatural means?" As noted above, we do not know what "witchcraft" measures in the local context: it can be interpreted only as a measure of local indigenous beliefs.

[23] One might even argue providing an explanation and a solution for suffering is the purpose of religion.

[24] The survey question is "Do you or your family ever use traditional religious healers when someone is sick?"

for an affirmative answer. The figure shows a binned scatter plot of the two variables on traditional healer use and witchcraft beliefs in the Pew data, using country fixed effects.[25] Those who hold indigenous religious beliefs are 16 percentage points more likely to use traditional healers, which suggests that supernatural beliefs can influence health behavior.[26]

Figure 1: Prevalence of Indigenous Supernatural Beliefs and Traditional Healer Use in Sub-Saharan Africa



(a) Prevalence of indigenous religious beliefs

(b) Prevalence of traditional healer use

Note: Panel 1a: The figure plots the share of respondents answering "yes" to the question "Do you believe in witchcraft? (yes/no)" by region in each country. Panel 1b: The figure plots the share of respondents answering "yes" to the question "Do you or your family ever use traditional healers when someone is sick?" by region in each country. The data come from the Pew Forum on Religion and Public Life survey from 2009 for both maps. Kananga is the site of the field experiment.

Fact II.2: Supernatural beliefs regarding HIV/AIDS are linked to stigmatizing attitudes toward those with HIV/AIDS.

In addition to impacts on the take-up of modern medicine, the anthropology literature points out a second important consequence: Believing that disease is a manifestation of supernatural forces such as spirits or demonic possession or a sign of being a malicious agent with ancestral powers (a "witch") can lead to stigmatization of those with illness, that is, negative attitudes or discrimination toward ailing people, including marginalization, ostracism, violence, and withholding of care (Kleinman,

[25]The survey question for belief in witchcraft is "Do you believe in witchcraft? (yes/no)."

[26]Whether traditional and modern medicine are used as complements or substitutes, simultaneously or sequentially, is an open question. Understanding the patterns of use is relevant, as prolonged reliance on traditional methods may pose the risk of conditions becoming exacerbated beyond treatability (Hatchett et al., 2004, Thomas, 2007).

1988).[27] I explore empirical evidence for the relationship between supernatural beliefs about illness and stigmatization of those with illness for two reasons. First, such stigma may impact treatment-seeking and thereby uptake of modern medicine of the afflicted. Second, such stigma can have direct effects on the physical and mental health of the afflicted, including higher mortality.

I explore beliefs in sub-Saharan Africa about HIV/AIDS, one of the most stigmatized conditions.[28] I use the DHS data, including a sample of 16 surveys across 15 countries conducted between 2004 and 2013, focusing on periods before the introduction of HIV treatment, as it could affect the relationship. I measure supernatural beliefs via agreeing with the statement "One can get HIV/AIDS from witchcraft or other supernatural means (yes=1)", and stigmatizing attitudes via agreeing with the statement "People with AIDS should be ashamed of themselves (yes=1)".

Indeed, I find that supernatural beliefs about HIV/AIDS and stigma toward those with HIV/AIDS are positively correlated, as demonstrated by the binned scatter plot including country fixed effects in Appendix Figure A.6.

III. Are supernatural beliefs about illness malleable?

Fact III.1: Supernatural beliefs regarding HIV/AIDS are associated with the availability of modern medicine.

I examine whether there is motivational evidence from sub-Saharan Africa for the malleability in beliefs – my third research question. Specifically, I explore the correlation of such beliefs with the availability of modern treatment as an indication that exposure to modern medicine may causally affect supernatural beliefs about illness. Anthropological accounts provide insights into the mechanism: efficacious diagnosis and treatment of conditions through modern medicine can disprove that a disease has a supernatural character (Jilek-Aall et al., 1997, Cox and Phillips, 2015). Variation in exposure to modern medicine across sub-Saharan Africa might, in fact, explain some of the observed variation in supernatural beliefs about HIV/AIDS across countries (see Appendix Figure A.2).

To investigate the relationship between modern medical treatment and beliefs about disease, I exploit the rollout in sub-Saharan Africa of antiretroviral therapy (ART) for HIV treatment, which began in the early 2000s and significantly expanded with the launch of the U.S. President's Emergency Plan for AIDS Relief (PEPFAR) in 2003. I measure ART prevalence via the share of the population receiving ART in a country–year using World Health Organization (WHO) data.

[27] Jilek-Aall (1999) illustrates this vividly with the example of individuals living with epilepsy in Tanzania, who face neglect and ostracism due to the prevailing fear of the spirits believed to cause epilepsy, with tragic consequences.
[28] The association between HIV/AIDS and its supernatural connotations has been a focal point in medical anthropology literature (Awusabo-Asare and Anarfi, 1997, Kalichman and Simbayi, 2004, Thomas, 2007, Farmer, 2006).

I employ DHS data from 69 surveys across 29 countries spanning 2003 to 2018 and measuring supernatural beliefs regarding HIV/AIDS via agreement with the statement "One can get HIV/AIDS from witchcraft or other supernatural means (yes=1)".

I examine the relationship through an ordinary least squares (OLS) regression. Appendix Table A.1 gives the regression results.[29] Column (1) shows that a one-standard-deviation increase in a country's lagged HIV treatment prevalence is associated with a 0.170-standard-deviation decrease in a respondent's likelihood of holding supernatural beliefs about HIV/AIDS with country and year fixed effects – a result that is significant at the 1% level. The table also shows that HIV treatment prevalence is associated with a higher likelihood of consenting to an HIV test (Lowes and Montero, 2021) and a lower likelihood of holding stigmatizing attitudes toward those with HIV/AIDS in columns (2) and (3). These results motivate the outcomes I consider in the later field experiment.[30]

In this section, I gave motivational evidence that supernatural beliefs about illness are common in sub-Saharan Africa and that they may be relevant for health behavior: they correlate with the use of healers and stigmatization of those with certain conditions such as HIV/AIDS, which could impact take-up of medical treatment. I found that the availability of HIV treatment in sub-Saharan Africa negatively correlates with supernatural beliefs about the illness. If part of this relationship is causal, beliefs could be malleable and might be influenced by exposure to modern medical care. These patterns motivate me to examine the prevalence of supernatural beliefs about illness and their correlates with health outcomes through an original data collection in the DRC in Section 3 and to test whether it is possible to shift beliefs and increase take-up of modern medicine through a randomized controlled trial in Section 6.

3 Setting in Kananga and Survey Design

In Section 2, I gave motivational evidence that supernatural beliefs about illness are common across sub-Saharan Africa and may be relevant for health behavior. However, the data examined above do

[29] I use OLS to estimate equation 1.

$$\text{HIV/AIDS supernatural}_{ict} = \alpha + \beta_1 \text{HIV treatment prevalence}_{c,t-1} + \mathbf{X}_{ict}\mathbf{\Gamma} + \delta_c + \theta_t + \varepsilon_{ict}, \quad (1)$$

where i indexes individuals, t indexes a survey year, and c indexes a country. HIV/AIDS supernatural$_{ict}$ represents the outcome of supernatural beliefs about HIV/AIDS. HIV treatment prevalence$_{c,t-1}$ measures the lagged country-level prevalence of ART. $\mathbf{X}_i$ includes the individual-level covariates sex, age, age squared, education in years, indicator variables for marital status, and a wealth index. δ_t is year fixed effects, and λ_c is country fixed effects. ε_{ict} denotes the error term with cluster-robust standard errors at the country level (Bertrand et al., 2004).

[30] The DHS program conducts HIV testing in select surveys to assess prevalence. Technicians collect blood via a finger prick. The respondent does not receive individual results due to anonymous sampling. Note that some surveys offer home-based testing with counseling and referrals for healthcare facility follow-up. For additional information on HIV testing, visit https://dhsprogram.com/topics/HIV-Corner/.

not allow me to examine beliefs beyond HIV/AIDS and mechanisms connecting supernatural beliefs and take-up of modern treatment, motivating me to conduct a large-scale survey in Kananga, DRC. In this section, I describe the setting, sampling, and survey design.

Setting. I conducted surveys with a representative sample of 800 respondents in the city of Kananga in the DRC. The DRC is the fourth most populous country in Africa and among the five poorest countries globally. It is characterized by a high burden of disease and frequent disease outbreaks including Ebola. Kananga is the capital of Kaisai Province and has an estimated population of 1.5 million. It is an urban setting with high rates of poverty. The unemployment rate is 37%, and the sample's median monthly household income is 60 USD. Slightly more than half of the individuals in the sample (53%) have no source of electricity including batteries and solar panels, and almost two-thirds (60%) live in houses with clay or stick walls.

In Kananga, modern medicine is available, but focuses mainly on primary and maternal care. Nongovernmental organizations, including UNICEF, Doctors Without Borders, and the World Health Organization, play a significant role in providing healthcare services. In my sample, only about 12% of respondents have never consulted a medical professional because primary care is available. In addition to the use of modern medicine, the use of traditional medicine in the forms of herbal remedies and spiritual healing using the power of the ancestors is widespread. In my sample, half of the respondents have consulted traditional practitioners..

Sampling. My target size for the baseline survey was 800 respondents. I sampled respondents using two-stage clustered sampling in the following way. The city was initially divided into enumeration areas – or polygons – based on Google satellite imagery from 2016. The number of houses in each polygon was then counted to estimate the population size. In a second step, I randomly selected 50 out of the 443 polygons, where the probability of choosing a particular polygon was proportional to its estimated population size. I stratified by the median distance to the city center, where the collaborating hospitals are located.[31] In a third step, enumerators sampled 16 households in each polygon based on a household-skip pattern to ensure a geographically representative sample.

For each sampled household, the enumerator first asked to interview the household head, and if he or she was not present, the enumerator interviewed another adult member of the household. The respondent was eligible to participate in the survey if he or she had heard about epilepsy and understood Tshiluba well. Only one respondent was ineligible. The data were collected between March and June of 2022.

[31] Appendix Figure A.7 shows the selected polygons in Kananga.

Survey design. The baseline survey comprised questions about a variety of common adulthood illnesses: malaria, typhoid, tuberculosis, fractures, snakebite, sterility, hypertension, diabetes, COVID-19, swollen limbs, HIV/AIDS, anemia, and epilepsy.

At least 90% of respondents had heard about all illnesses and conditions before, suggesting that biomedical definitions of illnesses are clearly defined to respondents (see Appendix Table A.2).

Exposure to these illnesses varies. Malaria, typhoid, and epilepsy are the diseases most people reported having exposure to, with greater than 90% of respondents knowing somebody, including themselves, who had had the illness, while COVID-19 and HIV/AIDS are the conditions with lowest exposure, with rates of 19.05% and 36.11%, respectively.

Main measures of beliefs about illness. Throughout the paper, I make use of the following main belief measures for every illness, including epilepsy.

Supernatural illness. For every illness, I elicited the respondent's belief about whether the illness's cause is only supernatural, only natural, or both. The survey question is as follows: "According to you, can illness [...] be caused only by witchcraft, evil spirits, bad spell/curse, or fetishism, can [...] be caused only by something natural, or can [...] be caused by both?'[32]. The enumerator selected an answer choice of "only supernatural", "only natural", or "both", which was not read to the respondent. I create the dummy variable "illness can be supernatural", which is equal to one if the respondent gives the answer "only supernatural" or "both natural and supernatural" and zero otherwise.

In addition, I elicited the perceived share of cases of an illness with a supernatural cause. I explained the exercise[33] and elicited this share via the question "Out of ten people who have [...], how many do you think have [...] caused by witchcraft, evil spirits, or curses, that is, not by natural causes?" The respondent gave an answer between 0 and 10. If the respondent had trouble understanding the question, the enumerator used a board with ten figures that could be allocated to a field with the text "supernatural" or a field with the text "natural". I also make use of the variable "share of illness supernatural", for which I divide the answer by 10.

Efficacy of modern medicine. I elicited respondents' beliefs about the efficacy of modern medicine.

[32]The words used in local French are *sorcellerie*, *mauvais esprits*, *mauvais*, *sort*, *fetishisme*

[33]The explanation was the following: "Then, for each of the following disease or conditions, please imagine 10 people who have the disease or condition. It doesn't mean that these 10 people have to be your family members or that you have to know 10 people with that disease. Imagine that you take 10 people who have the disease by chance from the population. Then, you tell me how many of these 10 people you think have the disease caused by witchcraft, evil spirits, or curses. This means that these people do not have the disease from a natural cause. If you think a disease can have only supernatural causes, you say '10'. If you think a disease can have only natural causes, you say '0'. You can also think of percentages if it is easier for you. For example, if you think that 30% of all people who have diarrhea have diarrhea caused by evil spirits or witchcraft, you'd say '3"'.

The survey prompt was as follows: "For each of the following diseases or conditions, please tell me how good modern medicine or a doctor of modern medicine is at treating and diagnosing it: very good, good, neither good nor bad, not so good, not good at all". Then, the enumerator went through a list of illnesses including epilepsy. I create the dummy variable "modern medicine is effective", which is equal to one if the respondent chooses "very good" or "good" and zero otherwise.

Efficacy of traditional medicine. I elicited respondents' beliefs about the efficacy of traditional medicine in a similar way. The survey prompt was as follows: "For each of the following diseases or conditions, please tell me how good traditional medicine either at the basis of herbs or at the basis of ancestral powers is at treating and diagnosing it[34]: very good, good, neither good nor bad, not so good, not good at all". Then, the enumerator went through a list of illnesses including epilepsy. I create the dummy variable "traditional medicine is effective" equal to one if the respondent chooses "very good" or "good" and zero otherwise.

4 Descriptive Evidence on Beliefs about Illness in the DRC

Motivated by the patterns from sub-Saharan Africa indicating that supernatural beliefs about illness are common and relevant for health behavior in Section 2, I exploit my original data to examine the prevalence of supernatural beliefs about illness, the variation across individuals and illnesses, and the relationship with beliefs about the efficacy of modern medicine and stigmatization of those with certain illnesses in this section.

I. Are supernatural beliefs about illness common?

Fact I.1: Supernatural beliefs about illness are very common.

In Kananga, supernatural explanations for diseases can involve evil spirits, bad spell/curses, supernatural punishment, or interventions by people with ancestral powers and malicious intent (witches).[35]

I find that supernatural beliefs about illness are very common: 94% of respondents hold a supernatural belief about at least one illness. This number masks large heterogeneity in the extent of beliefs across individuals, as shown in Figure 2a. The figure depicts the histogram of the number of illnesses that an individual thinks can be supernatural. On average, respondents believe that

[34] "Traditional medicine at the basis of ancestral powers" is the local way of describing healing practices that do not involve herbal medicine.

[35] Appendix Figure A.8 shows an agnostic measure of perceived causes of disease in Kananga for the example of epilepsy by means of a wordcloud of the answers to the open-text question "Can you explain the causes of epilepsy to me in your own words?"

4.8 out of the 13 illnesses can be supernatural. Only 0.9% of respondents believe that all the illnesses can be supernatural, and only 5.6% of respondents believe that none of the illnesses can be supernatural.

Fact I.2: An individual may embrace supernatural explanations for only some illnesses or some cases of an illness.

The discussed variation points to a second relevant finding: an individual may offer different explanations for different illnesses. This coexistence of supernatural and natural beliefs could mean that beliefs are adaptable. Do explanations even vary by cases of the same illness? Focus group discussions in Kananga suggested that individuals form a belief about the specific case of an illness, relying on information about the context such as demographics and past behavior of the ailing person.[36]

I examine variation across illness events for the example of epilepsy, using the survey question "Out of 10 people with epilepsy, how many have it from supernatural causes?" Appendix Figure A.10 shows the distribution of answers. Slightly more than a fifth of respondents (21.4%) choose "0", implying that epilepsy never has supernatural causes, and a tenth of respondents chooses "10", implying that epilepsy always has supernatural causes. Many respondents choose a number between "1" and "9", implying that epilepsy may have a supernatural cause only sometimes.[37]

With the findings above taken together, the variation in causal beliefs across different illnesses and events highlights a crucial aspect of these beliefs in terms of adaptability, as they may be defined by their frequency of use for explanation.

Fact I.3: Some people are more likely to hold supernatural beliefs about illnesses, but the propensity to embrace supernatural explanations is unrelated to education, age, or wealth.

The substantial variation in individuals' propensity to attribute illnesses to supernatural causes raises the question of who embraces such explanations. One hypothesis links these supernatural beliefs to education and wealth–a connection that has important implications for their evolution over time.

To shed light on the hypothesis, I explore individual-level predictors of supernatural beliefs about illness. I regress a Kling et al. (2007) index of the variables for whether an illness can

[36] Research in psychology on supernatural beliefs on HIV/AIDS in South Africa support this finding (Legare and Gelman, 2008, Legare et al., 2012, Lynch and Medin, 2006).

[37] Additional analyses in Appendix Section A examine determinants of which cases supernatural explanations are used for, specifically the social proximity to the affected person.

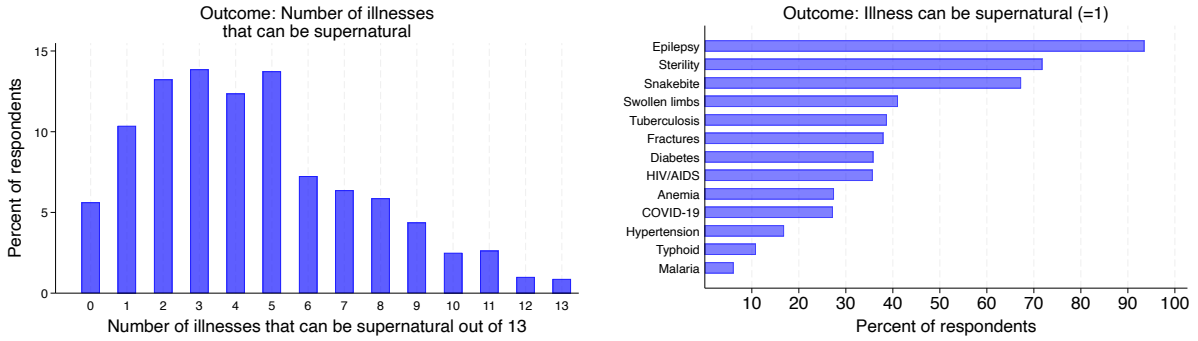
have supernatural causes across the 13 illnesses on demographics. Figure A.12 plots the regression coefficients. Education, age, wealth, and being born in a city have almost no relationship with the supernatural illness index. The only demographic variables with predictive power are being a woman and belonging to a Pentecostal or Protestant church (compared to not belonging to either Pentecostal, Catholic, or Protestant churches).[38] These results do not support the hypothesis that nonscientific beliefs about illness stem from wealth or education.

Fact I.4: Supernatural beliefs about illness vary by illness, and some illnesses are more commonly attributed to supernatural forces than others.

The depicted variation in supernatural beliefs raises the question: are there certain illnesses that are systematically attributed to supernatural causes? I examine the percentage of respondents who believe that an illness can have supernatural causes, shown in Figure 2b.

I find substantial heterogeneity across diseases in the population. Epilepsy is the disease most commonly attributed to supernatural forces, with 93% of respondents believing that epilepsy can have supernatural causes. For this reason, the field experiment discussed below focuses on epilepsy. Malaria and typhoid are the diseases least often given a supernatural explanation.

Figure 2: Variation in Supernatural Beliefs Across Individuals and Illnesses



(a) Variation in illness beliefs across individuals (b) Variation in supernatural beliefs across illnesses

Notes: Panel 2a: The histogram shows the distribution of the variable on the number of illnesses that an individual believes can be supernatural in origin (out of 13). The variable is based on the question of whether an illness j has only supernatural causes, only natural causes, or both. See Section 3 for the variable description. Panel 2b: The figure shows the percent of respondents believing an illness can have supernatural causes by illness, constructed in the same way. The data come from the baseline survey (N=800).

The variation in Figure 2b raises the question of why some illnesses are perceived to be supernatural more often than others. The shares of 38% for fractures and 67% for snakebites suggest that observing the mechanical trigger of a condition does not rule out an attribution of the ultimate

[38]Some churches, including Pentecostal churches in Kananga, have incorporated indigenous beliefs more than others.

cause to supernatural forces. For example, more than 90% of respondents believe that epilepsy always occurs in the brain, and yet more than 90% of respondents believe that epilepsy can have a supernatural cause. The fact that HIV/AIDS and COVID-19 are not the diseases most commonly attributed to supernatural forces rules out the conjecture that individuals attribute only novel and misunderstood diseases to supernatural causes. Another hypothesis is that only low-prevalence and thus low-exposure illnesses are perceived as being of supernatural character, but epilepsy has high exposure, with more than 90% of respondents knowing someone with epilepsy alive in Kananga. Finally, as epilepsy and sterility are complex diseases with complex treatment while malaria and typhoid are common but are associated with modern and readily available testing and treatment, it may be that the availability of effective modern medicine could explain the patterns, which I will explore in the following.

II. Are supernatural beliefs about illness relevant for health behavior?

Fact II.1: Supernatural beliefs about illness are strongly negatively correlated with beliefs about the efficacy of modern medicine.

The motivational evidence from sub-Saharan Africa in Section 2 suggests that supernatural beliefs may impact take-up of medical treatment, but due to data limitations, the mechanism whereby such an impact may operate remains unknown.

Before exploring the mechanism in my data, I confirm that supernatural beliefs negatively correlate with modern medicine use. I exploit my data at the individual–illness level and the variable for whether the respondent has ever used modern medicine in the form of testing or examination for a given illness. I regress whether a respondent has used modern medicine for a given illness on whether the respondent believes the illness can be supernatural and individual fixed effects, using estimating equation **??**. I find that believing that an illness can be supernatural is associated with a 25.6-percentage-point lower likelihood of having used modern medicine for the illness, as shown in Appendix Table A.3 Panel B column (2). As one concern may be that certain illnesses drive this relationship, I use illness fixed effects instead and show that the coefficient of -4.8 percentage points is still negative and significant in column (3).

Estimations of the relationship between supernatural beliefs and past use of modern medicine are confounded by the prevalence and severity of the disease and availability of care. For this reason, I aim to understand the relationship between supernatural beliefs and modern medicine use conceptually: how do beliefs about the origin of disease affect take-up of treatment? Focus group

discussions illustrated that individuals adhere to a logic according to which modern medicine cannot treat a supernatural disease, exemplified by the survey response "If this disease is natural, modern medicine can treat it because it is the specialist. But if it is supernatural, it is in the realm of traditional medicine".[39] This quote motivates me to examine the relationship between supernatural beliefs and beliefs about the efficacy of modern medicine.

First, I investigate the relationship by comparing population means of supernatural beliefs and beliefs about modern medicine's efficacy for every illness. Figure 3a shows the share of respondents who believe that modern medicine is effective in treating the illness on the y-axis and the share of respondents who believe an illness can be supernatural on the x-axis. I find that beliefs that an illness can be of supernatural character negatively correlate with beliefs that modern medicine is effective at the population level. Malaria, typhoid, hypertension, and anemia exhibit low supernatural beliefs and high beliefs about the efficacy of modern medicine. The results for the new and less prevalent disease of COVID-19 follow this pattern, providing evidence of the link between beliefs even when respondents have little experience with the illness. The results for HIV/AIDS deviate, possibly due to extensive information campaigns about the transmission mechanisms. In contrast, snakebites, sterility, and epilepsy show high supernatural attributions and low beliefs in the efficacy of modern medicine.

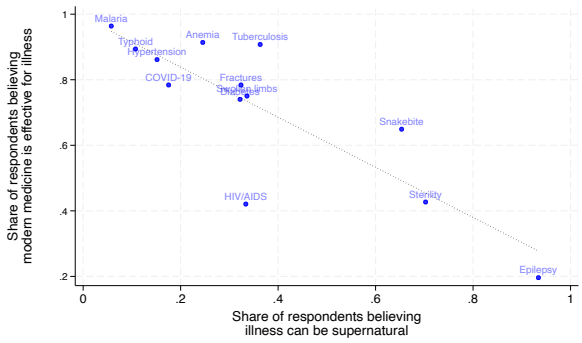
Next, using individual fixed effects in Figure 3b, I demonstrate that this negative relationship holds across beliefs about illness for a given individual. The figure shows a binned scatter plot of the belief that modern medicine is effective for an illness on the y-axis and the belief that the illness can have supernatural causes on the x-axis, including individual fixed effects.[40] The evidence underlines that the relationship is not driven by particular illnesses or individual-level factors such as age, education, wealth, or general trust in medicine.

In summary, beliefs in supernatural causes of illness are strongly negatively correlated with beliefs about the efficacy of modern medicine. This association holds with individual and illness fixed effects. Causality could go in both directions. On the one hand, the relationship means that supernatural beliefs could affect take-up of treatment. On the other hand, beliefs about modern medicine could causally affect supernatural beliefs. Therefore, I design a medicine-based intervention for the field experiment below, as it may shift supernatural beliefs about illness.

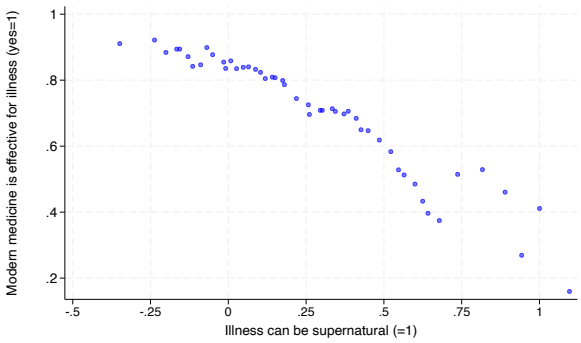
[39] See Appendix Section C for more anthropological accounts.

[40] Appendix Table A.3 shows the corresponding regression results in Panel A column (6). Columns (7)–(8), Panel B columns (6)–(8), and Appendix Figure A.3 show that the negative relationship holds when I consider variation within an illness by means of illness fixed effects and when I control for the individual's experience with modern medicine for a particular illness.

Figure 3: Relationship Between Supernatural Beliefs and Beliefs about Modern Medicine



(a) Relationship of beliefs that modern medicine is effective and that illness is supernatural, by illness



(b) Relationship of beliefs that modern medicine is effective and that illness is supernatural, at illness–individual level with individual fixed effects

Notes: Panel 3a: The figure shows the mean of the dummy variable for whether an illness can have supernatural causes by illness on the y-axis and the mean of the dummy variable for whether modern medicine is effective for an illness on the x-axis. See Section 3 for the construction of the variables. The data come from the baseline survey (N=800). Panel 3b: The figure shows the binned scatter plot of the dummy variable for whether an illness can have supernatural causes for an illness on the x-axis and the dummy variable for whether modern medicine is effective for an illness on the y-axis. The regression includes individual fixed effects with observations at the illness–individual level in the baseline survey (N=800). See Section 3 for the construction of the variables.

Fact II.2: Supernatural beliefs regarding epilepsy predict stigma toward those with epilepsy.

In Section 2, I depicted a positive association between supernatural beliefs regarding HIV/AIDS and stigma toward those with this condition. Focus group discussions in Kananga confirmed the motivational evidence, revealing that the effect of supernatural beliefs on the perception of the ailing individual is a relevant dimension of the experience of illness and another obstacle to take-up of treatment.[41]

As HIV/AIDS could be an outlier in stigmatizing attitudes due to the transmission mechanisms and population associated with HIV/AIDS, I explore stigmatization of those with epilepsy, as the disease cannot be transmitted and can affect all age and sex groups.

I explore the predictors of stigmatizing attitudes toward those with epilepsy, measured via a dummy variable equal to one if the respondent agrees that one's children should not play with epileptic children. First, I examine the belief that people living with epilepsy (PLWE) are witches, that is, people believed to possess supernatural or magical powers, often associated with malevolent intent.[42] Second, as one could imagine supernatural beliefs increasing sympathy toward the ailing

[41] Jilek-Aall (1999) discovered the high prevalence of epilepsy in Tanzania not because people with epilepsy came for epilepsy treatment at her clinic but because they arrived seeking treatment for burn wounds.

[42] The respondents were asked whether they agreed with the statement "Somebody with epilepsy is a witch" on a

person if the attribution of a supernatural cause is understood to imply that the illness is beyond the person's own control and responsibility, I examine beliefs that PLWE are bewitched or under a spell or curse.[43] As fears of contracting the illness could be another reason to avoid people with epilepsy, I include a dummy variable equal to one if the respondent believes that epilepsy can be transmitted from human to human.[44]

Figure A.13 plots the regression coefficients. The belief about transmission exhibits the highest predictive power of stigmatizing attitudes, with a coefficient of 0.45. Respondents who believe that PLWE are witches are 11.7 percentage point more likely to hold stigmatizing beliefs toward PLWE, a result that is significant at the 1% level. In contrast, beliefs that PLWE are bewitched do not predict stigma.[45]

This difference points to the complexity of supernatural beliefs. They can cause both sympathy and stigma. As supernatural beliefs positively correlate with stigma toward those with epilepsy (and not negatively), I do not anticipate unintended negative consequences of an information treatment and therefore evaluate its effects on stigma in Section 6.3.

In this section, I showed that holding supernatural beliefs about illness is common in Kananga but that the variation in espousing such beliefs across individuals is large. An individual may hold supernatural explanations for only some illnesses or cases of an illness, pointing to the adaptability of explanations. Some illnesses are more commonly attributed to supernatural causes than others; this is the case for epilepsy, the target of the video campaign in my experiment. Supernatural beliefs about illness appear to be relevant for health behavior, as they strongly negatively correlate with beliefs about the efficacy of modern medicine and stigma toward those with epilepsy. If access to modern medicine can causally affect supernatural beliefs, a medicine-based intervention may shift them.

5 Survey Experiment Description

I turn to the question of whether it is possible to shift supernatural beliefs about illness and increase take-up of modern treatments. In Section 4, I showed that an individual may recur to supernatural

5-point scale from "strongly disagree" to "strongly agree". The outcome variable is a dummy variable equal to one if the respondent answered "strongly agree" or "agree".

[43]The respondents were asked whether they agreed with the statement "Somebody with epilepsy is bewitched" on a 5-point scale from "strongly disagree" to "strongly agree". The outcome variable is a dummy variable equal to one if the respondent answered "strongly agree" or "agree". The local French word used was *ensorcelé*.

[44]This transmission belief does not rule out supernatural contagion. For example, the illness could be believed to be transmitted from one human to another through a spirit.

[45]This difference raises the question of whether certain characteristics of affected people lead to the embrace of a particular type of explanation, which Appendix Section A addresses.

explanations for only some illnesses or some cases of an illness, which could make beliefs malleable. Moreover, while an individual's propensity to resort to supernatural explanations is unrelated to wealth or education in my sample, I gave motivational evidence that a medicine-based intervention could shift beliefs and behaviors: I found that supernatural beliefs regarding HIV/AIDS negatively correlate with the availability of HIV treatment in sub-Saharan Africa in Section 2 and that supernatural beliefs about illness strongly negatively correlate with beliefs about modern medicine's efficacy in Section 4.

Based on this evidence, I partnered with healthcare providers at the provincial Ministry of Health in the city of Kananga to develop an intervention providing information about the biomedical cause and treatment of epilepsy through videos. I focused on epilepsy as it is the disease most commonly associated with supernatural forces and is very prevalent in Kananga, as in other less developed countries. I implement an RCT to test whether the intervention can shift beliefs from supernatural toward medical explanations and increase take-up of treatment. In this section, I present the design of the information intervention and the RCT.

5.1 Design of Intervention

Background on Epilepsy. Epilepsy is one of the most common serious disorders of the brain. It occurs among individuals of all ages, especially in childhood and adolescence. It is relatively more prevalent in low- and middle-income countries because of the elevated risk of brain injuries in these countries – for example, because of infectious diseases or complications in pregnancy and childbirth. Epilepsy affects around 50 million people worldwide and 10 million people on the African continent, accounting for 1% of the global disease burden (World Health Organization, 2005, World Health Organization, 2004). The annual incidence of epilepsy in less developed countries is 81.7 per 100,000, compared to 45.0 per 100,000 in more developed countries (Ba-Diop et al., 2014). The prevalence of epilepsy is estimated to be 939 per 100,000 in sub-Saharan Africa compared to 638 per 100,000 in the U.S. (Ba-Diop et al., 2014, Fiest et al., 2017).[46]

PLWE face an elevated risk of premature death. Mortality for PLWE is two to three times higher than that of the average population worldwide and up to ten times higher in sub-Saharan Africa because of status epilepticus, sudden unexpected death in epilepsy syndrome, and loss of consciousness in unfortunate circumstances, for example, leading to trauma or drowning (Ba-Diop

[46]Obtaining incidence, prevalence, and mortality rates of epilepsy in sub-Saharan Africa is challenging because very few studies exist and measurement techniques vary.

et al., 2014).[47]

In more developed countries, if early and appropriate care is given, antiepileptic drugs can control seizures in 70–80% of cases (Ba-Diop et al., 2014). In Africa, an estimated 80% of cases remain untreated with modern drugs (World Health Organization, 2004).

In Kananga, 91% of respondents know at least one living person with epilepsy, putting it among the top 3 diseases with the highest exposure in my sample, after malaria and typhoid. Almost everybody (96%) has seen an epileptic seizure, with an average of 8.6 attacks. Respondents know 4.5 people with epilepsy alive on average, and 10.5% of respondents have a child, sibling, or parent with epilepsy. [48]

In Kananga, modern medicine to diagnose and treat epilepsy exists. Antiepileptic drugs are available but cost approximately 30 USD per month. Demand for treatment exists, but individuals seek treatment mainly with traditional medicine.[49] The majority of respondents (63.3%) believe that modern medicine can never treat epilepsy, and only 9.9% of respondents believe that modern medicine to treat epilepsy exists in Kananga, which creates an opportunity for the information treatment.

Treatment group. I collaborated with two medical professionals from the local Ministry of Health to design the treatment content. These experts have experience treating epilepsy in Kananga and conducting information campaigns. Given logistical constraints, we decided to design an intervention mimicking information one would receive at a local doctor's office instead of providing real medicine. In addition, given limited access to smartphones and internet, we showed the videos to respondents individually on tablets rather than distributing them through social media.

The treatment video bundled different pieces of information to reflect information that a patient could receive at a local doctor's office[50]: (1) details on the efficacy of modern medicine and availability of treatment for epilepsy in Kananga, (2) information on the occurrence of epilepsy in the brain,[51] (3) discussion of the biomedical causes of epilepsy such as meningitis or birth-related injuries, (4) details on the lack of efficacy of traditional medicine, and (5) information on the nonassociation of epilepsy with curses, evil spirits, or witchcraft.[52]

[47] Appendix Section A provides more details on the disease of epilepsy.
[48] In the survey, I defined epilepsy as cases in which a person had experienced more than one attack in her lifetime and the attacks were unrelated to other illnesses such as fever or diabetes.
[49] Fodjo et al. (2019) found that, in Ituri province in the DRC, PLWE spent 46.5% of the mean monthly household income on epilepsy care, 68.2% of which was spent on traditional medicine.
[50] Appendix Section B gives the full treatment text.
[51] While more than 90% of respondents know that epilepsy occurs in the brain, this piece of information was included to improve the overall credibility of the treatment information (see Bennett et al., 2018).
[52] The medical professionals added this piece of information as they always note this nonassociation with supernatural

The two local medical professionals delivered the treatment message using relatable examples and accessible language in the local language, Tshiluba.[53] They also insisted on discussing information about the supernatural attributions of the causes of epilepsy. In addition, as testimonials of disease are a common local practice used in chruches or on the radio, the video featured a woman giving a testimonial about her daughter's treatment journey for epilepsy. For easier retrieval of the provided information, the respondents received an information leaflet with a summary of the information in French and Tshiluba and illustrations.

As part of the treatment, the enumerator asked the treated respondents what they thought about the video and what they had learned from it immediately after showing it, a pedagogical exercise to enhance encoding and processing of the information. As a pedagogical nudge to encourage thinking about the video's implications, the enumerator also asked the treated respondents whether they thought the video had significance for other diseases with respect to, for example, their origin and treatment.

Control group. The control group watched a placebo video to experience an equivalent exposure to technology. The video discussed children's games that require minimal resources[54] and was delivered by the same two medical professionals, who did not identify themselves as such. The respondents received an information leaflet with graphic instructions on how to make a paper airplane.

5.2 Survey and Experimental Flow

The survey experiment was included in the data collection in Kananga. For details on the setting and sampling frame, see Section 3. Each respondent was visited twice. During the first visit, the enumerator conducted the baseline survey, showed the experimental videos, and immediately conducted a midline survey. The endline survey was conducted in a second visit about one week later.[55]

Randomization of videos. The survey software randomized the respondent into the treatment or control group at the time that the video was shown by means of a computerized random assignment algorithm and displayed the video automatically, which ensured that the enumerators did not

forces in their campaigns.

[53] As working with a script proved too unnatural, the professionals and I discussed the content, but the professionals ultimately delivered the content in free speech and thus had greater agency over the content.

[54] For example, drawing in the sand, running races, jumping rope with ropes made out of bamboo, making paper airplanes, and playing team games with self-made balls.

[55] Appendix Figure A.15 illustrates the survey flow.

know which video the respondent would see. A total of 413 respondents watched the treatment video (51.62%), while 387 watched the control video (48.38%).

The treatment and control videos lasted 15 and 10 minutes, respectively. To encourage attention, respondents were offered a payment of 500 FC (approximately 0.25 USD) if they correctly answered a question related to the video. The control and treatment groups received the same question about the general topic of the video, which 93.5% of control group respondents and 97.5% of treatment group respondents answering correctly.[56] Both videos were well received given the scarcity of televisions and smartphones and the general interest in the subject of epilepsy.[57]

Midline and endline surveys. The midline survey comprised various questions and incentivized measures, including estimations of the efficacy of epilepsy treatment for modern and traditional medicine in Kananga. It also included willingness-to-pay measures for hospital consultation vouchers, valuations of epilepsy consultations for third parties, and gauging the willingness to collaborate with individuals living with epilepsy. The respondent received a voucher for free HIV testing and consultation and a voucher for a free hypertension examination and consultation at the local hospital.

The endline survey during the second visit about one week later served to mitigate experimenter demand effects and social desirability biases and to assess the persistence of effects (see Haaland et al., 2023). The survey sample comprised 782 respondents, representing 97.75% of the baseline sample. The survey included the same belief measure modules as the baseline survey. Moreover, at the end of the visit, the respondent received a voucher that any adult could use for a free hospital consultation for seizures.

5.3 Estimating Equations

I use OLS to estimate the following equation:

$$y_i = \alpha + \beta_1 T_i + \beta_2 y_i^0 + \mathbf{X}_i \mathbf{\Gamma} + \varepsilon_i, \tag{2}$$

where i indexes individuals. T_i is an indicator variable equal to one if the individual watched the treatment video and equal to zero if the individual watched the control video, meaning that β_1 estimates the average causal effect of the treatment video on the outcome of interest (y_i). I control for the outcome of interest at baseline $\left(y_i^0\right)$ or a proxy thereof. I use robust standard errors. $\mathbf{X}_i$ is individual-level covariates. All regressions control for gender, age, and age squared. In addition,

[56] The difference in accuracy rates is not statistically significant.

[57] In the control and treatment groups, 69% and 77% of respondents, respectively, discussed the video with others, and 65% and 72% of respondents from the control and treatment groups, respectively, shared and discussed the information leaflet with others. These numbers were elicited in the survey on the second visit.

I include the dummy variable for whether the respondent knew medication for epilepsy existed in Kananga and whether the respondent is a widow because these variables are imbalanced, as I show in Section 5.4 below. In the tables, in addition to p-values calculated through OLS, I give p-values based on standard errors from randomization inference (RI) and bootstrapping using 1,000 iterations.

5.4 Balance

I check randomization by estimating equation (1) (without covariates) using as the outcome: (i) past use of traditional and modern medicine, (ii) familiarity with epilepsy, (iii) individual demographic and economic characteristics, and (iv) overall survey enumeration characteristics, such as attrition and trust in the surveyor (Appendix Table A.4). The individual-level covariates for whether the respondent believes modern medication to treat epilepsy exists in Kananga and the respondent's being a widow are imbalanced at the 5% level. I include the imbalanced covariates in $\mathbf{X}_i$. While the difference in monthly earnings is significant at the 10% level, there is no significant difference in $log(1 + income)$.

6 Survey Experiment Results

In this section, I report the survey experiment results. I start with the experimental results on belief updating, before turning to the experimental results on the take-up of modern medicine and the experimental results on stigma.

6.1 Experimental Results on Beliefs

6.1.1 Zero Stage: Respondents Understand the Video

First, I test whether treated respondents understand and believe the main facts conveyed by the treatment video. Appendix Table A.5 shows that treated respondents retrieve the information that medication to treat epilepsy exists in Kananga, that doctors to treat epilepsy exist in Kananga, and that epilepsy occurs in the brain.[58] It is noteworthy that 91% of respondents in the control group agree that epilepsy occurs in the brain.

As shown in column (3), the treated group is also less likely to agree with a statement that

[58]The respective variables are measured in the following ways: (i) The survey question is: "Is there medication to treat epilepsy in Kananga?" (yes=1). (ii) The survey question is: "Are there medical doctors who treat epilepsy in Kananga?" (yes=1). (iii) The outcome variable is a dummy variable equal to one if the respondent agrees or strongly agrees with the statement: "Epilepsy always happens in the brain", with answer choices on a 5-point scale from "strongly disagree" to "strongly agree".

epilepsy always occurs in the heart, shown in column (3), which alleviates a concern that the effects are driven by agreeableness. In summary, as a zero stage, respondents understand and believe the factual information contained in the video.

Finally, while the treatment video did not explicitly mention the transmissibility of epilepsy, I examine the treatment effect on such beliefs to inform later results. Appendix Table A.5 column (7) shows that right after the video was shown in the first visit, treated respondents were indeed 8.5 percentage points less likely ($p<0.001$) to believe that epilepsy is transmissible compared to control respondents with a control mean of 0.305. However, this treatment effect does not persist through the endline survey of the second visit. The treatment effect on the same outcome in the second visit endline survey is 0.005 and not significant in column (8).

6.1.2 Experimental Evidence on Updating on the Cause of Epilepsy

Having learned that the respondents understood the main factual information conveyed in the video, I examine whether treated respondents updated on the supernatural cause of epilepsy.

I examine four key beliefs about epilepsy: whether it can have supernatural causes, the share of cases attributed to supernatural causes, whether PLWE are witches, and whether PLWE are bewitched. Table 1 Panel A reports the regression results.

First, the treatment reduces beliefs in supernatural causes of epilepsy. The outcome variable is a dummy variable equal to one if the respondent thinks epilepsy can have supernatural causes (see Section 3). Table 1 Panel A column (1) shows the treated group is 20.6 percentage points less likely to think epilepsy can have supernatural causes compared to the control group's mean of 0.889.

Second, the treatment reduces the perceived share of epilepsy cases with supernatural causes. Since beliefs are contingent on individual cases and contexts, presenting information that epilepsy can stem from other infectious diseases such as meningitis or result from brain injuries during pregnancy or childbirth might lead respondents to reconsider the presumed cause of specific cases. I use the outcome variable of the perceived share of people with epilepsy attributable to supernatural causes. Table 1 Panel A column (4) shows the treated group's estimated share is 0.293 lower than the control group's mean of 0.582.

Third, the treatment reduces beliefs that PLWE are witches. The outcome variable is a dummy variable equal to one if the respondent agrees that somebody with epilepsy is a witch.[59] Table 1

[59]The outcome variable is a dummy variables equal to one if the respondent agrees or strongly agrees with the statement "Somebody with epilepsy is a witch"', with answer options on a 5-point scale from "strongly disagree" to "strongly agree".

Panel A column (3) shows the treated group is 31.8 percentage points less likely to believe PLWE are witches than the control group's mean of 0.632.

Finally, the treatment reduces beliefs that PLWE are bewitched. The outcome variable is a dummy variable equal to one if the respondent agrees that somebody with epilepsy is bewitched.[60] Table 1 Panel B column (4) shows the treated group is 36.9 percentage points less likely to believe PLWE are bewitched in the second visit than the control group's mean of 0.749.

In summary, individuals update on all four dimensions measuring supernatural beliefs about epilepsy: supernatural causes of epilepsy, share of supernatural cases of epilepsy among all cases of epilepsy, PLWE as witches, and PLWE as bewitched.

6.1.3 Experimental Evidence on Updating on Beliefs about Modern Medicine's Efficacy in Treating Epilepsy

Having learned that the treated group updated on the supernatural cause of epilepsy, I turn to the question of whether the treatment induced belief updating about the efficacy of modern medicine and traditional medicine as well.

Survey measures. First, I examine belief updating on survey measures. The first survey measure is a dummy variable equal to one if the respondent believes modern medicine is effective in treating epilepsy (see Section 3). Column (1) in Panel B of Table 1 shows that the treated group is 47.4 percentage points more likely to believe that modern medicine is effective for epilepsy that the control group with its mean of 0.328.

The second survey measure is a dummy variable equal to one if the respondent believes that traditional medicine is effective for epilepsy (see Section 3), where traditional medicine entails healing on the basis of plants and/or ancestral powers. Column (2) in Panel B of Table 1 shows that the treated group is 30.2 percentage points less likely to believe that traditional medicine is effective for epilepsy than the control group, for which the mean is 0.674. The control means reveal that more people in the population believe traditional medicine to be effective than believe modern medicine to be effective.

Incentivized measures. Next, I test the updating of beliefs on the efficacy of modern medicine and traditional medicine through incentivized measures, as survey measures can be prone to experimenter demand effects or social desirability bias.

[60] The outcome variable is a dummy variables equal to one if the respondent agrees or strongly agrees with the statement "Somebody with epilepsy is bewitched", with answer options on a 5-point scale from "strongly disagree" to "strongly agree".

Table 1: Experimental Evidence on Beliefs about Epilepsy

Panel A: Beliefs about supernatural cause of epilepsy				
	(1) Epilepsy can be supernatural	(2) Share epilepsy supernatural	(3) Epileptic is a witch	(4) Epileptic is bewitched
Treatment	-0.208***	-0.293***	-0.318***	-0.369***
	(0.028)	(0.021)	(0.033)	(0.033)
p-value OLS	0.000	0.000	0.000	0.000
p-value randomisation inference	0.000	0.000	0.000	0.000
p-value bootstrap	0.000	0.000	0.000	0.000
Control mean	0.892	0.582	0.632	0.749
R^2	0.114	0.252	0.199	0.205
Observations	782	776	782	782
Panel B: Beliefs about modern medicine's and traditional medicine's efficacy and incentivized estimation				
	(1) Modern medicine effective	(2) Traditional medicine effective	(3) Modern medicine estimation	(4) Traditional medicine estimation
Treatment	0.474***	-0.302***	0.154***	-0.195***
	(0.032)	(0.034)	(0.025)	(0.022)
p-value OLS	0.000	0.000	0.000	0.000
p-value randomization inference	0.000	0.000	0.000	0.000
p-value bootstrap	0.000	0.000	0.000	0.000
Control mean	0.328	0.674	0.334	0.467
R^2	0.243	0.093	0.080	0.114
Observations	782	782	766	781

Notes: This table reports estimates from Equation 2. "Epilepsy can be supernatural" is a dummy variable equal to one if the respondent answered "only supernatural" or "both supernatural and natural" to the question "Can epilepsy be caused only by witchcraft, evil spirits, curses, or fetishism, can it be caused only by something natural, or can it be caused by both?" The variable "Share epilepsy supernatural" is the answer to the question "Out of ten people who have epilepsy, how many have epilepsy caused by witchcraft, evil spirits, or curses, that is, not by natural causes?", divided by 10. The variables "Epileptic is a witch" and "Epileptic is bewitched" are dummy variables equal to one if the respondent agrees or strongly agrees with the statements "People with epilepsy are witches" and "People with epilepsy are bewitched", respectively, with answer options on a 5-point scale from "strongly disagree" to "strongly agree". "Modern medicine effective" and "traditional medicine effective" are dummy variables equal to one if the respondent answers "very good" or "good" to the questions "How good is modern medicine at diagnosing and treating epilepsy?" and "How good is traditional medicine at diagnosing and treating epilepsy?", respectively, with answer options on a 5-point scale from "strongly disagree" to "strongly agree". "Modern medicine estimate" is the respondent's answer to the incentivized question of how many out of 40 patients who took modern treatment for epilepsy had no seizures in the month after starting treatment, divided by 40. "Traditional medicine estimate" is the respondent's answer to the incentivized question of how many out of 10 patients who took traditional treatment for epilepsy had no seizures in the month after starting treatment, divided by 10. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

I elicited an incentivized estimation of the efficacy of modern medicine and traditional medicine treatment in Kananga. I obtained the true statistics on the treatment efficacy of modern medicine from the division of neuropsychiatry at the General Hospital in Kananga. Using patient records, the hospital derived a sample of patients who had had at least one seizure a month prior to starting medical treatment, whose seizure history was known, and who adhered to the treatment protocols. The final sample included 40 patients.[61] Then, the hospital counted how many of those patients had no seizures in the month after starting medical treatment, which turned out to be 13.

The survey prompt was "I have data on 40 patients who have or had epilepsy and started to take modern medicine for treatment as prescribed by a doctor here in Kananga. Before taking modern medicine, they had at least one seizure per month. How many of the 40 do you think had no seizures in the month after starting the treatment? Please guess". I derive the final variable "modern medicine estimation" by dividing the response by 40.

As it is impossible to obtain similar records from traditional practitioners, I resorted to information provided by the hospital collected through interviews of patients who had tried traditional medicine in the past. The subsample used for the statistic covers 10 patients who had tried traditional medicine in the past and who had had at least one seizure per month before starting traditional medical treatment. The hospital counted how many of the patients had no seizures in the month after starting treatment, which turned out to be zero.[62]

The survey prompt was: "I also have data on 10 patients who have or had epilepsy and that at some point in their life consulted a traditional practitioner and took the suggested remedy here in Kananga. Before they started the treatment, all of them had at least one seizure per month. How many of the 10 do you think had no seizure at all in the month after they started the treatment? Please guess". I derive the variable "traditional medicine estimate" by dividing the response by 10.

The measures were incentivized. Respondents would obtain 500 FC (0.25 USD) if they estimated the treatment efficacy of modern and traditional medicine in Kananga correctly. Nobody answered both questions correctly.[63]

I turn to the regression results, shown in Table 1 Panel B in columns (4) and (5). The treated group demonstrates a 0.154 higher estimate of the modern medicine efficacy than the control group

[61]The hospital's data collection is not part of a medical study; the statistic on the efficacy of modern medicine is not an unbiased estimate of the true treatment efficacy for epilepsy in Kananga. However, the survey text did not suggest that the question was based on a representative sample.

[62]The derived statistic is not an unbiased estimate of the true efficacy of traditional medicine in Kananga, but it was not communicated as such to respondents.

[63]Note that i) the survey texts did not give the information that treatment for epilepsy exists in Kananga and ii) both the control and treatment groups were exposed to the same information.

with a mean of 0.334, a difference that is significant at the 1% level. The treated group demonstrates a 0.195 lower estimate of the efficacy of traditional medicine than the control group with its mean of 0.467, a difference that is again significant at the 1% level. It is noteworthy that the treatment efficacy is estimated to be 0.3 for modern medicine and 0.5 for traditional medicine in the control group. That is, an incentivized measure shows that respondents deem traditional medicine more effective in treating epilepsy than modern medicine.

One concern is that respondents update to "0", the maximum ("10" or "40)", or round numbers, which could result in different treatment effects because of the different denominators. Appendix Figure A.17 alleviates this concern, showing a shift in the estimated treatment efficacy for modern medicine and traditional medicine along the distribution.[64]

In summary, the survey and incentivized measures give evidence that treated respondents increased their beliefs about the efficacy of modern medicine and decreased their beliefs about the efficacy of traditional medicine.

6.1.4 Heterogeneous Treatment Effects on Supernatural Epilepsy Beliefs

In this section, I explore treatment effect heterogeneity on supernatural beliefs about epilepsy to shed light on potential mechanisms. I do so by regressing the outcome variable on the treatment variable interacted with the heterogeneity variable of interest, expanding estimating equation 2. [65]

The outcome variable is a Kling et al. (2007) index comprising the three dummy variables for believing that epilepsy can have supernatural causes, agreeing with the statement that PLWE are witches, and agreeing with the statement that PLWE are bewitched. Appendix Table A.8 reports the regression results.

The heterogeneity analysis suggests three key insights about how the intervention affected beliefs. First, the intervention worked primarily through informing people about treatment availability in Kananga. Those who already knew about available medication show a 40% lower treatment effect that is not statistically different from zero (column 4). The effect of prior knowledge about medicine's efficacy is notably smaller, with only a 13.5% lower treatment effect (column 5).

Second, the intervention seemed to have worked by building on the logical connection between

[64] As another incentivized measure to capture the respondent's beliefs about the efficacy of modern medicine, I elicited the respondent's valuation of another person's medical consultation for seizures. The measure and results are discussed in Appendix Section B.

[65] I use OLS to estimate the following regression equation:

$$y_i = \alpha + \beta_1 T_i + +\gamma\ T_i \times H_i^0 + \delta H_i^0 + \beta_2 y_i^0 + \mathbf{X}_i \mathbf{\Gamma} + \varepsilon_i, \tag{3}$$

where i indexes individuals. H_i^0 is the variable measured at baseline used for the heterogeneity exercise.

medical treatability and supernatural causes, namely, if epilepsy is medically treatable, it cannot be supernatural. Those who agreed with such a logic at baseline show a 27% higher treatment effect (column 6).

Third, the intervention did not seem to work by improving the biological understanding of disease, that is, the proximate cause of disease. I cannot find detectable treatment effect heterogeneity by baseline knowledge of epilepsy's neurological basis in the brain (column 7), as, in fact, over 90% of respondents already knew that epilepsy occurred in the brain. This result contrasts with Bennett et al. (2018), who enhanced the credibility of germ theory by showing bacteria under a microscope during a hygiene campaign in Pakistan.

The result on the biological understanding of the proximate cause of epilepsy in the brain gives empirical evidence supporting the theory posited by anthropologists that it is beliefs about the ultimate cause and not the proximate cause that drive medical decision-making – and the reason behind this paper's focus on beliefs about the ultimate cause. In my setting, respondents' correct understanding of the proximate cause (brain involvement) coexists with incorrect beliefs about the ultimate cause (supernatural origins).

To test further whether learning about biological causes drove the intervention's effects, I examine whether having a close family member (parent, sibling, or child) with epilepsy affects treatment response. The rationale is that individuals with epileptic relatives should be more familiar with the patient's medical history and potential biological causes (e.g., past meningitis or birth injuries). If belief updating were primarily driven by learning about these biological causes, we would expect smaller treatment effects for those with epileptic relatives. However, Column (8) shows no differential treatment effect by family exposure. This suggests that the intervention's impact operates through learning about modern medicine's effectiveness rather than through new information about biological causes.

Moreover, Appendix Table A.9 shows no significant treatment effect heterogeneity by demographics including sex, age, education in years, having been born in a city, and a wealth index. These results align with previous findings that supernatural beliefs about illness generally do not correlate with demographics, except for gender. In particular, the results on education again underline that the supernatural beliefs about the cause of epilepsy are not a phenomenon based on education or biological understanding, as discussed above.

Taken together, the heterogeneity analysis suggests the intervention reduced supernatural beliefs primarily by: (1) increasing awareness of treatment availability, (2) activating the logical connection

between medical treatability and non-supernatural causes, and (3) shifting beliefs about ultimate causes while building on existing correct understanding of proximate causes.

6.1.5 Experimental Evidence on Belief Updating about Other Illnesses

In Section 4, I showed that individuals in my setting have a general propensity to resort to supernatural explanations for illness and that beliefs about illnesses are correlated within an individual. This finding raises the question: can information about one illness affect beliefs about illnesses more broadly? For example, we may want to know whether the rollout of HIV treatment in sub-Saharan Africa discussed in Section 2 affected beliefs about illnesses beyond HIV/AIDS, which the DHS data do not allow me to test for.

I estimate the treatment effect on beliefs about the 12 other illnesses measured in the endline survey. I use the following outcome variables: (i) the respondent's estimated share of people with an illness j who have it from supernatural causes,[66] (ii) a dummy variable equal to one if the respondent believes that modern medicine is effective for illness j, and (iii) a dummy variable equal to one if the respondent believes that traditional medicine is effective for illness j (see Section 3). I use estimating equation 2 for each outcome–illness combination.

Figure 4 depicts the treatment effect on all three outcomes visually by plotting the adjusted treatment group mean and the control group mean for every outcome and every illness. In Figure 4a, we observe that the treatment shifted beliefs about the supernatural cause of illness across illnesses. The treatment effect on the share of cases of an illness being supernatural varies between -0.04 for malaria to -0.08 for sterility, excluding epilepsy, with its associated treatment effect of -0.21. All treatment effects are significant at least at the 5% level.

Figure 4b illustrates that the treatment also shifted beliefs about the efficacy of modern medicine across illnesses. The treatment effect on beliefs about modern medicine's efficacy for an illness varies from 0.01 for malaria to 0.13 for sterility, excluding epilepsy, with its treatment effect of 0.46. All effects with the exception of the coefficient for malaria are statistically significant at least at the 10% level. The control group means for beliefs about modern medicine's efficacy illustrate that respondents already believe the efficacy of modern medicine to be high for some of the illnesses, limiting the margin for updating.

Finally, Figure 4c illustrates that the treatment shifted beliefs about the efficacy of traditional medicine. The treatment effect varies from -0.04 for COVID-19 to -0.12 for sterility, excluding

[66] This measure is derived from the question "Out of 10 people with illness j, how many have it from supernatural causes?" The answer is divided by 10.

epilepsy, with its treatment effect of -0.3.

Heterogeneity in Belief Updating Across Illnesses. The spillover effects raise the question of what the mechanism is and, specifically, whether it is associated with baseline supernatural beliefs. I examine this potential mechanism by estimating treatment effect heterogeneity using illness fixed effects and my data at the individual–illness level. The outcome variable is the estimated share of cases of illness j of supernatural causes.[67]

Appendix Table A.7 reports the regression results. I find that those who thought an illness j is of supernatural origin at baseline exhibit a 162.5% higher treatment effect than those who did not. Those who thought that epilepsy is supernatural at baseline exhibit a 250% higher treatment effect than those who did not. Those who scored higher on an "illnesses supernatural index" at baseline, which is a Kling et al. (2007) index of the dummy variables for whether an illness can have supernatural causes for the 13 illnesses, exhibit a higher treatment effect. Finally, those who attributed a larger share of illnesses to supernatural forces at baseline exhibit a higher treatment effect. Overall, the heterogeneity in supernatural beliefs about illnesses at baseline can explain some of the variation in belief updating across illnesses.

The data do not allow to test mechanisms for spillover effects further. However, the psychology and economics literature gives some insights on possible interpretations. A category-based or similarity-based induction theory would suggest that individuals make predictions based on shared attributes within a category,[68] which could be "supernatural" in this case. Cognitive psychology research also emphasizes the importance of explanations for learning across categories and understanding the world, as explanations allow the discovery of generalizations across categories (Williams and Lombrozo, 2010).[69]

[67] I use OLS to estimate the following equation:

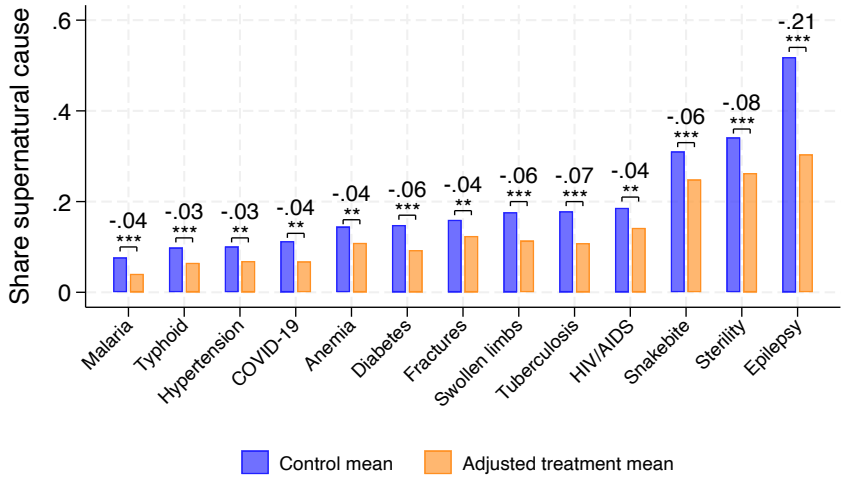
$$\text{Share supernatural}_{ij} = \mu_j + \beta\ T_i + \gamma\ T_i \times H^0_{ij} + \delta H^0_{ij} + \lambda \text{illness supernatural}^0_{ij} + \mathbf{X}_i\mathbf{\Gamma} + \varepsilon_{ij} \tag{4}$$

where i indexes individuals and j indexes illnesses. The outcome variable measures the respondent's estimated share of individuals with an illness j of supernatural causes. I use a continuous outcome variable to mitigate ceiling effects. The outcome variable spans all illnesses with the exception of epilepsy. I consider different variables H_{ij} that I interact with the treatment variable indicator. I control for whether the respondent thought illness j could be supernatural in the baseline survey, variable illness supernatural$^0_{ij}$. μ_j is illness fixed effects. $\mathbf{X}_i$ is the individual-level covariates gender, age, age squared, being a widow, and knowing that medication to treat epilepsy exists in the baseline survey. ε_{ij} is the error term.

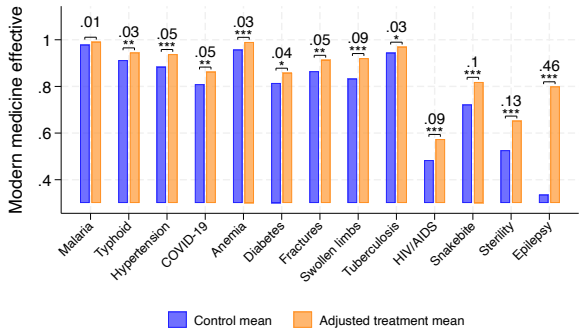
[68] For example, inferring that an unfamiliar bird has feathers and can fly based on the category "birds". Refer to López et al. (1992), Osherson et al. (1990), Tversky (1977), Peski (2011), Fryer and Jackson (2008), Mullainathan (2002), Mullainathan et al. (2008), and Alsan et al. (2024).

[69] Lombrozo (2006) offers an example: When informed that herring and tuna are afflicted with a disease, people who lack expertise in the subject are more inclined to assume that wolffish also possesses the disease rather than dolphins as wolffish seem more similar to tuna than dolphins. On the other hand, fishing experts, who can provide a logical explanation for why the disease might be present e.g., tuna contracting the disease from infected herring, are less

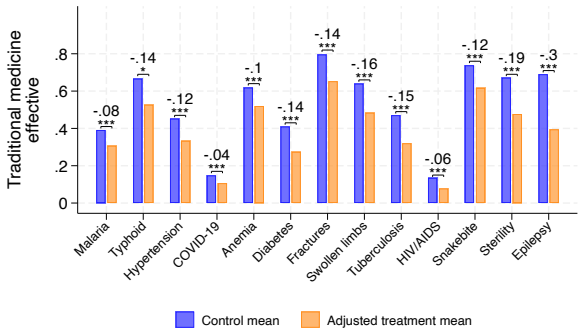
Figure 4: Spillover Effects: Treatment Effects on Beliefs Across Illnesses



(a) Treatment effect on share of people with illness of supernatural cause



(b) Treatment effect on belief that modern medicine is effective



(c) Treatment effect on belief that traditional medicine is effective

Note: The figure shows the control mean, adjusted treatment mean, and treatment effect for three different outcome variables by illness from separate regressions using equation 2. The outcome in Figure 4a is the answer to the question "Out of ten people who have [...], how many have [...] caused by witchcraft, evil spirits, or curses, that is, not by natural causes?" for every illness divided by 10. The outcomes in Figures 4b and 4c are dummy variables equal to one if the respondent answered "very good" or "good" to the questions "How good is modern medicine at diagnosing and treating [...]?" and "How good is traditional medicine at diagnosing and treating [...]?", respectively, for every illness, with answer options on a 5-point scale from "strongly disagree" to "strongly agree". The figures show the treatment effect coefficient and significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ based on OLS robust standard errors.

Overall, the results show that the treatment reduced beliefs about supernatural causes of illness, increased beliefs in the efficacy of modern medicine, and decreased beliefs in the efficacy of traditional medicine for other illnesses, albeit in smaller magnitudes than for epilepsy. The results suggest that information about one illness can induce belief updating on other illnesses, shedding light on how individuals think about illness and a potential "mental model" for understanding the causes of illness.

6.2 Experimental Evidence on Take-up of Modern Medicine

I showed that the intervention decreased beliefs in supernatural causes of epilepsy, increased beliefs in the efficacy of modern medicine, and decreased beliefs in the efficacy of traditional medicine. The incentivized measures confirm the results on beliefs about the efficacy of modern and traditional medicine. To address remaining concerns about experimenter demand effects, I now turn to the following question: did the intervention increase the take-up of modern medicine?

6.2.1 Experimental Evidence on the Use of a Voucher for an Epilepsy Consultation

My main outcome is the take-up of modern medicine for epilepsy. At the end of the second visit, the respondent was offered a voucher that any adult could use for a consultation at the neuropsychiatric division of the General Hospital in Kananga.[70] The General Hospital, located in the city center, is the largest and best known hospital in Kananga. The respondents' average distance to the hospital is 3.4 km.

The voucher was offered at the end of the second visit. The respondent could accept or reject the voucher. Accepting the voucher incurred a time cost, conveyed through the survey text "If you accept this voucher, I will need a few minutes to fill out the voucher". The voucher was given at the very end of the second visit to prevent confounding of any other measures.[71]

I use the two outcome variables for whether the respondent accepted the voucher and whether the voucher was used. Table 2 reports the regression results. Column (1) reports that the treated group is 3.4 percentage points more likely to have accepted the voucher than the control group, with its mean of 0.712. The treatment effect is not statistically significant. Despite the time cost

influenced by similarity. Instead, they extend the disease property from tuna to dolphins because dolphins also heat herring and thus the explanation can be generalized to them.

[70] The neuropsychiatric division is operated by the Centre Neuro-Psychiatrique de Katuambi, a hospital for neurological and psychiatric illnesses that is well known in Kananga. However, since it is far from Kananga (18 km), it has a branch at the General Hospital.

[71] While the survey text did not explicitly say that effective treatment for epilepsy exists in Kananga, I cannot rule out the possibility that the voucher signaled that treatment might exist in Kananga. However, the treatment and control groups received the same survey text. I implemented elaborate monitoring systems to check that the enumerator would not give information beyond the survey text.

of accepting the voucher, 71.2% of respondents accepted it in the control group.

Column (2) reports the main regression results for the main outcome of interest: the respondent's accepting the voucher and the voucher's being used. The likelihood of the voucher use is 3.8 percentage points higher in the treatment group than in the control group. The effect is statistically significant at the 10% level. The control group exhibits a voucher use rate of 7.7%, implying that a simple and low-cost intervention can increase voucher use by 50%.

Column (3) presents the results including controls selected by means of the LASSO methods of Belloni et al. (2014a) (see also Belloni et al., 2014b) from the full set of controls variables used for balance and variables reflecting baseline beliefs about epilepsy.[72] The treatment effect and significance are unchanged. Column (4) reports the treatment effect for the subsample of respondents who accepted the voucher. In this sample, voucher use is 5 percentage points higher than the control mean of 10.8%, a difference that is significant at the 10% level.

In 70 out of the 74 cases, a third party redeemed the voucher. For a third party to redeem the voucher, several steps needed to be taken. The respondent was required to provide the relevant information to another individual and potentially persuade them to pursue treatment. The recipient, in turn, needed to place trust in the respondent and travel to the hospital, where she would need to locate the correct department. Despite the one-month validity period of the voucher, it was typically redeemed within a few days of issuance, underscoring the substantial demand for treatment.

The treatment effect on voucher use can be interpreted as a signal that beliefs about the existence and efficacy of modern medicine changed. Another mechanism might be the reduction in stigmatizing beliefs toward PLWE, as the respondent gave the voucher to someone supposedly with epilepsy, which I will I examine in Section 6.3. Ultimately, the result on voucher use can be interpreted only in its reduced form.

6.2.2 Heterogeneous Treatment Effects on the Epilepsy Voucher Use

In this section, I examine heterogeneous treatment effects on the voucher use. I use the outcome variable of whether the voucher is accepted and used. Appendix Table A.10 reports the regression results of estimating equation 3.

Motivated by the heterogeneous treatment effects on supernatural belief updating, I examine treatment effect heterogeneity along the dimension of the respondent's ex ante knowledge that medication for epilepsy exists in Kananga. Column (1) shows that those who knew medication

[72] The controls selected by LASSO are a respondent's not being able to identify epilepsy from its symptoms and a respondent's being in a polygamous marriage.

Table 2: Experimental Evidence on Take-Up of Medical Treatment for Epilepsy

	Voucher accept	Voucher accept + use		Voucher use
	(1)	(2)	(3)	(4)
Treatment	0.034	0.038*	0.035*	0.050*
	(0.032)	(0.021)	(0.021)	(0.027)
Control mean	0.712	0.077	0.077	0.108
R^2	0.033	0.016		0.032
Observations	782	782	782	574
p-value OLS	0.283	0.063		0.067
p-value randomisation inference	0.271	0.069		0.087
p-value bootstrap	0.279	0.061		0.059
Regular controls	yes	yes	no	yes
LASSO-selected controls	no	no	yes	no
Sample	Endline	Endline	Endline	Voucher accepted

Notes: This table reports estimates from Equation 2. "Voucher accept" is a dummy variable equal to one if the respondent accepted the voucher. "Voucher accept + use" and "voucher use" are dummy variables equal to one if the respondent's voucher was redeemed. Regressions in columns (1), (2), and (4) include the standard set of control variables. Column (3) includes controls selected based on the LASSO methods of Belloni et al. (2014a) from the full set of variables used for balance exercises and variables reflecting beliefs about epilepsy in the baseline survey. The LASSO-selected controls are: not being able to identify epilepsy from its symptoms and being in a polygamous marriage. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

for epilepsy exists in Kananga exhibit a 49% lower treatment effect than those who did not know medication existed. The difference is not statistically significantly different from zero. The finding suggests that the intervention's provision of information on the existence of modern medicine could be a driver of take-up of modern medicine. The mechanisms could be direct – that is, people might find out that medication exists – and indirect – that is, the information might shift beliefs about the supernatural character of the illness and thereby shift attitudes about those with illness, lowering the cost of approaching them and handing them the voucher.

Second, I explore effect heterogeneity by beliefs about the efficacy of modern medicine. Column (2) shows that those who believed modern medicine is effective in the baseline survey exhibit a 150% higher treatment effect. The difference is not statistically significantly different from zero. One explanation for the higher treatment effect for this subgroup could be that, if respondents already believed that medication for epilepsy was effective, the information about the existence of treatment in Kananga could have reinforced this belief.

Third, I examine heterogeneity in the treatment effect on voucher use by whether the respondent has a parent, sibling, or child (close family member) with epilepsy. The treatment effect in column (3) is 4.8 percentage points lower for those with a close family member with epilepsy than for those without. This difference of -0.048 is larger in magnitude than the treatment effect on those without a close family member with epilepsy of 0.035. The overall treatment effect for those with a close family member with epilepsy is not statistically significant. In contrast, this means that those

without a close family member with epilepsy exhibit a treatment effect of 0.035, which is significant at the 10% level.

One hypothesis that could reconcile these findings is that individuals give the voucher to their close family members regardless of their beliefs because giving the voucher to a close family member is not costly. Individuals without a person with epilepsy in their close circle may require more persuasion to give the voucher to somebody who may need it. The treatment may have increased this group's willingness to identify, locate, and engage with someone with epilepsy, potentially even through the channel of reduced stigma (see Section 6.3). There could also be behavioral explanations, such as warm glow and altruism, for why one would be more likely to pass on a voucher to a socially close person.

Appendix Table A.12 explores further heterogeneity in the treatment effects on voucher use, including demographics, distance to the hospital, number of people with epilepsy whom a respondent knows, and having a shop. Almost all the coefficients in this heterogeneity analysis are close to zero or insignificant. Those who own a shop exhibit the greatest difference in treatment effect, which is 8.1 percentage points higher, potentially because they have more opportunities to give the voucher to somebody else.

Overall, the voucher use results are driven by those who did not know ex ante that medication for epilepsy existed and those who do not have a parent, sibling, or child with epilepsy.

6.2.3 Experimental Evidence on Take-up of HIV and Hypertension Testing

The results on the take-up of modern medicine for epilepsy raise the question of whether the intervention also increased the take-up of modern medicine for other conditions, that is, if the intervention's spillover effects on beliefs about other conditions (Section 4) translate into behavioral change.

To do so, I collected two measures capturing the take-up of modern medicine for other conditions at endline. First, I elicited willingness-to-pay measures for vouchers for consultations and testing for a range of other illnesses described in Appendix Section C. I find no treatment effect on the willingness-to-pay measures for vouchers for consultations and testing for other illnesses (see Appendix Section C). The treatment effects are almost zero and not statistically significant. Some potential explanations for the null effect are that respondents do not understand the exercise, do not believe the survey team would charge a price, or simply do not have any money.

Second, I measured the respondent's take-up of two vouchers for HIV and hypertension testing

and consultation, respectively, described in Appendix Section D.[73] I find no treatment effect on the use of a voucher for HIV testing and consultation or hypertension testing and consultation (see Appendix Section D). The treatment effects are almost zero and not statistically significant. One possible explanation for this null effect is that respondents did not need testing or consultation for HIV or hypertension. However, the vast majority of respondents redeemed both vouchers if they redeemed one of them.[74] If take-up were driven by a demographic group more likely to need testing, we would expect a larger difference in the take-up rate between the two conditions.

Together, these results indicate that, while the intervention had spillover effects on supernatural and medical beliefs for other illnesses, the intervention did not induce behavioral change for other illnesses. This null-result is informative for the design of interventions.

6.3 Experimental Evidence on Stigma

I showed that the intervention reduced beliefs associating epilepsy with the affected person's being a witch or bewitched. In Section 4, I provided evidence that beliefs about witchcraft regarding epilepsy predict stigma toward those with epilepsy. Did the intervention reduce stigma toward those with epilepsy? Now, I turn to testing whether the experiment reduced stigma toward those with epilepsy. I employ two survey measures and an incentivized measure at endline.

Survey measures. The first measure is a dummy variable equal to one if the respondent agrees that one's children should not play with children who have epilepsy (see Section 4). The second measure is a dummy variable equal to one if the respondent agrees that one should not touch or be close to people when they have an epileptic attack.[75] This measure was motivated by conversations with my collaborators at the Ministry of Health, noting that people are afraid of spirits and do not help epileptics during a seizure. This fear increases the affected person's risk of injury, burning, or drowning while cooking over open fire or fetching water in the river. Both measures were elicited in the second visit endline survey.

Incentivized measure. In the endline survey of the first visit, the respondent was informed that

[73] I chose a voucher for testing and consultation for these two conditions intentionally, as testing can be beneficial even in the absence of symptoms. I chose hypertension and HIV testing to cover different degrees of invasiveness, stigma for testing, and the demographic group most likely to need testing. While testing and consultation are an imperfect measure of using treatment, they are the first step toward diagnosis and subsequent treatment.

[74] Just 1.5% of respondents used only the hypertension testing voucher and 0.9% of respondents used only the HIV testing voucher.

[75] The two outcomes are dummy variables equal to one if the respondent agrees or strongly agrees with the statements "One's children should not play with children who have epilepsy" and "One shouldn't touch or be close to people when they have an epileptic attack", respectively, with answer options on a 5-point scale from "strongly disagree" to "strongly agree".

an NGO is planning to launch a project aimed at providing support and activities specifically for individuals with epilepsy. As part of this project, the NGO would hire staff. The respondents were asked if they would like to have their name included on a list of potential candidates for job interviews. To avoid subscription only for reasons of self-image or image toward the enumerator, the respondent was asked the same question about a project targeting people with disabilities caused by road accidents. Thus, the respondent could indicate on which list (or both) she wanted to list her name.

The survey text was, "An NGO we work with is thinking about launching a project, in which the NGO provides support and activities to epileptic people. They might need to hire people. They might also hire people for a project providing support and activities to people who are handicapped because of road accidents. Shall I put your phone number on a list of people that the NGO could call if the NGO needed to hire more people? Would you like to be put on the list for the project with epileptic people, handicapped people or both? "

I create the dummy variable "NGO project with epileptic people" equal to one if the respondent only chose the list for the epilepsy project. The measure was included in the midline survey of the first visit. The variable gauges respondents' authentic willingness to engage naturally with individuals with epilepsy. Respondents perceived the offer as genuine. Enumerators sought referrals as proof of respondents' belief in the authenticity of the question. Given the high unemployment rates in this research setting, including one's name on job interview lists is customary, and declining has tangible consequences.

Table 3 reports the regression results for the three outcome variables in columns (1)–(3). Column (1) shows that treated respondents are 7.2 percentage points less likely to think that one's children should not play with epileptic children than the control group respondents, whose mean is 0.289 ($p<0.01$). Column (2) reports that treated respondents are 12.6 percentage points less likely to believe one should avoid people with epilepsy during the attack than the control group respondents, with its mean of 0.54 ($p<0.001$). Column (3) shows that the treated group is 4.6 percentage points more likely to be willing to take a job working with epileptic patients than the control group, with a mean of 0.132; this difference is significant at the 10% level.

Are the results on stigma driven by updating on beliefs about the transmissibility of epilepsy instead of its supernatural nature? As transmissibility beliefs demonstrate highest predictive power for stigmatising attitudes (Figure A.13), they constitute a second conceivable mechanism for the intervention's effect on stigma – even though the intervention did not explicitly mention the trans-

Table 3: Experimental Evidence on Stigma toward Those with Epilepsy

	(1) Children shouldn't play with epileptic children (=1)	(2) Should avoid epileptic during attack (=1)	(3) Chooses NGO project with epileptic people (=1)
Treatment	-0.072**	-0.126***	0.046*
	(0.028)	(0.033)	(0.026)
p-value OLS	0.009	0.000	0.073
p-value randomisation inference	0.005	0.000	0.076
p-value bootstrap	0.011	0.000	0.063
Control mean	0.289	0.540	0.132
R^2	0.209	0.181	0.017
Observations	782	782	800

Notes: This table reports estimates from equation 2. "Children shouldn't play with epileptic children" and "Should avoid epileptic during attack" are dummy variables equal to one if the respondent strongly agrees or agrees with the statements "One's children shouldn't play with epileptic children" and "One shouldn't touch or be close to people when they have an epileptic attack", respectively, with answer options on a 5-point scale from "strongly disagree" to "strongly agree". "NGO project with epileptic children" is a dummy variable equal to one if the respondent chooses to be put on a list for job interviews for an NGO project targeting epileptic people. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

mission of epilepsy.

As discussed in Section 6.1.1, the intervention did have a significant impact on transmission beliefs measured right after showing the intervention videos, but these beliefs did not persist over time until the second visit. For further evidence, I examine heterogeneous treatment effects on the three stigma outcomes by baseline beliefs about transmissibility in Appendix Table A.13. For all three outcomes, those who already thought epilepsy was not transmissible at baseline exhibit a treatment effect of similar magnitude to that estimated in the regressions of the stigma variables without interaction terms in Table 3. This finding suggests that the treatment effects on stigma are not entirely driven by updating of beliefs about transmission. In this context, some of the transmission beliefs are in fact of supernatural nature (e.g. "catching a spirit") and not of biomedical nature.

In summary, the intervention reduced stigmatizing attitudes toward PLWE. Thus, even if the intervention had not changed beliefs about medicine or had not increased the take-up of medicine, the treatment effect on stigma renders the intervention relevant. This low-cost intervention yields tangible benefits on the quality and quantity of life of those with epilepsy.

The results also provide further evidence that respondents updated on supernatural beliefs, as these constitute the only mechanism through which the intervention could have affected stigma. The heterogeneity exercise results rule out updating on transmission beliefs as the sole driver of the stigma results.

7 Conclusion

In this paper, I show (i) that many people attribute the cause of illness to supernatural forces in sub-Saharan Africa and the DRC, (ii) that these beliefs matter for health behavior through beliefs in the efficacy of modern medicine and its take-up, but (iii) that a low-cost information intervention can shift beliefs and increase the take-up of modern medicine.

I start by conducting an original data collection in Kananga, DRC, to show that supernatural beliefs concerning illness are highly prevalent: 94% of respondents in a representative sample of 800 individuals believed that at least one illness can have supernatural causes such as spirits or "witchcraft". Moreover, I find that these beliefs vary by illness and illness event, suggesting malleability of beliefs. Some illnesses such as epilepsy, fractures, sterility, or snakebites are systematically attributed to supernatural forces more often than others such as malaria or typhoid. I give evidence that these beliefs can lead to inefficiencies in terms of the take-up of medicine and negative externalities in terms of stigma toward the ill: Supernatural explanations of illness highly negatively correlate with beliefs in the efficacy of modern medicine and past use of modern medicine for an illness within a given individual—supporting the notion that "modern medicine cannot treat a curse or a spirit"—and positively correlate with stigma toward those with HIV/AIDS and epilepsy. The stigma could further impact the take-up of treatment.

In a second step, I conducted a field experiment in Kananga, DRC, and showed that it is possible to shift beliefs toward medical beliefs and increase the take-up of modern medicine. Since the descriptive patterns suggest that the existence of modern medicine could causally affect supernatural beliefs—based on the notion "if modern medicine can treat a disease, it cannot be supernatural"—I designed an informational video campaign mimicking the rollout of modern medicine. I partnered with medical professionals at the local health ministry and designed an informational video on the biomedical cause and treatment of epilepsy, as it is the disease most commonly associated with supernatural forces and very prevalent in my setting. Then, I randomly showed either the treatment or a placebo control video on a tablet to my representative sample of 800 in Kananga.

I find that the intervention shifted beliefs from supernatural toward medical beliefs for epilepsy and spilled over to beliefs about other illnesses. It increased take-up of hospital consultations for seizures among individuals connected to the treatment group by 50%. Moreover, the intervention reduced stigma toward those with epilepsy.

The intervention holds the potential to disrupt an existing equilibrium characterized by high

recurrence to supernatural explanations, limited experimentation with modern medicine due to stigma and preconceived beliefs about its efficacy, and low exposure to it. However, the evidence suggests that individuals are open to adopting biomedical explanations for illness and exploring modern medical treatments.

The evidence underscores the importance of understanding local beliefs for health policy. Deterioration in healthcare systems or provision of less than effective modern medicine – as in the case of epilepsy – can reinforce existing beliefs. For example, there is a belief in Kananga and other settings that the failure of modern medicine to treat an illness proves its supernatural character (Cox and Phillips, 2015). While my intervention reduced stigma associated with epilepsy, it is important to understand the roots of stigma beforehand. If supernatural attributions of a particular illness in Kananga and other settings increase sympathy with the ailing person, campaigns may have unintentional consequences. Furthermore, policies can capitalize on demonstration and spillover effects to educate about diseases lacking a clear viral, bacterial, or otherwise identifiable cause.

This paper also has implications for the study of religion. One might think that religion offers a complete and all-encompassing perspective on the world. Some might even argue that it is cognitively challenging to simultaneously hold supernatural and natural beliefs. However, I show that an individual can attribute the same type of event to both supernatural and natural forces. Furthermore, while supernatural beliefs inherently defy established natural laws, they are not espoused arbitrarily. I uncover consistent patterns and provide suggestive evidence for a causal effect of the availability of modern treatment on beliefs. Collectively, these findings shed light on how religion has evolved alongside scientific progress, addressing a major hypothesis in social science: the concept of secularization (Berkes et al., 2023, Inglehart and Norris, 2004).

The observed patterns may be specific to the intricacies of local beliefs in the DRC, which often revolve around localized supernatural entities linked to specific events, and which may therefore be more adaptable. As exposure to scientific advancements increases, individuals may transition toward more comprehensive religious belief systems ("big-God religions") if they coexist more harmoniously with scientific understanding. This hypothesis is consistent with the idea that religion has evolved from more localized or specific beliefs to encompass broader, overarching "big-God" beliefs (Norenzayan, 2013).

This paper raises several intriguing questions for future research. It is worth considering how beliefs may influence the actual effectiveness of modern medicine, for example via placebo effects or psychosomatic symptoms. Exploring the strengths of alternative medical systems and their

integration into modern medical systems is another promising avenue. As traditional medicine encompasses herbal and spiritual elements, it intersects with fields such as psychiatry and behavioral therapy, which have attracted increasing attention among development economists (Ridley et al., 2020). Existing medical infrastructures can be utilized to improve healthcare provision, particularly in resource-constrained settings with limited access to pharmaceutical care.

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A Online Appendix: Background

A Background on Epilepsy

Epilepsy is a chronic noncommunicable disease of the brain and one of the most common neurological diseases worldwide (World Health Organization, 2004). Epilepsy is defined as a condition characterized by recurrent seizures, at least two of which are unprovoked, occurring in a period of more than 24 hours. Recurrent seizures are brief episodes of involuntary movement that may involve a part of the body (partial epilepsy) or the entire body (generalized epilepsy). Sometimes seizures are accompanied by loss of consciousness and control of bowel or bladder function (World Health Organization, 2004).

Seizures are the result of excessive electrical discharges in a group of brain cells, which can occur in different parts of the brain. Seizures can vary in their manifestation, which could range from very short lapses of attention or muscle jerks to severe and prolonged convulsions, and in their frequency, which can range from less than one per year to several per day (World Health Organization, 2004). While the incidence of epilepsy in more developed countries is highest in the 30–50 age group, in less developed countries, particularly in sub-Saharan Africa, more than 90% of people with epilepsy are younger than 20 years.

There are four types of epilepsy: (1) idiopathic epilepsies, which are thought to be genetically determined, (2) symptomatic epilepsies, which are acquired conditions and are usually associated with a structural abnormality of the brain, (3) cryptogenic epilepsies, when no clear abnormality or putative risk factor can be identified for what is thought to be a symptomatic or acquired epilepsy, and (4) progressive epilepsies, which are associated with an evolving neurological condition (World Health Organization, 2005). Developed countries frequently report idiopathic epilepsies, while symptomatic epilepsies, commonly caused by factors such as family seizure history, birth trauma, and central nervous system infections, are more prevalent in Africa due to a high burden of disease (World Health Organization, 2004, Ba-Diop et al., 2014).

The primary risk factors for epilepsy in sub-Saharan Africa are family history of seizures, previous febrile seizures, perinatal trauma, head injury, and central nervous system (CNS) infections such as neurocysticercosis.[76] Perinatal causes account for between 2% and 65% of cases of epilepsy in sub-Saharan Africa. Difficult pregnancies or childbirth can lead to birth injuries (Ba-Diop et al.,

[76] Neurocysticercosis is a preventable parasitic infection caused by larval cysts of the pork tapeworm.

2014). Most neurological infections that cause seizures are of parasitic origin, including malaria, cysticercosis, onchocerciasis, and toxocariasis (Ba-Diop et al., 2014). Onchocerciasis (river blindness) has also been associated with seizure disorders (Ba-Diop et al., 2014). It is estimated that 30% of epilepsy in endemic regions results from neurocysticercosis (Ba-Diop et al., 2014). Traumatic brain injuries resulting from road accidents, assaults, injuries in war, or violent sports are also a common cause of epilepsy in sub-Saharan Africa (Ba-Diop et al., 2014).

Modern pharmaceutical treatment of epilepsy began with bomides (1856), phenobarbital (1912) and phenytoin (1938) (World Health Organization (2005)). To treat epilepsy, its cause has to be identified, antiepileptic drugs have to be given to control seizures, and comorbidities have to be prevented and treated. Epilepsy surgery can be performed but is rarely available in sub-Saharan Africa. The World Health Organization (WHO) claims that it is possible to diagnose and treat most people with epilepsy at primary healthcare facilities without the use of sophisticated equipment (Ba-Diop et al., 2014, World Health Organization, 2005). Bruno et al. (2012) find that, in rural areas in Mali with an epilepsy prevalence rate of 1,335 per 100,000 people, 59.6% of patients were seizure-free after 12 months of taking phenobarbital and receiving treatment from primary healthcare providers.

B Treatment Video Text

As using a script or an approach resembling a teleprompter in my setting was too unnatural, the medical professionals and I discussed the treatment video content in advance, which they then delivered in free speech. This gave the professionals degrees of freedom with regard to the content but rendered the treatment video very natural and the campaign as close as possible to a campaign conducted by local professionals. The following presents the treatment text translated from Tshiluba into French and then into English.

Dr. Tshibangu:

Hello dear all, I am Dr. John Musenga Tshibangu, I am the Leader of an institution that deals with diseases of the brain or cranial diseases here in our province of Central Kasai.

Dr. Badibanga:

As for me, I am Dr. Pacifique Lushiku Badibanga. I am a specialist in brain diseases. I work in the health division of the province of Central Kasai, especially in the coordination of brain diseases here in Kananga.

Dr. Tshibangu:

Today we will talk to you about the disease of seizures or epilepsy. Brothers and sisters, epilepsy is a disease that affects the brain. The brain is located in the skull and in it are also the neurons. There are many nerves that are connected, and these nerves are called neurons. Whenever someone thinks, these neurons send a current. It is by giving this current that you have the possibility to walk, to talk, and to make any movement, and that you study or do calculations.

Dear friends, as we have talked about how a person can have an epileptic seizure, we affirm that these neurons in the brain are connected. During a seizure, the neurons send a strong current like during a thunderstorm; this is what causes the person to fall, and when they fall, they start to agitate, having convulsions because the current is very strong. A person may not withstand this current, so they may fall, start to agitate, make movements and also have convulsions.

Because it is the brain that helps you walk, this brain is like a computer, which has many parts inside it, and these parts help it so that everything that enters inside the computer can reach the memory of the computer. The brain helps the person to think, and every time there is no communication between the neurons, there is no way the brain can work. So, we have shown that the brain is located in the skull, it's like the radio that transmits when there are batteries and doesn't transmit when there are no batteries.

It's comparable to the television: if you see images on the television, that means the television is in good condition, and when the images become dark, that means there is a problem with the television. And if we think about the brain like the television, when it doesn't work, a person cannot think well, they may fall, have an epileptic seizure.

Dr. Tshibangu:

Now we will talk about the causes of epilepsy.

Epilepsy or seizure is not a disease of sorcery. It's not a disease that occurs when you have used charms or when someone has cast spells on you. And here's how this disease affects someone.

Firstly, all the diseases that affect the brain can cause epilepsy. These diseases, meningitis for example, can cause the victim to develop epilepsy. Head trauma that affects the brain can also cause the victim to develop epilepsy.

Secondly, malaria can affect someone and affect the brain and develop epilepsy.

Brothers and sisters, let's remember that a child can develop epilepsy if they were resuscitated

at birth and/or if they came through a birth with complications. Their brain can be injured at birth and make them develop epilepsy. Let's also remember that every child or adult who has received a blow to the head and whose brain is injured, can develop this disease.

We also inform you that a mother or a father who has had epilepsy seizures can have a child who will have epilepsy, which means that this disease can be hereditary.

We explain well that this disease does not come from witchcraft.

Dr. Badibanga:

We want to talk to you now about the treatment of epileptic seizures or convulsions. The treatment for this disease is a treatment of many days. The medications with which to treat such a patient are numerous in our city of Kananga.

For this, we can prescribe a product to such a patient. They can take one tablet in the morning and another in the evening; twice for the whole day.

This patient has time to stay at home to take the products and when the month is over, they are asked to come back to the doctor so that he can know if it's working and continue in this way. These medications, when they are prescribed, they decrease the epileptic seizures and these so that this patient can get better. In short, I mean this: The products are there to be taken for many days and can also stop the seizures. And these products can stop any movement when the patient falls.

Mrs. Nagalula:

My name is Josefine Ngalula.

Regarding the disease of epilepsy that my daughter suffered from, I took the traditional treatment, which did not serve me any solution.

But in the modern treatment followed with her, I saw a total change in my daughter. This is why I am here to testify to you about this treatment. Modern treatment has an effective solution compared to the traditional treatment.

Let's take modern treatment, because it is indeed this treatment that has been brought to us for the healing of our children. This treatment that will address all head diseases.

In the course of seeking traditional treatment for the child, we suffered a lot. People who told us "my product is effective" and asked us not to eat from other people's pots and not to eat pork, and said 'let's see at the end of this month if it will continue". We walked everywhere and they

were only lying to us. All the doctors always asked us to give pots and money – we did everything, but with no favorable outcome. We walked a lot for this treatment; we were asked to give chickens, clothes, etc. Everyone said their product was effective, we did everything because we wanted us all to be well because if you are well and the other is sick, you will not have an appetite. And in all this, we did not have a solution. The solution we had is in God and in modern medicine. We must put God and modern medicine first because the first person that God sent to heal and give life was the modern doctor.

When I went to traditional medicine, I did not find an effective treatment. I went through all the hospitals, and everywhere I went, they told me the child suffered from malaria, meningitis, and in all this, I did not have a solution or treatment, and so I went to see Dr. Richard. When I arrived, he examined the child, scanned her head, administered a product and still there is a change because before the child had epileptic seizures all the time (she would fall, fall, fall). Since Dr. Richard treated her, currently the child no longer has seizures like before. Since then, she no longer falls like before, she can already go two months without seizures because she could fall every month, she could injure herself very badly. And when she fell, she could wake up as if from sleep. That's how I speak of modern treatment for you who have children with sick heads or even adults. Stop agitating/bothering people by talking to them about traditional treatment. Because in this treatment, there is no solution.

Someone can give you traditional treatment, and the child goes two months or one month without having seizures, and after that, they relapse, whereas in modern treatment, we continue to take this product because it is in this modern treatment that there is a solution. So go to the modern doctors for good treatment, because with the modern treatment that I took, today I have a solution in my family.

C Anthropological Accounts

C.1 Account 1: Beng Farmers in West Africa

In Gottlieb (2004), anthropologist Alma Gottlieb describes her fieldwork among the Beng farmers of West Africa, recounting her failed efforts to persuade them to boil their drinking water.

"During our stays in Beng villages, Philip and I have always either boiled or filtered our own drinking water. To our dismay, our neighbors often derided our laborious efforts. One day we

thought to explain our mysterious actions. The village had been experiencing an especially crippling outbreak of Guinea worm. After reading about the disease, Philip and I were convinced that polluted drinking water was the cause of our neighbors' misery. We urged our friends to boil their water as protection against future infestation. But even our closest and most open-minded friends dismissed our suggestion with casual laughter. 'Can you see the worms in our water?' our friend Yacouba challenged us. We admitted we couldn't. 'There's nothing wrong with the water,' he insisted. 'Anyway, even if the Guinea worms come to us through the water, they're put there by witches.' Yacouba added emphatically, 'Boiling the water wouldn't stop the witches."' (Gottlieb, 2004, p. 189).

C.2 Account 2: India

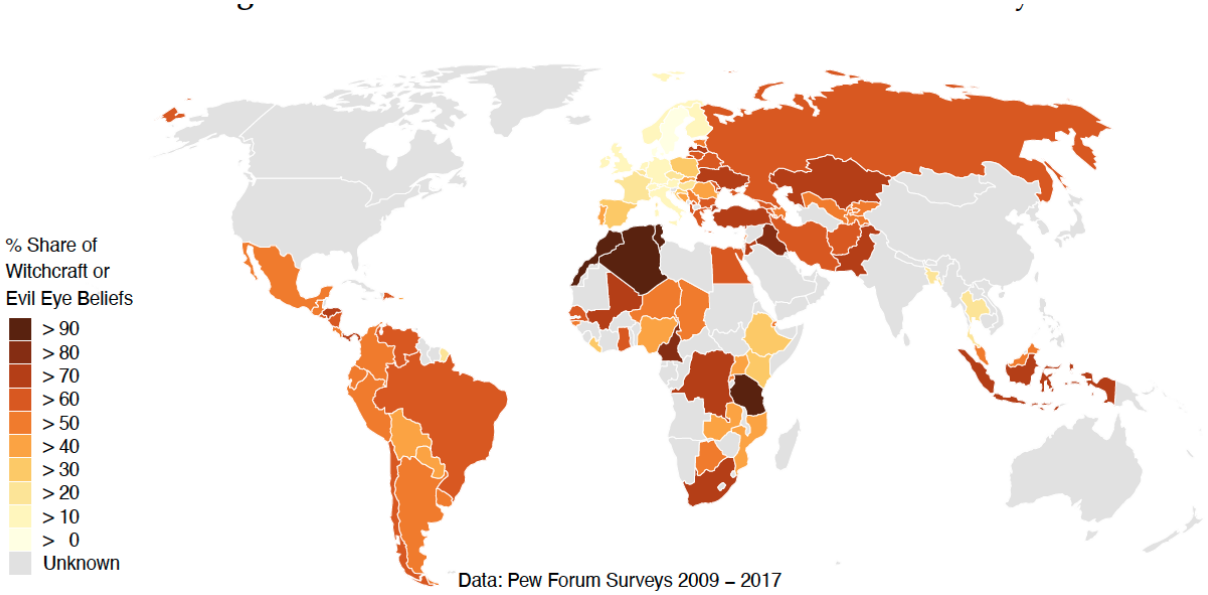
Luschinsky (1963) recounts a village woman's reasoning about an aching tooth.

"A village woman of Noniya caste squatted near the door rubbing her jaw. She said that she knew why her teeth were aching. An evil spirit was troubling her. The village shaman had told her so and she was performing ceremonies to placate the spirit under the shaman's direction. An American research worker had tried to persuade her to go to a dentist in Banaras, but she had refused, asking, What would such a man know about evil spirits?" (Luschinsky, 1963, p.66)

B Online Appendix: Supplementary Figures and Tables

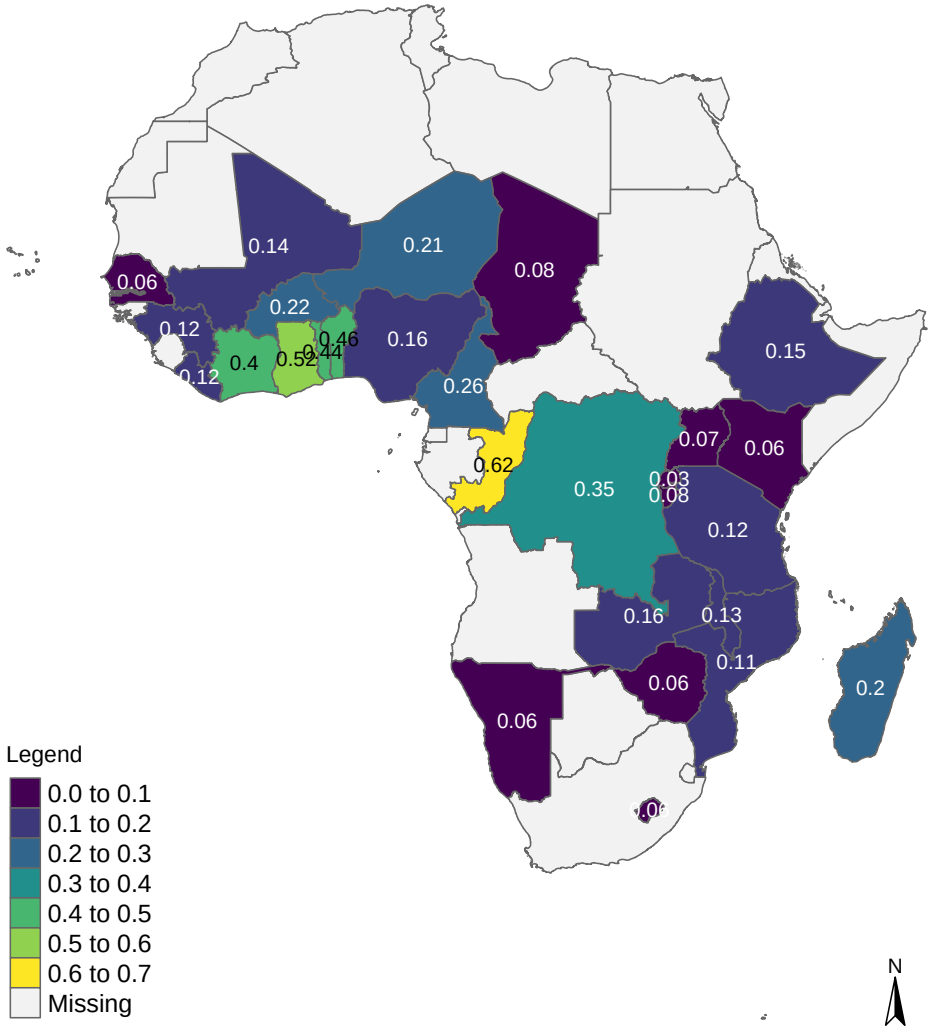
A Appendix Figures

Figure A.1: Global Prevalence of Beliefs in Witchcraft or Evil Eye



Source: Butinda et al. (2023). *Notes:* The map illustrates data gathered by the Pew Forum in various nationally representative survey waves spanning from 2009 to 2017. Participants were surveyed on their beliefs, specifically regarding (i) belief in witchcraft and (ii) belief in the evil eye or that certain people can cast curses or spells that cause bad things to happen to someone. In western European countries, the survey included the evil eye question but omitted the witchcraft question. Butinda et al. (2023) calculate the country-level shares of individuals who believe in witchcraft or the evil eye (or both) using the sampling weights of the survey data.

Figure A.2: Share of Respondents with Supernatural Belief Regarding HIV/AIDS Across Countries in Sub-Saharan Africa



Note: The figures show the share of respondents who agree with the statement "One can get HIV/AIDS from witchcraft or other supernatural means". The data come from the Demographic and Health Surveys and the Gallup World Poll 2009.

Figure A.3: Association of Supernatural Beliefs with Healer Use in Sub-Saharan Africa

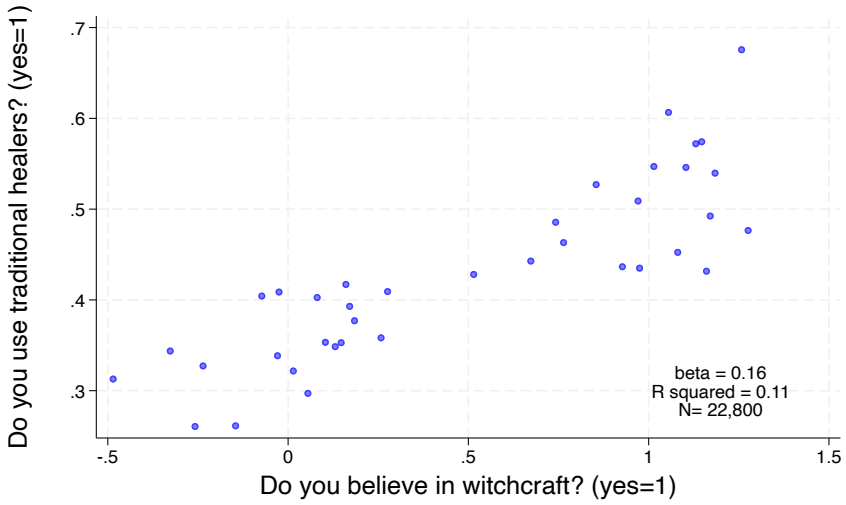


Figure A.4: Association of Supernatural Beliefs with Healer Use

Note: The figure shows a binned scatter plot of the use of traditional healers on beliefs in witchcraft including country fixed effects. The data come from the Pew Forum on Religion and Public Life survey.

Figure A.5: Association of Supernatural Beliefs with Stigma in Sub-Saharan Africa

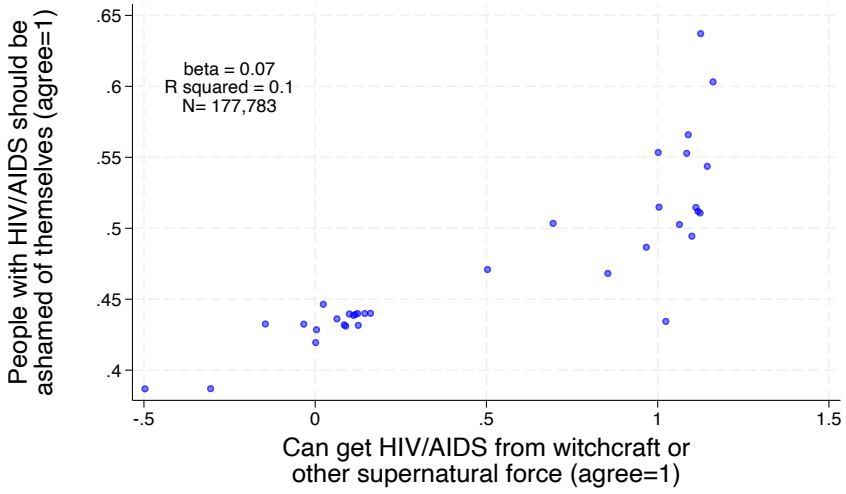
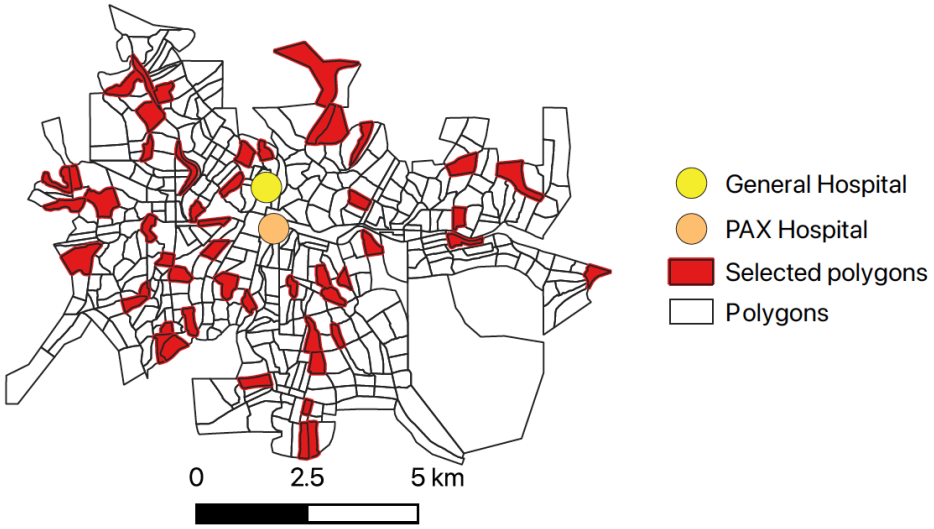


Figure A.6: Association of Supernatural Beliefs with Stigmatizing Attitudes

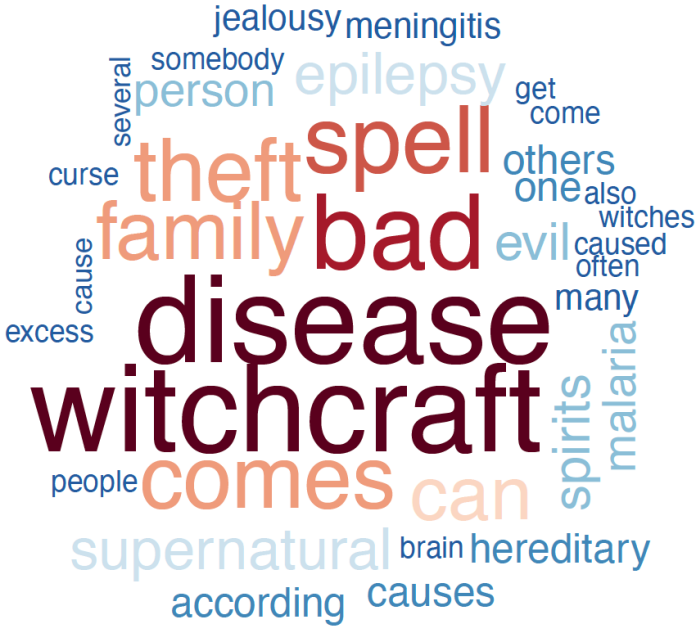
Note: Panel A.6: The figure shows a binned scatter plot of the variable "People with HIV/AIDS should be ashamed of themselves" (yes=1) on the variable "One can get HIV/AIDS from witchcraft or other supernatural means" (yes=1) including country fixed effects. The sample is restricted to the years before the introduction of HIV treatment. The data come from all Demographic and Health Surveys covering the variables and time periods in sub-Saharan Africa.

Figure A.7: Sampling in Kananga



Note: The map depicts the selected neighborhoods (polygons) for the sample using two-stage clustered sampling. The selection of polygons was stratified by median distance to the city center. General Hospital is the hospital where the voucher for an epilepsy consultation could be used (see Section 6.2.1). PAX Hospital is the hospital where the hypertension and HIV testing vouchers could be used (see Section 6.2.3).

Figure A.8: Word Cloud on Causes of Epilepsy in Kananga



Note: Word cloud of the answers to the open question "Now I'd like to talk about the causes of epilepsy here in Kananga. Can you explain the causes of epilepsy to me in your own words?" Data from subsample in baseline survey. N=90.

Figure A.9: Case-Based Supernatural Attributions for Epilepsy

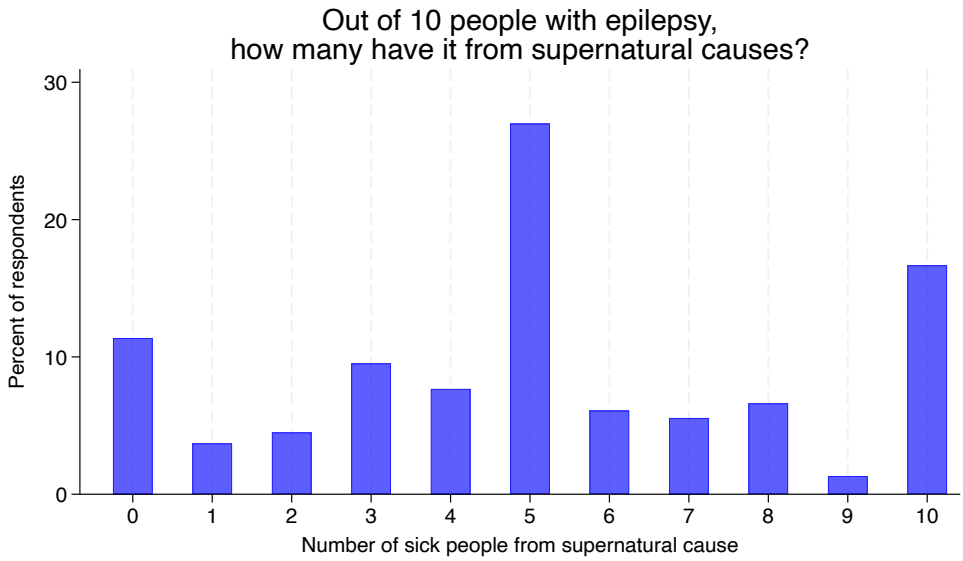


Figure A.10: Case-based supernatural attributions for epilepsy

Notes: The histogram shows the distribution of responses to the question "Out of 10 people with epilepsy, how many have it from supernatural causes?" The data come from the control group in the midline survey (N= 378).

Figure A.11: Correlates of Supernatural Beliefs about Illness

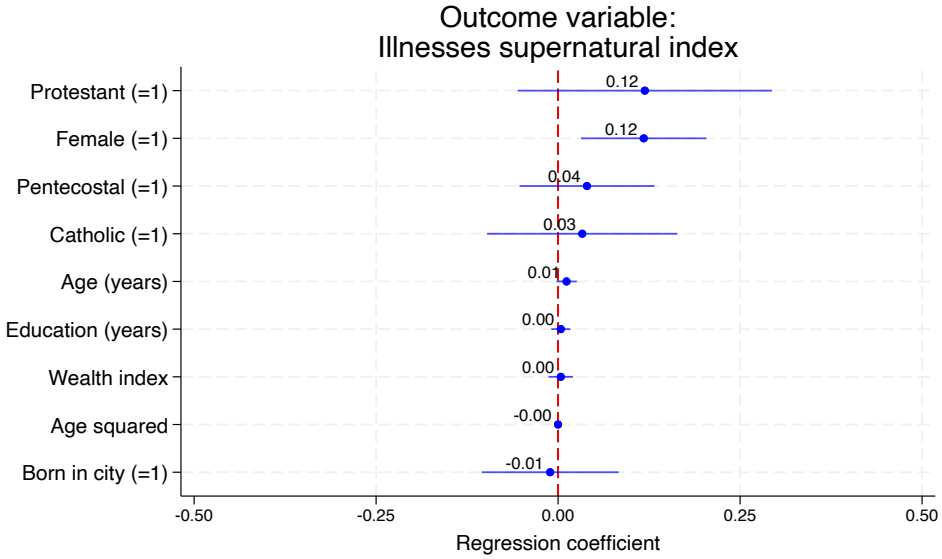
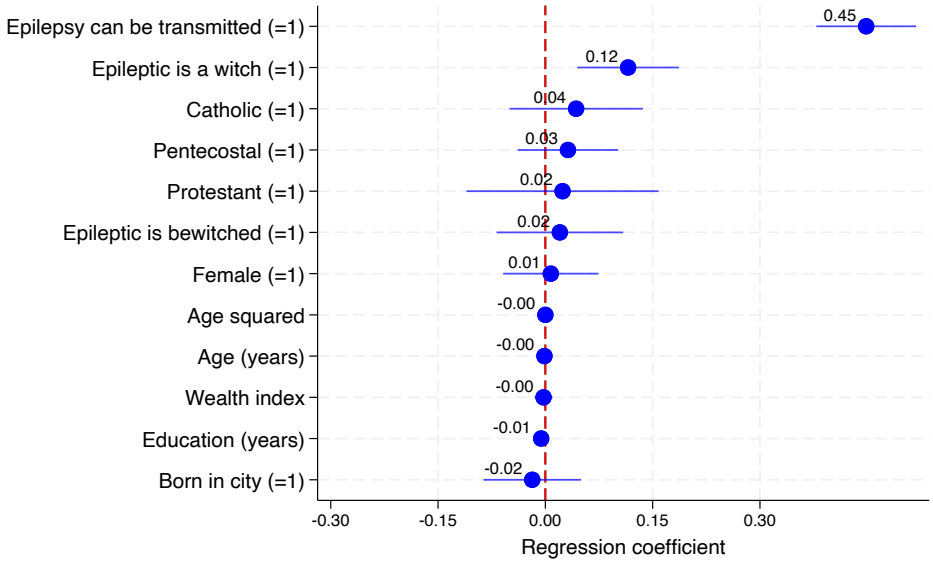


Figure A.12: Outcome variable: Illnesses supernatural index

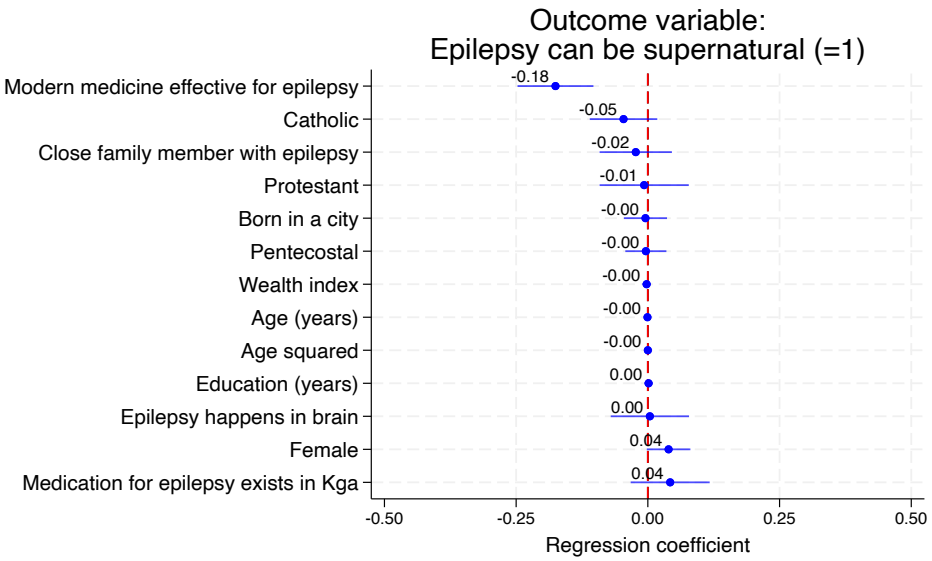
Note: Panel A.12: The figure plots the regression coefficient of the *epilepsy supernatural index* for different individual-level variables from the same regression. The *illnesses supernatural index* is a Kling et al. (2007) index of the variables for whether the respondent believes an illness can have supernatural causes across 13 illnesses. See 3 for the description of the variables.

Figure A.13: Predictors of Stigma toward Those with Epilepsy



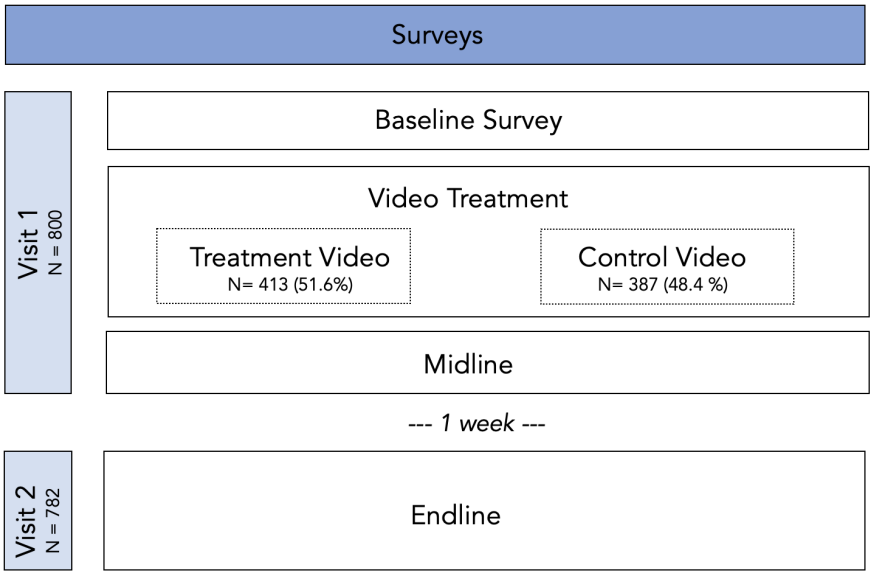
Note: Panel A.13: The outcome variable is a dummy variable equal to one if the respondent agrees or strongly agrees with the statement "One's children shouldn't play with epileptic children". The figure plots the regression coefficients of different individual-level variables. Dependent variable mean of 0.359. The data come from the baseline survey (N=800).

Figure A.14: Correlates of Supernatural Beliefs about Epilepsy



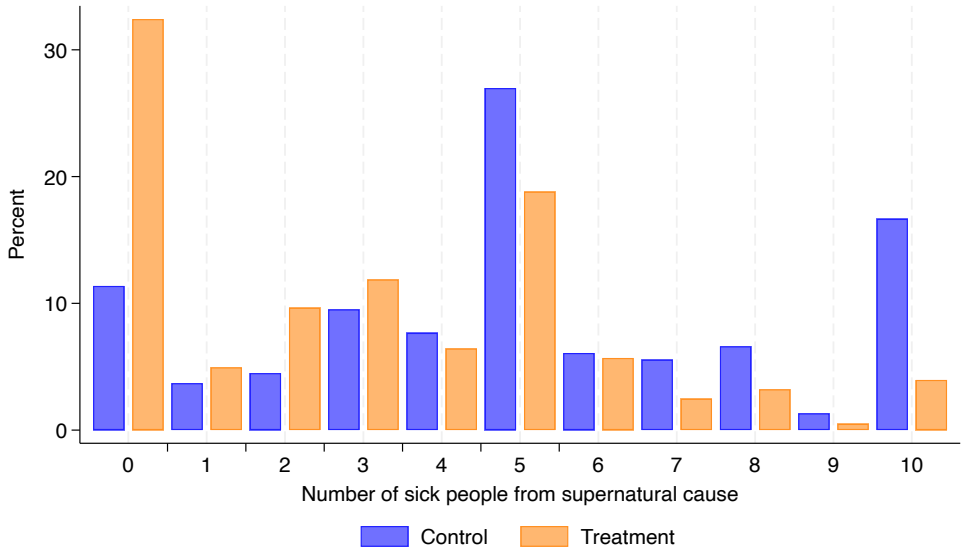
Notes: The figure shows the regression coefficients of the regression of whether epilepsy can be supernatural on demographics and beliefs about epilepsy. All variables elicited in baseline survey. The dependent variable mean is 0.923. 95% confidence intervals.

Figure A.15: Survey Flow



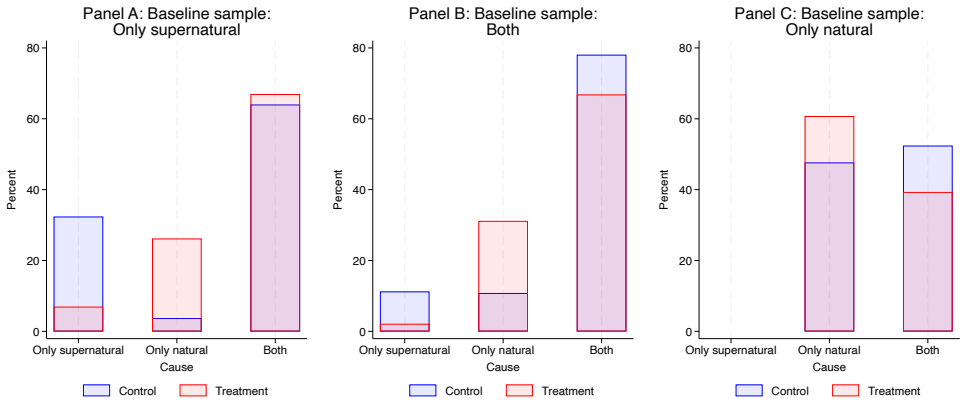
Notes: The figure shows the survey flow.

Figure A.16: Distribution: Share of Epilepsy Cases Caused Supernaturally by Treatment Group



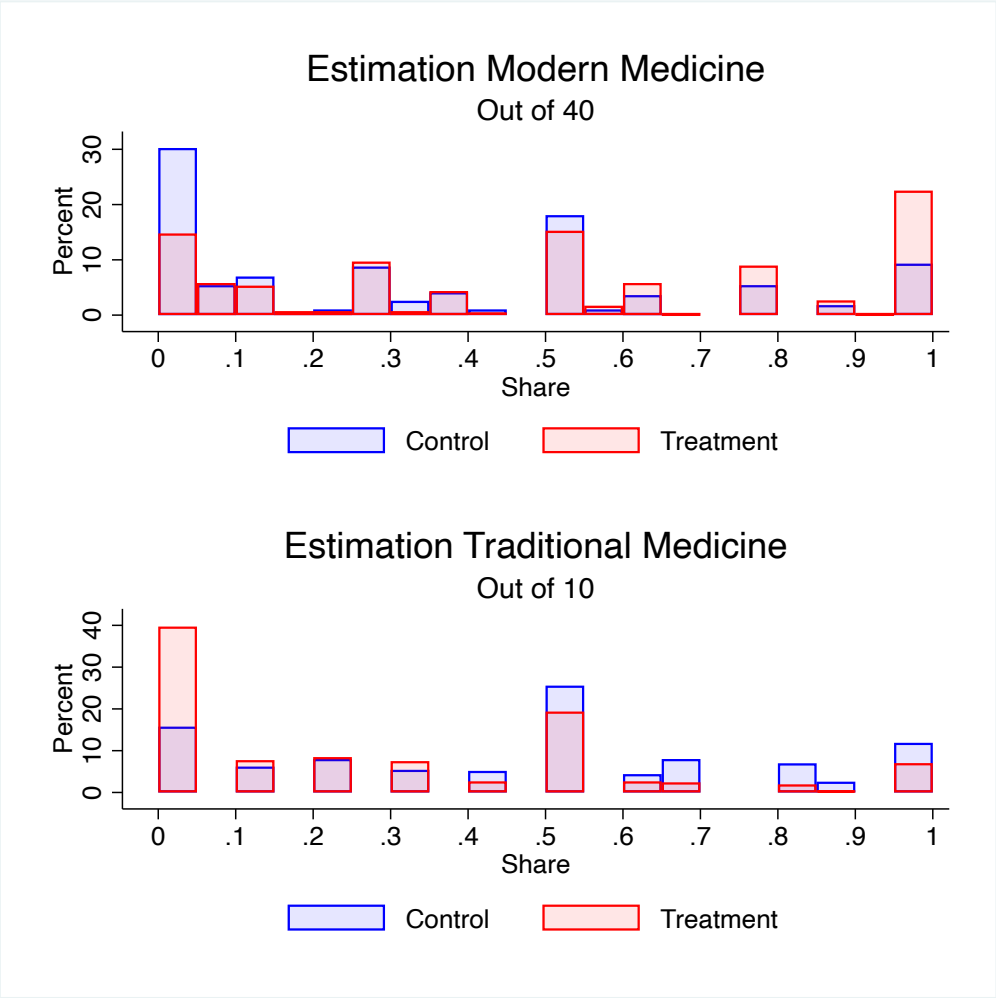
Note: The figure shows the distribution of the answer to the question "Out of 10 people with epilepsy, how many have it from supernatural causes?" by treatment group elicited in the endline survey in the second visit.

Figure A.18: Frequency of Supernatural, Natural, or Both Types of Explanations of Epilepsy by Treatment Group and Subsample of Baseline Beliefs



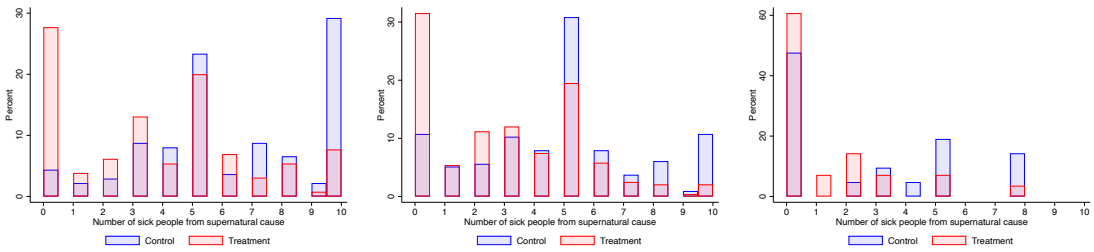
Note: The figure shows the frequency of beliefs that epilepsy can only be supernatural, can only be natural, or can be both in the endline survey by treatment group and subsample of baseline beliefs. Each panel shows a different subsample: The subsample of respondents thinking epilepsy can only be supernatural in Panel A, the subsample of respondents thinking epilepsy can be both supernatural and natural in Panel B, and the subsample of respondents thinking epilepsy can only be natural in Panel C.

Figure A.17: Distribution of Estimations of Efficacy for Modern and Traditional Medicine by Treatment Group



Note: The figure shows the distribution of respondents' estimates of the treatment efficacy of modern medicine and traditional medicine in Kananga by treatment status. The estimated efficacy for modern medicine is calculated as the estimated number of patients with epilepsy out of 40 who received modern medical treatment and had no seizures in the month after starting treatment. The estimated efficacy for traditional medicine is calculated as the estimated number of patients with epilepsy out of 10 who took traditional medicine and had no seizure in the month after starting traditional treatment. The estimates were incentivized based on numbers provided by the hospital.

Figure A.19: Updating on the Share of Epileptic Cases Attributed to Supernatural Causes at Endline by Baseline Belief Subsample



(a) For baseline subsample: Respondents who thought epilepsy has only supernatural causes in the baseline survey

(b) For baseline subsample: Respondents who thought epilepsy can have both natural and supernatural causes in the baseline survey

(c) For baseline subsample: Respondents who thought epilepsy have only natural causes in the baseline survey

Note: The figures show the distribution of answers to the question "Out of 10 people with epilepsy, how many have it from supernatural causes?" by treatment group elicited in the second visit endline survey and by subsample of baseline beliefs. A.19a shows the distribution for the subsample of respondents who thought epilepsy has only supernatural causes in the baseline survey (N=267). A.19b shows the distribution for the subsample of respondents who thought epilepsy has both supernatural and natural causes in the baseline survey (N=455). A.19c shows the distribution for the subsample of respondents who thought epilepsy has only natural causes in the baseline survey (N=49).

B Appendix Tables

Table A.1: Supernatural Beliefs about AIDS and Their Relationship with Stigmatizing Attitudes and HIV testing, and Impact of Availability of HIV Treatment on These Beliefs

	(1)	(2)	(3)
	HIV/AIDS supernatural	HIV test	HIV/AIDS stigma
HIV treatment prevalence$_{t-1}$	-0.018**	0.170***	-4.629***
	(0.008)	(0.020)	(0.635)
R^2	0.150	0.064	0.146
Observations	761982	545279	202351
Country FE	yes	yes	yes
Year FE	yes	yes	yes
Controls	yes	yes	yes

Notes: Coefficients are standardized and represent the change in the dependent variable (in standard deviation units) with a one-standard-deviation change in the independent variable. Regressions include the control variables sex, age, age squared, education in years, indicator variables for marital status, and a wealth index. *HIV/AIDS supernatural* is a dummy variable equal to one if the respondent agrees that one can contract AIDS/HIV from witchcraft or by other supernatural means. *AIDS stigma* is a dummy variable equal to one if the respondent agrees that people living with HIV/AIDS should be ashamed of themselves. *HIV test* is a dummy variable equal to one if the respondent consents to the HIV test. *HIV treatment prevalence* measures the share of the population receiving antiretroviral therapy (ART) in the previous year at the country level. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS standard errors clustered at country level in parentheses. *Source:* Demographic and Health Surveys data. The sample includes all countries in sub-Saharan Africa and all associated years for which the variables of interest are available and downloadable from IPUMS. Column (1) sample: Benin 2006, 2011, 2017; Burkina Faso 2010; Burundi 2010, 2016; Cameroon 2004, 2018; Chad 2004, 2014; Congo 2005, 2011; Cote d'Ivoire 2011; DRC 2007, 2013; Eswatini 2006; Ethiopia 2005, 2011, 2016; Ghana 2003, 2008, 2014; Guinea 2005, 2012, 2018; Kenya 2008, 2014; Lesotho 2004, 2009, 2014; Liberia 2007, 2013; Madagascar 2008; Malawi 2004, 2010, 2016; Mali 2006, 2012, 2018; Mozambique 2011; Namibia 2006, 2013; Niger 2006, 2012; Nigeria 2003, 2008, 2013, 2018; Rwanda 2010, 2014; Senegal 2005, 2010, 2014, 2015, 2016, 2017; Tanzania 2004, 2010; Togo 2013; Zambia 2007, 2013, 2018; Zimbabwe 2005, 2010, 2015. Column (2) sample: Benin 2006; Congo 2005; DRC 2007; Eswatini 2006; Ethiopia 2005; Guinea 2005; Lesotho 2009; Mali 2006; Namibia 2006; Niger 2006; Nigeria 2008, 2013; Rwanda 2005; Senegal 2005; Tanzania 2004; Zambia 2007, 2013; Zimbabwe 2005. Column (3) sample: Angola 2015; Burkina Faso 2010; Burundi 2016; Cameroon 2011, 2018; Chad 2014; Cote d'Ivoire 2011; DRC 2007, 2013; Eswatini 2006; Ethiopia 2011, 2016; Ghana 2014; Guinea 2012, 2018; Kenya 2008; Lesotho 2009, 2014; Liberia 2007, 2013; Malawi 2010, 2016; Mali 2006, 2012; Namibia 2013; Niger 2006, 2012; Rwanda 2010, 2014; Senegal 2010, 2017; South Africa 2016; Togo 2013; Zambia 2007, 2013, 2018; Zimbabwe 2005, 2010, 2015. Estimates on antiretroviral therapy and population numbers from World Health Organization.

Table A.2: Exposure to Illnesses in Sample and Prior Use of Traditional Medicine or Modern Medicine

	For illness			
Illness	Heard about (%) (1)	Know somebody (incl. self) (%) (2)	Used modern medicine for consultation or testing (%) (3)	Used traditional medicine (%) (4)
Malaria	99.87	99.09	82.85	44.57
Typhoid	100	91.82	64.13	56.99
Tuberculosis	98.37	55.96	16.16	7.78
Fractures	93.37	51.49	9.66	18.07
Snakebite	94.75	56.31	6.08	15.73
Diabetes	96.63	62.5	12.18	4.6
Anemia	96.74	74.77	24.77	21.59
Swollen limbs	90.1	67.01	15.74	20.48
HIV	98.62	36.11	15.82	2.25
Sterility	97.37	64.49	5.81	9.09
Hypertension	99.5	67.27	26.39	11.11
Covid	96.86	19.05	16.6	1.16
Epilepsy	99.88	90.89	1.88	4.4

Notes: The table shows the percentage of respondents who have heard about the illness before, who know somebody who has had the illness including the respondent herself, who have used modern medicine for testing or consultation before, and who have used traditional medicine before by illness. The variables were elicited in the baseline survey. Variables of columns (1) and (3) collected from all baseline survey respondents; variables in columns (2) and (4) collected from a subset of around 100 control respondents in the baseline survey.

Table A.3: Regression Results of Beliefs about Modern Medicine's Efficacy on Supernatural Origin of Illness

Panel A								
Dep. var.:	Illness can be supernatural (=1)				Modern medicine effective for illness (=1)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	0.362***	0.917***	0.058***	0.611***	0.845***	1.295***	0.972***	1.281***
	(0.008)	(0.000)	(0.000)	(0.010)	(0.006)	(0.010)	(0.001)	(0.011)
Illness can be supernatural					-0.284***	-0.322***	-0.106**	-0.082***
					(0.012)	(0.011)	(0.025)	(0.012)
Dep var mean	0.362	0.362	0.362	0.362	0.715	0.715	0.715	0.715
R^2	0.000	0.235	0.266	0.499	0.097	0.277	0.291	0.466
Observations	9,913	9,913	9,913	9,913	9,913	9,913	9,913	9,913
Individual FE	no	yes	no	yes	no	yes	no	yes
Disease FE	no	no	yes	yes	no	no	yes	yes
Panel B								
Dep. var.:	Has used modern medicine for illness (=1)				Modern medicine effective for illness (=1)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Illness can be supernatural	-0.209***	-0.256***	-0.048**	-0.046***	-0.260***	-0.289***	-0.105**	-0.082***
	(0.009)	(0.009)	(0.012)	(0.010)	(0.012)	(0.012)	(0.025)	(0.012)
Has used modern medicine for illness					0.119***	0.126***	0.032*	0.029**
					(0.010)	(0.010)	(0.015)	(0.011)
	(0.008)	(0.008)	(0.001)	(0.013)	(0.008)	(0.012)	(0.012)	(0.014)
Dep. var. mean	0.232	0.232	0.232	0.232	0.715	0.715	0.715	0.715
R^2	0.056	0.232	0.302	0.467	0.110	0.288	0.291	0.466
Observations	9,896	9,896	9,896	9,896	9,896	9,896	9,896	9,896
Individual FE	no	yes	no	yes	no	yes	no	yes
Disease FE	no	no	yes	yes	no	no	yes	yes

Notes: The table shows OLS regression results of equation **??**. The variables are a dummy variable equal to one if the respondent thinks an illness can have supernatural causes, a dummy variable equal to one if the respondent thinks modern medicine is effective for an illness (see Section 4 for the variable construction), and a dummy variable equal to one if the respondent has ever used modern medicine in the form of an examination or testing for the illness. The survey text was "For each of the following diseases or conditions, please tell me if you have ever used modern medicine for testing or examination". Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors clustered at individual and illness level in parentheses.

Table A.4: Summary Statistics and Balance Checks

	Summary Statistics					Balance test	
	Mean	Std. dev.	Min	Max	N	β_1	Std. err.
Age (years)	38.14	16.13	18	83	800	-1.714	1.141
Female (dummy)	0.49	0.50	0	1	800	-0.044	0.035
Monthly household earnings (USD)	88.02	103.06	0	1100	755	12.726*	7.500
Log(1+income)	3.98	1.13	0	7	755	0.126	0.082
No schooling (dummy)	0.01	0.12	0	1	782	-0.014	0.009
Education (years)	12.90	4.03	0	21	800	0.252	0.286
Single, never married	0.19	0.39	0	1	800	0.018	0.028
Married monogamous	0.68	0.47	0	1	800	0.013	0.033
Married polygamous	0.04	0.19	0	1	800	0.005	0.013
Divorced, separated	0.01	0.11	0	1	800	0.009	0.008
Widowed	0.06	0.24	0	1	800	-0.044***	0.017
Born in a city (dummy)	0.68	0.47	0	1	782	-0.017	0.033
Pentecostal (dummy)	0.49	0.50	0	1	779	0.012	0.036
Catholic (dummy)	0.16	0.37	0	1	779	0.008	0.026
Protestant (dummy)	0.06	0.25	0	1	779	-0.014	0.018
No religion (dummy)	0.06	0.25	0	1	779	-0.014	0.018
Unemployed (dummy)	0.37	0.48	0	1	689	-0.010	0.037
Medical profession (dummy)	0.02	0.13	0	1	689	-0.000	0.010
Family member with salary (dummy)	0.33	0.47	0	1	782	0.037	0.034
Nuclear family has shop or enterprise (dummy)	0.18	0.38	0	1	782	0.034	0.027
Owns motorbike (dummy)	0.13	0.33	0	1	782	-0.003	0.024
Any source of electricity (dummy)	0.47	0.50	0	1	781	-0.009	0.036
House with brick or cement walls (dummy)	0.40	0.49	0	1	779	0.021	0.035
Distance Katuambi (km)	3436.30	1521.65	765	11027	801	77.083	107.503
Distance Pax (km)	3269.70	1466.74	455	10081	801	47.534	103.571
Knows hospital (dummy)	0.93	0.26	0	1	800	-0.003	0.018
Treated at hospital before (dummy)	0.24	0.43	0	1	743	0.017	0.032
Traditional medicine - never	0.55	0.50	0	1	787	0.034	0.036
Traditional medicine - 2 weeks	0.06	0.23	0	1	787	-0.014	0.016
Traditional medicine - 30 days	0.05	0.22	0	1	787	0.022	0.016
Traditional medicine - 30 to 60 days	0.06	0.24	0	1	787	-0.017	0.017
Traditional medicine - 60 days or more	0.28	0.45	0	1	787	-0.025	0.032
Modern medicine - never	0.14	0.35	0	1	791	0.010	0.025
Modern medicine - 2 weeks	0.12	0.32	0	1	791	0.002	0.023
Modern medicine - 30 days	0.10	0.30	0	1	791	0.011	0.021
Modern medicine - 30 to 60 days	0.13	0.33	0	1	791	0.019	0.024
Modern medicine - 60 days or more	0.51	0.50	0	1	791	-0.043	0.036
Identifies epilepsy from symptom (dummy)	0.87	0.33	0	1	776	0.003	0.024
Knows N alive with epilepsy	4.49	35.85	0	1000	800	1.965	2.460
Close family member with epilepsy (dummy)	0.10	0.31	0	1	800	0.033	0.022
Seen epileptic attack (dummy)	0.96	0.20	0	1	800	-0.002	0.014
N attacks seen	8.56	10.60	0	90	768	-0.755	0.768
Distrust in researcher	1.50	0.53	1	4	800	-0.008	0.037
Has identity card (dummy)	0.81	0.39	0	1	800	0.008	0.028
Attrition	0.02	0.15	0	1	800	-0.001	0.011
Days between visits	6.80	3.29	2	24	782	0.116	0.235
Medication for epilepsy exists (dummy)	0.10	0.30	0	1	800	0.046**	0.021
Doctors for epilepsy exist (dummy)	0.13	0.34	0	1	800	0.029	0.024

Notes: The first five columns provide summary statistics about the variables indicated (whose unit/type is indicated in parentheses). Some variables have a lower N because of nonresponse to certain survey questions. The last two columns summarize results from OLS estimations of equation 2 (without covariates) with each variable as the outcome.

Table A.5: Zero Stage: What Respondents Retrieve about Epilepsy from the Video

	Dependent variables all referring to epilepsy							
	Medication exists in Kananga	Doctors exist in Kananga	Occurs in brain		Occurs in heart		Transmissible	
Survey	Midline	Midline	Midline	Endline	Midline	Endline	Midline	Endline
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	0.657***	0.645***	0.072***	0.039***	0.305***	0.228***	-0.085***	0.005
	(0.026)	(0.025)	(0.015)	(0.013)	(0.029)	(0.031)	(0.025)	(0.028)
Control mean	0.256	0.289	0.910	0.943	0.527	0.568	0.305	0.258
R^2	0.493	0.493	0.169	0.062	0.254	0.153	0.354	0.215
Observations	800	800	800	782	800	782	800	782
p-value OLS	0.000	0.000	0.000	0.004	0.000	0.000	0.001	0.853
p-value RI	0.000	0.000	0.000	0.001	0.000	0.000	0.002	0.884
p-value bootstrap	0.000	0.000	0.000	0.005	0.000	0.000	0.001	0.854

Notes: This table reports estimates from Equation 2. The outcome in column (1) is a dummy variable equal to one if the respondent answers "yes" to the survey question "Is there medication to treat epilepsy in Kananga?" The outcome in column (2) is a dummy variable equal to one if the respondent answers "yes" to the question "Are there medical doctors who treat epilepsy in Kananga?" The outcomes in columns (3) and (5) are dummy variables equal to one if the respondent agrees or strongly agrees with the statement "Epilepsy always happens in the brain" and "Epilepsy can be transmitted from human to human", respectively, with answer choices on a 5-point scale from "strongly disagree" to "strongly agree". The outcomes in columns (3)–(4) and (7)–(8) are dummy variables equal to one if the respondent agrees or strongly agrees with the statement "Epilepsy always happens in the brain" and "Epilepsy can be transmitted from human to human", respectively, with answer choices on a 5-point scale from "strongly disagree" to "strongly agree". The outcome in columns (5)–(6) is a dummy variable equal to one if the respondent disagrees or strongly disagrees with the statement "Epilepsy always occurs in the heart", with answer choices on a 5-point scale from "strongly disagree" to "strongly agree". The outcome in columns (7)–(8) is a dummy variable equal to one if the respondent agrees or strongly agrees with the statement "Epilepsy can be transmitted from one person to another", with answer choices on a 5-point scale from "strongly disagree" to "strongly agree". Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

Table A.6: Heterogeneity Analyses: Treatment Effect on Beliefs about Cause of Epilepsy by Subsample of Baseline Beliefs

Baseline sample:	Only supernatural			Both			Only natural		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dep. var.:	Only supernatural	Both	Only natural	Only supernatural	Both	Only natural	Only supernatural	Both	Only natural
Treatment	-0.202***	-0.162***	0.216***	-0.083***	-0.179***	0.220***	0.000	-0.131	0.195
	(0.044)	(0.047)	(0.043)	(0.023)	(0.038)	(0.036)	(.)	(0.155)	(0.145)
Control mean	0.167	0.889	0.111	0.167	0.889	0.111	0.167	0.889	0.111
R^2	0.255	0.838	0.237	0.101	0.787	0.276	.	0.474	0.611
Observations	267	267	267	455	455	455	49	49	49

Notes: This table reports estimates from equation 2. The table reports regression results for different subsamples: columns (1)–(3) for the subsample of respondents who believed epilepsy can have only supernatural causes in the baseline survey, columns (4)–(6) for the subsample of respondents who believed epilepsy can have both supernatural and natural causes in the baseline survey, and columns (7)–(9) for the subsample of respondents who believed epilepsy can have only natural causes. The outcome variables are dummy variables equal to one if the respondent believed that epilepsy can have only supernatural causes, both natural and supernatural causes, or only natural causes in the second visit endline survey. All regressions include the control variables sex, age, age squared, widowed, and whether the respondent knew epilepsy treatment existed in Kananga in the baseline survey. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

Table A.7: Relationship of Supernatural Explanations in Baseline and Treatment Effect on Updating of Beliefs about Supernatural Origin and Modern Medicine's Efficacy for Other Illnesses

	Dep var: Share of illness from supernatural cause			
	(1)	(2)	(3)	(4)
Treatment	-0.032***	-0.018	-0.047***	-0.015
	(0.009)	(0.022)	(0.010)	(0.017)
Treat × Interaction var.	-0.053***	-0.045	-0.035*	-0.087*
	(0.017)	(0.033)	(0.021)	(0.050)
Interaction var.	0.168***	0.111***	0.079***	0.187***
	(0.013)	(0.025)	(0.016)	(0.039)
Interaction var.	Illness supernatural$_{ij}$	Epilepsy supernatural$_i$	Illnesses supernatural index$_i$	Share illnesses supernatural$_i$
Control mean	0.197	0.197	0.197	0.197
R^2	0.170	0.185	0.189	0.188
Observations	8900	8796	8900	8900
Illness FE	yes	yes	yes	yes

Notes: This table reports estimates from equation 4 including illness fixed effects. Each observation is at the illness–individual level. The outcome variable is respondent i's estimated share in the endline survey of individuals with an illness j who are believed to have it from supernatural causes. "Interaction variable" indicates which baseline variable the treatment variable is interacted with, where i indexes individuals and j indexes illnesses. "Illness supernatural" is a dummy variable equal to one if the respondent believed the illness can have supernatural causes in the baseline survey (see Section 4). "Epilepsy supernatural" is a dummy variable equal to one if the respondent believed epilepsy can have supernatural causes in the baseline survey. "Illnesses supernatural index" is a Kling, Liebman, and Katz (2007) index of the dummy variables for whether a respondent believed an illness can have supernatural causes for the illnesses malaria, typhoid, tuberculosis, hypertension, HIV/AIDS, fractures, swollen limbs, diabetes, COVID-19, snakebite, anemia, sterility, and epilepsy in the endline survey at the individual level. "Share illnesses supernatural" is the mean of the dummy variables for whether an illness can have supernatural causes across illnesses by individual in the endline survey. The variable measures the share of all illnesses that an individual believes can have supernatural causes. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors clustered at individual level in parentheses. The disease epilepsy is excluded from the analysis.

Table A.8: Heterogeneity in Belief Updating on Supernatural Cause of Epilepsy Index

	Dep. var.: Epilepsy supernatural index							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	-0.719***	-0.719***	-0.706***	-0.733***	-0.717***	-0.623***	-0.638***	-0.703***
	(0.060)	(0.094)	(0.059)	(0.063)	(0.066)	(0.084)	(0.228)	(0.063)
Treat × Interaction var.	-0.240***	0.019	0.088	0.294	0.097	-0.171	-0.072	-0.037
	(0.072)	(0.119)	(0.105)	(0.190)	(0.153)	(0.117)	(0.235)	(0.194)
Interaction variable	0.479***	0.041	0.124*	-0.249*	-0.308**	0.040	0.055	0.048
	(0.051)	(0.075)	(0.070)	(0.132)	(0.120)	(0.073)	(0.159)	(0.132)
Interaction variable	Epilepsy supernatural index	Witchcraft belief (=1)	Diseases supernatural	Medication for epilepsy exists in Kananga (=1)	Modern medicine effective for epilepsy (=1)	Modern medicine disproves witchcraft (=1)	Epilepsy happens in brain (=1)	Close family member with epilepsy (=1)
R^2	0.261	0.252	0.262	0.254	0.261	0.254	0.252	0.252
Observations	782	782	782	782	782	782	782	782

Notes: This table reports estimates from equation 2. All variables interacted with the treatment variable are measured in the baseline survey. "Epilepsy supernatural index" is the outcome variable in all regressions and is a Kling et al. (2007) index of the three dummy variables for believing epilepsy can have supernatural causes, agreeing with the statement that PLWE are witches, and agreeing with the statement that PLWE are bewitched elicited in the second visit. "Witchcraft belief" is a dummy variable equal to one if the respondent knows at least one person affected by witchcraft. "Diseases supernatural index" is a Kling et al. (2007) index based on the variables for whether an illness can be supernatural across the 13 illnesses in the sample. "Close family member with epilepsy" is a dummy variable equal to one if the respondent has a close family member with epilepsy. "Epilepsy happens in brain" is a dummy variable equal to one if the respondent agrees that epilepsy always occurs in the brain. "Medication for epilepsy exists in Kananga" is a dummy variable equal to one if the respondent think medication to treat epilepsy exists in Kananga. "Modern medicine effective for epilepsy" is a dummy variable equal to one if the respondent thinks modern medicine is good or very good at treating and diagnosing epilepsy. "Modern medicine disproves witchcraft" is a dummy variable equal to one if the respondent agrees that, if modern medicine can treat epilepsy, the disease cannot have supernatural causes. All regressions include the control variables sex, age, age squared, widowed, whether the respondent knew epilepsy treatment existed in Kananga in the baseline survey and the baseline value of the outcome variable. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.9: Heterogeneity in Belief Updating on Supernatural Cause of Epilepsy

	Dep. var.: Epilepsy supernatural index				
	(1)	(2)	(3)	(4)	(5)
Treatment	-0.734***	-0.798***	-0.671***	-0.628***	-0.706***
	(0.083)	(0.152)	(0.205)	(0.109)	(0.059)
Treat × Interaction variable	0.057	0.002	-0.003	-0.105	0.014
	(0.118)	(0.004)	(0.015)	(0.129)	(0.025)
Interaction variable	0.108	0.004	-0.015	0.212**	-0.024
	(0.076)	(0.010)	(0.010)	(0.085)	(0.016)
Interaction variable	Female (=1)	Age	Education (years)	City born (=1)	Wealth index
R^2	0.252	0.252	0.255	0.258	0.254
Observations	782	782	782	782	782

Notes: This table reports estimates from equation 2. The outcome variable is always the supernatural belief of epilepsy index, a Kling et al. (2007) index of the three dummy variables for believing epilepsy can have supernatural causes, agreeing with a statement that PLWE are witches, and agreeing with a statement that PLWE are bewitched elicited in the second visit. All regressions include the control variables sex, age, age squared, widowed, whether the respondent thought epilepsy treatment existed in Kananga in the baseline survey and the baseline value of the outcome variable. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A.10: Heterogeneity in Treatment Effect on Take-Up of Medical Treatment for Epilepsy by Epilepsy Variables

	Dep. var.: Epilepsy voucher accept + use		
	(1)	(2)	(3)
Treatment	0.037*	0.028	0.035*
	(0.022)	(0.023)	(0.020)
Treat × Medication for epilepsy exists	-0.018		
	(0.065)		
Treat× Modern medicine effective for epilepsy		0.042	
		(0.049)	
Treat × Close family member with epilepsy			-0.048
			(0.094)
Medication for epilepsy exists	-0.002	-0.012	-0.008
	(0.047)	(0.032)	(0.032)
Modern medicine effective for epilepsy	-0.017	-0.041	-0.014
	(0.025)	(0.030)	(0.025)
Close family member with epilepsy			0.145**
			(0.073)
Control mean	0.077	0.077	0.077
R^2	0.108	0.109	0.122
Observations	782	782	782
p-value treat + treat × interaction = 0	0.761	0.111	0.884

Notes: This table reports estimates from equation 3. The outcome variable is a dummy variable equal to one if the respondent accepted the voucher and the voucher was used. Regressions include the control variables sex, age, age squared, widowed, whether the respondent knew epilepsy treatment existed in Kananga in the baseline survey and whether the respondent thought modern medicine was good at treating and diagnosing epilepsy in the baseline survey. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

Table A.12: Heterogeneity in Treatment Effect on Take-Up of Medical Treatment for Epilepsy by Demographics

	Dep. var.: Epilepsy voucher accept + use							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	0.031	0.102**	-0.067	0.032	0.039*	-0.015	0.040*	0.024
	(0.029)	(0.047)	(0.074)	(0.039)	(0.021)	(0.058)	(0.021)	(0.023)
Treat × Female (=1)	0.015							
	(0.041)							
Treat × Age		-0.002						
		(0.001)						
Treat × Education (years)			0.008					
			(0.005)					
Treat × City born (=1)				0.008				
				(0.046)				
Treat × Wealth index					-0.014*			
					(0.008)			
Treat × Distance hospital (km)						0.016		
						(0.016)		
Treat × Knows N with epilepsy							-0.000	
							(0.001)	
Treat × Has shop (=1)								0.081
								(0.050)
Education (years)			0.000					
			(0.004)					
Born in a city (dummy)				-0.015				
				(0.030)				
Wealth index					0.001			

Table A.11: Heterogeneity in Treatment Effect on Take-Up of Medical Treatment for Epilepsy by Different Supernatural Variables: Subsamples

	Dep. var.: Epilepsy voucher accept + use							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treatment	0.077**	0.014	0.092***	-0.012	0.086***	-0.004	0.054*	0.022
	(0.032)	(0.026)	(0.027)	(0.031)	(0.027)	(0.031)	(0.029)	(0.029)
Control mean	0.055	0.088	0.037	0.115	0.038	0.113	0.051	0.099
R^2	0.028	0.024	0.038	0.020	0.034	0.022	0.023	0.015
Observations	293	489	392	390	390	392	352	430
Split variable	Epilepsy supernatural index		Illnesses supernatural index		Share of illnesses supernatural		Witchcraft belief index	
Sample	below median	above median	below median	above median	below median	above median	below median	above median
P-values different treatment effect	0.131		0.010		0.026		0.712	

Notes: This table reports estimates from equation 2. The outcome variable is a binary indicator for epilepsy voucher acceptance and use. Columns show estimates for subsamples split by the median of three baseline variables. For each variable, the first column represents observations below the median, and the second column represents observations at or above the median. Medians are calculated from the full sample. "Epilepsy supernatural index" is a Kling et al. (2007) index of three dummy variables from the baseline survey: believing epilepsy can have supernatural causes, agreeing that people living with epilepsy (PLWE) are witches, and agreeing that PLWE are bewitched. "Illnesses supernatural index" is a Kling et al. (2007) index of dummy variables indicating whether a respondent believed each of 13 illnesses could have supernatural causes. "Share illnesses supernatural" is the mean of these 13 dummy variables, representing the proportion of illnesses an individual believes can have supernatural causes. "Witchcraft belief index" is a Kling et al. (2007) index of the dummy variable indicating whether the respondent knows at least one person who has been affected by witchcraft and of the dummy variable indicating whether the respondent knows at least one person who has been possessed. Regressions include controls for sex, age, age squared, widowhood, baseline knowledge of epilepsy treatment in Kananga, and baseline opinion on modern medicine's efficacy in treating and diagnosing epilepsy. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses. Subsamples may be unequal due to observations at the median value.

Table A.13: Heterogeneity in Treatment Effect on Stigma toward People with Epilepsy

	(1) Epileptic children shouldn't play with other children	(2) Should avoid epileptic during attack	(3) NGO project with epileptic people
Treatment	-0.071**	-0.103***	0.037
	(0.030)	(0.039)	(0.031)
Treat × Epilepsy transmissible	-0.017	-0.104	0.031
	(0.065)	(0.069)	(0.056)
Epilepsy transmissible	0.088*	0.195***	-0.018
	(0.050)	(0.051)	(0.040)
Control mean	0.289	0.540	0.132
R^2	0.215	0.198	0.018
Observations	782	782	800

Notes: This table reports estimates from equation 3. Regressions include the control variables sex, age, age squared, widowed, whether the respondent knew epilepsy treatment existed in Kananga in the baseline survey and whether the respondent thought modern medicine was good at treating and diagnosing epilepsy in the baseline survey. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

C Online Appendix: Additional Analyses

A Whose Illnesses Are Attributed to Supernatural Causes?

Does a lack of information about health history, such as past infections, contribute to supernatural attributions? If so, we might expect fewer supernatural attributions for cases of an illness about which the respondent has more information, such as the cases of family members. To investigate this conjecture, I regress the outcome variable for whether people with epilepsy are bewitched on dummy variables indicating the relationship of the respondent to the person with epilepsy who is socially closest to the respondent.[77] For this exercise, I assume that the respondent puts high cognitive weight on the presumed cause of disease for the PLWE who is socially closest to her to answer the question about whether people with epilepsy are bewitched.

Figure A.20a plots the regression coefficients. A respondent's having a spouse with epilepsy has the largest predictive power in absolute terms of -0.45, followed by having a parent (-0.15) or a son or daughter with epilepsy (-0.05). Having a sibling, an extended family member, an in-law, a nonrelative adult, or a nonrelative child as the socially closest person with epilepsy has low predictive power for whether a respondent believes that people with epilepsy are bewitched. Thus, this evidence supports the hypothesis that having more information about the person's health history or occurrence of epilepsy decreases the likelihood of embracing supernatural beliefs about the cause of the illness.

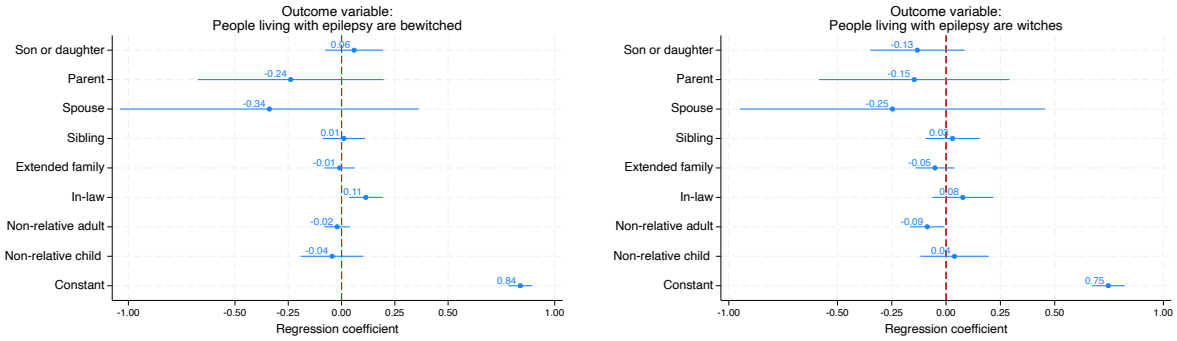
Another hypothesis is that the pattern of lower supernatural beliefs for sons/daughters, parents, and spouses is driven by decreasing altruism at greater social distances (Enke et al., 2023). I repeat the exercise using the outcome variable of believing that PLWE are witches. Assuming that an attribution of epilepsy to bewitchment is more altruistic than one to witchcraft, I expect attributions of bewitchment rather than of witchcraft to be espoused for closer family members.

Figure A.20b gives the regression results. The notable difference with respect to Figure A.20a is that having a son or daughter with epilepsy increases the likelihood of thinking PLWE are bewitched by 6 percentage points and decreases the likelihood of thinking that PLWE are witches

[77] These indicator variables are constructed from the survey question "If you think about the people you know who have epilepsy and who are alive, what is your relationship to the person who is closest to you?" The respondent could self-identify as a PLWE, but the respondent was not asked explicitly about whether she had epilepsy due to the sensitivity of the information. Only one person self-identified as a PLWE, and I do not include this category in the regression.

by 13 percentage points. Having a nonrelative child as the socially closest person with epilepsy decreases the likelihood of thinking PLWE are bewitched by 4 percentage points and increases the likelihood to thinking PLWE are witches by 4 percentage points. This is noteworthy as children are at risk of accusations of witchcraft and abandonment in the DRC, with epilepsy being one reason for this risk noted by Cimpric (2010). Overall, the results for the outcome of witchcraft are similar to the results for bewitchment, suggesting that altruism is not the sole driver.

Figure A.20: Beliefs that Epilepsy Can Have Supernatural Causes and that People Living with Epilepsy are Witches or Bewitched: Predictive Power of the Identity of Socially Closest Person Living with Epilepsy



(a) Outcome variable: People living with epilepsy are bewitched

(b) Outcome variable: People living with epilepsy are witches

Note: Panel A.20a: The figure plots the regression coefficient of the dummy variable equal to one if the respondent agrees that a person with epilepsy is bewitched on the dummy variables indicating who is the socially closest person with epilepsy known to the respondent. Panel A.20b: The figure plots the regression coefficient of the dummy variable equal to one if the respondent agrees that a person with epilepsy is a witch on the dummy variables indicating the respondent's relationship with the socially closest person with epilepsy known to the respondent. *Constant* includes those who do not know anyone with epilepsy or who do not answer the question on whom is the closest person with epilepsy known to them. All variables elicited in baseline survey. 95% confidence intervals.

B Valuation of an Epilepsy Consultation

As another incentivized measure to capture the respondent's beliefs about the efficacy of modern medicine, I elicited the respondent's valuation of another person's medical consultation for seizures. I elicited the valuation by means of an approach similar to the Becker–DeGroot–Marschak (BDM) method. The difference is that respondents decided for a third person and not for themselves.

The respondent was asked to decide whether a third person should receive a cash payment equal to a particular amount of money or the epilepsy consultation for free at the hospital. The respondent was told that this third person would be the next adult with seizures who is seeking a consultation at the hospital. The respondent was asked to decide whether the third person should

receive the consultation for free or a cash amount for different amounts of money. The amounts ranged from 0 to 10 USD, the true value of the consultation, and increased in increments of 0.5 USD. The valuation is calculated as the highest amount of money for which the respondent still prefers the consultation over the cash payment. The respondent was told that one of her choices would be selected with a probability and implemented.[78] The measure was included in the short midline survey during the first visit.

The outcome variable of interest is the calculated valuation in USD of the consultation for a person with seizures. Table A.14 reports the regression results. The treated group's valuation of the third-person consultation is 0.189 USD higher than the control group's. The treatment effect is not statistically significant. This measure of willingness to pay is subject to significant noise. In this context, individuals may find it challenging to comprehend this particular type of measure.

In summary, the treatment increased beliefs in the efficacy of modern medicine and reduced beliefs in the efficacy of traditional medicine, with the results corroborated by incentivized measures. The findings suggest a framework for illness within which beliefs about the efficacy of modern and traditional medicine for epilepsy treatment move in opposite directions.

Table A.14: Treatment Effect on Valuation of Epilepsy Consultation for Third Party

	(1) Valuation of epilepsy consultation of 3rd person (in USD)
Treatment	0.218
	(0.231)
Control mean	8.309
R^2	0.017
Observations	766
p-value OLS	0.343
p-value RI	0.353
p-value bootstrap	0.330

Notes: This table reports estimates from equation 2. The outcome variable measures the respondent's valuation of an epilepsy consultation for a third party elicited through a method similar to the Becker-DeGroot-Marschak method, with the exception that, in this case, a third party receives the item. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

C Willingness to Pay for Examination Vouchers for Different Conditions

As an incentivized measure of people's beliefs about the efficacy of modern medicine, I measured respondents' valuation of modern medicine by eliciting their willingness to pay for different vouchers

[78] Note that the survey text does not inform the respondent about the availability of medicine and doctors to treat epilepsy in Kananga.

for a consultation and testing/examinations for different illnesses through the BDM method. The diseases were typhoid, HIV/AIDS, malaria, anemia, tuberculosis, diabetes, and hypertension, which are a subset of the otherwise used list of diseases. The respondent was informed of the examinations and tests covered, the expiration date, and the value for each voucher.

The willingness was elicited in the following way. The enumerator read a list of prices for every voucher out loud. The list included units from 0 to the value of the voucher in increments of 0.5 USD. The voucher values were as follows: tuberculosis at 7.2 USD, hypertension at 5.8 USD, HIV/AIDS at 13.7 USD, diabetes at 9.9 USD, anemia at 8.5 USD, malaria at 8.5 USD, and typhoid at 13.7 USD. To incentivize the decision, the respondent was told that the tablet would choose a voucher–price combination and that the respondent's decision for this combination would be implemented.

For incentive compatibility, the tablet always chose the HIV or hypertension voucher at a price of 0, that is, for free, due to IRB concerns about equal distribution of benefits.

To examine the treatment effect on the willingness to pay for the different vouchers, I use regression equation 2, where I control for baseline beliefs about the efficacy of modern medicine for treating and diagnosing the particular illness and for whether the respondent had ever done any test or been examined for the disease before.

Table A.15 shows the results for the subgroup of respondents who understood the exercise. The level of understanding was measured by (1) consistency of answers[79], (2) accuracy of answers to the test questions, and (3) the enumerator's indication of whether the respondent had understood the exercise. The sample size varies for each item, as the BDM exercise was conducted for an item only if the respondent had heard of the illness.

The treatment effects are almost zero and not significant. The reduced sample is too small and the data are too noisy for me to detect significant effects. In this context, my application of the BDM method faced many challenges. Respondents did not have cash on hand and did not believe the enumerator's statement that they would actually have to pay for a voucher if it was selected.

Given the considerable noise, I examine whether the intervention increased acceptance of the voucher for free. Table A.16 shows the regression results for the outcome of the respondent's accepting the voucher for free. The treatment significantly increased the probability of accepting the tuberculosis voucher by 3.1 pp, the HIV voucher by 4.3 pp, and the diabetes voucher by 4.1

[79]Defined as a respondent's having only one switching point from choosing to not choosing, where the respondent chose the voucher at lower prices and then switched to not choosing at higher prices

pp. The effect on a willingness to pay index is positive and statistically significant at the 5% level. Overall, the treatment increased a respondent's probability of accepting the vouchers for free; that is, the treatment decreased the likelihood of a respondent's opting out of the vouchers.

Table A.15: Treatment Effect on Willingness to Pay for Vouchers for Consultations in Restricted Sample

	Dependent var: Willingness to pay (USD)							
	(1) TB	(2) Hypert	(3) HIV	(4) Diabetes	(5) Anemia	(6) Malaria	(7) Typhoid	(8) Index
Treatment	0.028	-0.020	0.092	0.085	-0.053	-0.165	0.006	-0.050
	(0.141)	(0.120)	(0.237)	(0.206)	(0.171)	(0.173)	(0.267)	(0.465)
p-value OLS	0.844	0.867	0.697	0.679	0.757	0.341	0.982	0.914
p-value rand. inf.	0.838	0.881	0.685	0.659	0.770	0.322	0.984	0.896
p-value bootstrap	0.832	0.871	0.691	0.677	0.747	0.362	0.982	0.916
Control mean	1.422	1.365	1.629	1.961	1.802	1.943	2.595	-0.206
R^2	0.032	0.034	0.019	0.027	0.055	0.047	0.043	0.050
Observations	572	583	575	564	562	585	586	586

Notes: This table reports estimates from equation 2. The outcome variables measure the respondent's willingness to pay in USD for a voucher for consultations and testing for the respective disease elicited through the Becker–DeGroot–Marschak method. The index is a Kling, Liebman, and Katz (2007) index of columns (1)–(7). Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses. The sample is restricted to those who understood the exercise and passed the test questions.

D Use of HIV or Hypertension Vouchers

The spillover effects on belief updating across illnesses raise the question of whether the intervention increased take-up of modern medicine for other illnesses as well, which I measured by providing two vouchers for free HIV and hypertension testing and consultations.

As part of the BDM exercise described in Section C, the respondent received vouchers for a free HIV consultation and test and for a free hypertension consultation and examination. I chose to provide the HIV and hypertension vouchers as the benefit of testing does not depend on one's having symptoms. While take-up of HIV and hypertension testing are only a proxy for the use of modern medicine, they are the necessary first step for receiving treatment.

The vouchers could be redeemed at the hospital PAX Medical Clinic (PAX) in Kananga. The hospital belongs to the Institut Chrétien Médical du Kasaï (IMCK, the Christian Medical Institute of Kasaï) and is very well known for its quality services. Only the respondent could use the voucher during a period of 2 weeks. Her identity was checked at the hospital through an ID card such as an electoral card. In my sample, 81% of respondents had an ID card, as these are a prerequisite to

Table A.16: Treatment Effect on Willingness to Accept Vouchers for Free Consultations in Restricted Sample

	Dependent var: Accepting voucher for free (=1)							
	(1) TB	(2) Hypert	(3) HIV	(4) Diabetes	(5) Anemia	(6) Malaria	(7) Typhoid	(8) Index
Treatment	0.031**	0.016	0.043**	0.041**	0.025*	0.005	0.012	0.669**
	(0.012)	(0.010)	(0.016)	(0.016)	(0.015)	(0.009)	(0.013)	(0.297)
p-value OLS	0.013	0.101	0.007	0.009	0.087	0.555	0.372	0.025
p-value rand. inf.	0.011	0.141	0.007	0.005	0.091	0.607	0.383	0.024
p-value bootstrap	0.015	0.102	0.006	0.008	0.084	0.565	0.334	0.022
Control mean	0.961	0.975	0.939	0.945	0.952	0.986	0.965	0.561
R^2	0.032	0.019	0.045	0.029	0.030	0.045	0.041	0.043
Observations	576	583	575	564	562	585	586	586

Notes: This table reports estimates from equation 2. The outcome variables measure whether the respondent is willing to accept a voucher for consultations and testing for the respective disease for free, which was offered as part of a Becker–DeGroot–Marschak exercise to elicit willingness to pay for the vouchers. The index is a Kling, Liebman, and Katz (2007) index of columns (1)–(7). Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.

vote.

I measure whether the respondent refused the voucher and whether the respondent used it. Accepting the voucher was not explicitly made costly.

I estimate an OLS regression using equation 2. I control for whether the respondent has ever had an HIV or hypertension test or exam before and how good the respondent deems modern medicine to be at treating and diagnosing HIV and hypertension.

Table A.17 reports the regression results. The treated group is 1.3 percentage points less likely to refuse the hypertension voucher and 1.1 percentage points less likely to refuse the HIV voucher in columns (1) and (2).

The treatment effects on the actual voucher use are negative but almost zero and not statistically significant in columns (3) and (4). Ex post calls showed that, although some respondents had wanted to use the voucher, the hospital was too full to accommodate them at times.

In summary, the treatment effect was not strong enough to induce respondents to take up HIV and hypertension testing.

Table A.17: Treatment Effect on Refusing and Using Hypertension and HIV Testing Vouchers

	(1) Hypertension Refuse	(2) HIV Refuse	(3) Hypertension Use	(4) HIV Use
Treatment	-0.013**	-0.011	-0.020	-0.017
	(0.006)	(0.009)	(0.030)	(0.030)
p-value OLS	0.026	0.209	0.502	0.560
p-value rand. inf.	0.024	0.197	0.506	0.574
p-value bootstrap	0.025	0.209	0.507	0.563
Control mean	0.013	0.021	0.258	0.251
R^2	0.016	0.036	0.060	0.052
Observations	800	800	800	800

Notes: The table reports estimates from equation 2. Respondents were given vouchers for free consultations and testing for HIV and hypertension at the local hospital. The outcomes in columns (1)–(2) are dummy variables equal to one if the respondent refused the respective voucher. The outcomes in (3)–(4) are dummy variables equal to one if the respondent redeemed the respective voucher. Significance levels of * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. OLS robust standard errors in parentheses.