

The Spillover Effect of Health Misinformation: Experimental Evidence from Mozambique^{*}

Nyah Phillips

December 7, 2023

Abstract

This paper looks at the effect of an HIV/AIDS program in rural Mozambique, *Força à Comunidade e Crianças* (FCC), on household outcomes during the COVID-19 pandemic. I find that direct FCC treatment has a negative effect on household COVID-19 knowledge, as measured by the primary respondent's score on a COVID-19 questionnaire. This result is complementary to the findings of the initial FCC study, which found that the program increased HIV misinformation and worsened stigmatizing attitudes (Yang et al., 2023). The primary explanation for these results is that the FCC program led to distrust in healthcare workers, which had persistent effects over time and spillover effects to the COVID-19 pandemic. I explore whether foreign healthcare workers, as proxied by exposure to Cyclone Idai, can offset these effects. I find that FCC-treated households most affected by the cyclone had higher scores on the questionnaire, suggesting that the presence of foreign healthcare workers may counteract misinformation spillovers by increasing trust in the health community.

^{*}I am grateful to my advisor, Dean Yang, for his invaluable guidance and support throughout this research process. I'd also like to thank Honors Economic Directors, Kathryn Dominguez and Nick Montgomery for their advice and encouragement on this project. Lastly, I'd like thank James Allen IV, Hang Yu, Ryan McWay, and Rita Neves for helping me organize and access the FCC and COVID-19 data used in this study.

1 Introduction

This paper aims to causally estimate the role of the *Força à Comunidade e Crianças* (FCC, “Strengthening Communities and Children”) in mitigating participants’ exposure to the COVID-19 pandemic. The FCC program is a randomized-controlled trial that was implemented in Mozambique in 2017 by the NGO World Education Inc/Bantwana and seeks to improve community-level HIV testing by improving knowledge and decreasing stigma around HIV/AIDS. The program’s primary goal is to increase HIV testing, but also measures participation in Village Savings and Loan Associations (VSLAs), life satisfaction, and household economic status. This paper will determine whether HIV/AIDS or other health information programs have persistent effects over time or spillover effects to other health contexts like the COVID-19 pandemic.

The COVID-19 pandemic triggered the largest global economic crisis in recent history. While nearly every country faced economic hardship, the pandemic disproportionately affected incomes, employment, and economic recovery in low- and middle-income countries (Egger et al., 2021). The timing of the pandemic was especially troublesome for Mozambique, a country already facing humanitarian crises and a limited public healthcare system (Jimenez and Daniel, 2020).

In 2019, Mozambique was impacted by Cyclones Idai and Kenneth. More than 2.4 million people were affected and in need of humanitarian assistance (UNICEF, 2019). The cyclones destroyed homes, healthcare facilities, and other crucial infrastructure, displacing hundreds of thousands of Mozambicans and reducing their access to safe water, sanitation products, and medical care. Mozambique was also facing an ongoing insurgency in the northern-most province of Cabo Delgado. By March of 2020, terrorist attacks had displaced thousands of people and threatened the development of a \$60 billion natural gas project that likely would have helped Mozambique achieve its development goals (BBC, 2020). Furthermore, Mozambique’s health infrastructure is limited (USAID, 2019b). There are only three doctors per 100,000 people and many Mozambicans have to walk at least an hour to reach the nearest health clinic. HIV, malaria, and malnutrition are among the most prevalent diseases in the country and many Mozambicans depend on a limited healthcare system for consistent care (Jimenez and Daniel, 2020).

Mozambique reported its first COVID-19 case on March 22, 2020. On March 30, President Nyusi declared a state of emergency, shutting down schools, banning large gatherings, closing the borders, and mandating face masks (IMF, 2021). Mozambique also asked its development partner’s to finance a \$700 million package to allow targeted and temporary tax exemptions to support families and the health sector and to increase spending in response to health and humanitarian needs. Despite this, Mozambique saw a 4.2 percentage point drop in GDP growth and a 0.34 percentage point increase in unemployment in 2020 (World Bank, 2023). “Combatting COVID-19 in Mozambique: Round 1 Summary Report” (Allen IV et al., 2020) found that

average household income fell by 33 percent from the onset of the pandemic (relative to a week in July-August 2020) and that 72 percent of households were food insecure.

Mozambique’s pre-existing challenges demand a unique set of tools and recovery strategies for addressing the pandemic. In fact, it is important that all policymakers have a diverse set of mechanisms with which they can prepare for and respond to widespread public health shocks to mitigate their affects on health and economic outcomes.

The President’s Emergency Plan for AIDS Relief (PEPFAR) is the U.S. government’s collective response to the HIV/AIDS pandemic (KFF, 2023). PEPFAR allocates a portion of its funding to assist orphans and vulnerable children (OVCs) who are especially exposed to the HIV/AIDS pandemic. OVC programs tend to take a multifaceted approach to improving health, education and economic outcomes among those affected by HIV. *Força à Comunidade e Crianças* (FCC) is one such OVC program.

I find that the FCC program has a negative effect on COVID-19 knowledge. Households that were directly-enrolled in the FCC program had less accurate COVID-19 knowledge than control households. These results may be driven by spillovers in health misinformation across domains through decreased trust in healthcare workers. However, greater exposure to Cyclone Idai led to the FCC program’s treatment effect on COVID-19 knowledge to be more positive. The increase in health spending and presence of foreign healthcare workers to areas with higher cyclone exposure may explain the interaction between the FCC treatments and cyclone exposure. These results are complementary to Yang et al. (2023), which finds that the FCC program had substantial negative effects on HIV testing rates driven by inadvertently increased misinformation about HIV transmission methods and worsened HIV-related stigmatizing attitudes.

The remainder of the paper proceeds as follows. Section 2 discusses prior literature and the significant contributions of this study. Section 3 describes the datasets that I use and presents summary statistics. I discuss the empirical model in Section 4 and present the main findings and a discussion of the results in Section 5. Section 6 concludes.

2 Literature Review

This study contributes to the existing literature on public health policy and behavioral spillover effects. Prior work by Chaudhuri (2005) explores spillover effects of a maternal and child health program in Bangladesh. She finds improved health outcomes for both the targeted population and non-targeted elderly women in low-income treated households. Her work suggests that standard cost-benefit and cost-effectiveness analyses omit these important externalities and subsequently over- or underestimate the cost of these programs. Chaudhuri takes a unique approach to address biased treatment estimates often found in program evaluation research. She uses data from a

uniformly and randomly distributed project, whereas many prior studies had endogenous program placement.

Similarly to Chaudhuri, [Carlsson et al. \(2021\)](#) suggests that cost-benefit assessments often underestimate the economic benefits of social information programs because spillover and persistent effects of the treatment are not measured. [Carlsson et al. \(2021\)](#) measure behavioral spillovers across domains in the environment economics context. They study the effect of a social information program aimed at reducing water usage on electricity usage. Their results show that treated households already at an efficient level of water usage had a statistically significant reduction in electricity usage after the campaign. [Carlsson et al. \(2021\)](#) credit a moral concern and cognitive dissonance theory where individual's tend away from dissonance and toward consistency by reducing consumption of both water and electricity.

While this paper is thematically similar to [Chaudhuri \(2005\)](#) in that it explores the spillovers of health information programs in the developing country context, it is more methodologically similar to [Carlsson et al. \(2021\)](#) which explores behavioral spillovers and persistent effects of a treatment across domains. Both papers suggest that cost-benefit and cost-effectiveness analyses are incomplete without measuring the spillover and persistent effect of these health and social information programs. These incomplete analyses can lead to viable projects being underestimated and eliminated while costly projects get implemented.

On the other hand, [Bursztyn et al. \(2020\)](#) studies the effects of misinformation broadcast on media platforms during the COVID-19 pandemic. Using a selection-on-observables and instrumental variable approach, they find that areas in the United States with greater exposure to media that downplays the threat of COVID-19 experienced more cases and deaths. This paper differs from [Chaudhuri \(2005\)](#) and [Carlsson et al. \(2021\)](#) in that it does not explore the spillover effects of information. However, they do provide an important context that misinformation in settings with high-stakes outcomes can have harmful and serious consequences.

The main contribution of this paper is to identify spillover effects in health information programs in the developing country context. Economic research on behavioral externalities or the effects of health programs in other non-targeted domains appears to be minimal. I aim to fill this gap by looking at the persistent treatment effects of an HIV/AIDS program on household behaviors and well-being during the COVID-19 pandemic.

3 Data

This study uses data from the FCC program and a following COVID-19 study. Both projects are part of *The Economics of Health Decision Making in Mozambique* initiative at the University of Michigan. FCC treatment data comes from the FCC baseline survey which includes observations from 3,658 households in 76 communities in the provinces of Sofala, Manica and Zambezia. The baseline survey was conducted

Table 1: Summary Statistics

Statistic	N	Mean	St. Dev.	Min	Max
FCC-enrolled	2,306	0.14	0.35	0	1
FCC-ambient	2,306	0.34	0.47	0	1
Cyclone Idai Exposure	2,306	50.51	31.12	0	89.89
FCC Baseline Last Month Income	360	325.5769	755.2758	0	7916.313
FCC Baseline Last Month Income Missing	2,306	0.84	0.36	0	1
FCC Baseline OVC Controls Missing	2,306	0.50	0.50	0	1
COVID-19 Round 2 Last Week Income	2,092	11.98	26.97	0	706.81
COVID-19 Round 2 Knowledge Index	2,190	0.77	0.12	0.30	1
COVID-19 Round 2 Social Distancing	2,190	0.08	0.26	0	1
COVID-19 Round 2 Cases	2,306	35.25	51.24	0	124

Note: Income was measured in Mozambican meticaïs but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaïs per USD as of August 26, 2020.

between May 2017 and February 2018, and the endline survey was conducted between April 2019 and October 2019. Both surveys include information on household composition, income, shocks, beliefs and health. The endline survey also includes information on Cyclone Idai and displacement related to the storm. The FCC baseline survey will serve as the baseline observations when looking at household outcomes during the pandemic.

The COVID-19 data will come from the baseline COVID-19 treatment surveys conducted in 2020. The surveys include observations from 2,306 households in the same provinces as the FCC program. The first two surveys (round 1 and round 2) are pre-treatment rounds, while the latter two are post-treatment (round 3 and round 4). I will be using data from the round 2 surveys to serve as the endline results. The round 2 surveys take place before the COVID-related treatment is implemented and occurs further into the pandemic than the round 1 survey. The second round was conducted in 2020 between August 26 and October 4, almost a year following the end of the FCC study. It includes data on participant’s knowledge, beliefs, and behaviors around the virus. I will examine the effect of the FCC treatment on household income, COVID-19 knowledge and social distancing practices during the pandemic. The summary statistics for the outcome and explanatory variables of interest are presented in Table 1.

FCC-enrolled and FCC-ambient are binary variables that equal 1 for households that are enrolled in the corresponding level of treatment. FCC-enrolled households are those that were strongly encouraged to participate in the FCC program and have a high take-up rate. FCC-ambient households did not receive strong encouragement and had a community-average take-up rate. Cyclone Idai Exposure is the predicted wind speed measured in knots at each school in the study communities. FCC Baseline Last

Month Income is reported in USD and is the household’s reported level of income in the previous month. For my regressions, I account for the 1,946 missing observations by replacing them with 0 and including FCC Baseline Last Month Income Missing which is a binary variable that equals 1 if the household did not report their last month income during the survey and 0 if they did report. FCC Baseline OVC Controls Missing accounts for missing observations in the 11 OVC control variables. There were 1,154 missing observations per OVC control variable with all 11 observations being either missing or present for a single household (there were no cases where some OVC variables were missing while some were present). FCC Baseline OVC Controls Missing is a binary variable that equals 1 if the baseline controls are missing and 0 if the controls are present. Similarly to the FCC Baseline Last Month Income, I replaced missing observations with 0. Baseline OVC controls include the following: (1) an indicator for grandparent being the head of the household with a child, (2) the ratio of children to adults is greater than or equal to four, (3) has school-aged children who do not attend school, (4) eats less than two meals per day, (5) goes some days without food, (6) no source of income or the primary income source is from illegal activities, (7) has chronically ill members, (8) has an HIV positive member, (9) has a member on antiretroviral medication (ART), (10) has orphaned children, (11) has adults who have died from a chronic illness in the last five years.

The COVID-19 Round 2 Last Week Income is reported in USD and is the household’s reported level of income for the previous week. The Round 2 Knowledge Index is reported as the percent of COVID-related questions, out of 20, that the primary respondent answered correctly. These questions include topics on virus transmission and government policy. Round 2 Social Distancing is a binary variable that equals 1 if the primary respondent believes that they have been social distancing according to themselves and others, and 0 if they have not been social distancing. The COVID-19 Round 2 cases are measured at the district level.

4 Methods

In order to causally estimate the FCC’s role in mitigating COVID-19 exposure, I will run OLS and ANCOVA regression specifications. The main regression is as follows:

$$Y_{ij} = \beta_0 + \beta_1 T_{ij} + \beta_2 D_{ij} + \beta_3 P_j + \beta_4 Y_{ij}^{pre} + X'_{ij} \gamma + \epsilon_{ij} \quad (1)$$

Y_{ij} is the outcome variable for household i in community j . The primary outcome variables are household income, COVID-19 knowledge, and social distancing. T_{ij} is an indicator variable for community j being an FCC treatment community. T_{ij} is equal to 1 when community j is part of the treatment group and 0 when community j is part of the control group. D_{ij} represents the predicted wind speed (measured in knots) of Cyclone Idai for household i in community j . This serves as a cyclone exposure measure for each household. P_j is the number of COVID-19 cases at the district

level for each community j . This variable serves as the household exposure measure for COVID-19. Y_{ij}^{pre} is the pre-disaster value of dependent variable for household i in community j . This variable is only present when looking at household income as the outcome variable. There is no measure of COVID-19 knowledge or social distancing in the FCC baseline survey. Including Y_{ij}^{pre} makes this regression an ANCOVA specification. X_{ij} represents a vector of individual and household baseline (OVC) controls that account for non-random disaster exposure. These also include FCC Baseline Last Month Income Missing and FCC Baseline OVC Controls Missing to control for missing observations in the baseline control variables. ϵ_{ij} is a mean-zero error term. I cluster standard errors at the community level.

The treatment indicator, T_{ij} can be split into two variables, FCC-enrolled and FCC-ambient, which account for directly treated households and indirectly treated households. Following the initial analysis, I will examine each treatment as separate variables and will interact these treatments with Cyclone Idai exposure and COVID-19 exposure. By interacting these terms, I can examine heterogeneity in treatment effects on households with different levels of exposure to the pandemic and cyclone Idai.

5 Results

Table 2¹ displays the first set of results outlined in the methods section. I find that the FCC program has no effect on household last week income, COVID-19 knowledge, or social distancing. However, Cyclone Idai exposure is positively correlated with the household COVID-19 knowledge index and social distancing (see columns 2 and 3). On average, an increase of 1 knot of predicted wind speed during the cyclone is correlated with a 0.02 percentage point increase in the COVID-19 knowledge index and a 0.1 percentage point increase in the probability of the household social distancing. The standard deviation of the predicted wind speed is 31.12 knots, suggesting that a one standard deviation increase in the predicted wind speed leads to a 0.6 percentage point increase in the knowledge index (the average score on the knowledge index is 77%). Although the magnitude of these results is small, they do suggest that households more impacted by the cyclone may have been better prepared for or better able to respond to the pandemic. Lastly, district level COVID-19 cases are positively correlated with the household COVID-19 knowledge index (see column 2). On average, an increase of 1 COVID-19 case at the district level is correlated with a 0.03 percentage point increase in the knowledge index or a one standard deviation increase in COVID-19 cases results in a 1.1 percentage point increase in the knowledge

¹There are 214 missing observations for Last Week HH Income and 116 missing observations for Knowledge Index and Social Distancing. I check for treatment-related selection bias by regressing a binary missing variable for each outcome variable on their main regression specifications (see appendix Tables A1 and A2). I find that there is no treatment-related selection bias on Knowledge Index or Social Distancing. However, FCC-enrolled was statistically significant and negatively correlated with the missing binary variable for Last Week HH Income when interaction terms are present.

Table 2: Effect of FCC Treatment on COVID-19 Outcomes

	<i>Dependent variable:</i>		
	Last Week HH Income	Knowledge Index	Social Distancing
	(1)	(2)	(3)
Treatment	0.109 (1.266)	0.002 (0.007)	-0.005 (0.017)
Cyclone Idai Exposure	-0.014 (0.019)	0.0002* (0.0001)	0.001*** (0.0003)
COVID-19 Cases	-0.004 (0.009)	0.0003*** (0.0001)	0.00000 (0.0002)
Constant	16.094*** (2.981)	0.742*** (0.010)	0.031* (0.016)
Observations	2,092	2,190	2,190
R ²	0.013	0.049	0.022
Adjusted R ²	0.005	0.042	0.015
Residual Std. Error	26.906 (df = 2074)	0.117 (df = 2174)	0.263 (df = 2174)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticaais but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaais per USD as of August 26, 2020. The Knowledge Index is measured as the percent of COVID knowledge questions (out of 20 questions) the primary respondent answered correctly. Social distancing is a binary variable that takes the value of 1 if the primary respondent claims that they are social distancing according to themselves and others, and 0 if they are not social distancing according to themselves and others. Treatment is a binary variable that takes the value of 1 for FCC-enrolled and FCC-ambient households and 0 for households in control communities. Cyclone Idai Exposure is the predicted wind speed for each local school. COVID-19 Cases is measured at the district level.

index. This could be because households located in districts with more COVID-19 cases are likely to have more knowledge about the symptoms and transmission of the virus through friends, family, or community members.

In Table 3, I divide the FCC treatment into two variables: FCC-enrolled and FCC-ambient. This was intended to identify any differences in the effect of the varying level of treatment exposure on the three outcome variables. However, I find that both FCC-enrolled and FCC-ambient treatments have no effect on the household income, COVID-19 knowledge or social distancing. Cyclone Idai exposure and COVID-19 cases have the same effect as the previous regressions displayed in columns 2 and 3 in Table 2.

In Table 4, I explore the interaction between the FCC treatment variables and COVID-19 cases. Again, I find that FCC-enrolled and FCC-ambient treatments have no effect on the three outcome variables. There are also no statistically significant effects of the interaction terms on the outcome variables, suggesting that exposure to COVID-19 does not play a role in the relationship between the treatment and outcome variables. Cyclone Idai exposure and COVID-19 cases have the same effect

Table 3: Effect of Varying FCC Treatments on COVID-19 Outcomes

	<i>Dependent variable:</i>		
	Last Week HH Income	Knowledge Index	Social Distancing
	(1)	(2)	(3)
FCC-enrolled	1.789 (1.628)	0.0003 (0.011)	-0.018 (0.020)
FCC-ambient	-0.630 (1.387)	0.002 (0.007)	0.001 (0.019)
Cyclone Idai Exposure	-0.014 (0.019)	0.0002* (0.0001)	0.001*** (0.0003)
COVID-19 Cases	-0.004 (0.009)	0.0003*** (0.0001)	-0.00000 (0.0002)
Constant	15.980*** (3.002)	0.742*** (0.011)	0.033** (0.016)
Observations	2,092	2,190	2,190
R ²	0.014	0.049	0.022
Adjusted R ²	0.005	0.042	0.015
Residual Std. Error	26.903 (df = 2073)	0.117 (df = 2173)	0.263 (df = 2173)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticaais but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaais per USD as of August 26, 2020. The Knowledge Index is measured as the percent of COVID knowledge questions (out of 20 questions) the primary respondent answered correctly. Social distancing is a binary variable that takes the value of 1 if the primary respondent claims that they are social distancing according to themselves and others, and 0 if they are not social distancing according to themselves and others. FCC-enrolled and FCC-ambient are binary variables that take the value of 1 for direct FCC treatment and indirect FCC treatment, respectively, and 0 for households in control communities. Cyclone Idai Exposure is the predicted wind speed for each local school. COVID-19 Cases is measured at the district level.

as the previous regressions displayed in Tables 2 and 3, except I get a slightly higher p-value on the coefficient for Cyclone Idai exposure effect on COVID-19 knowledge (see columns 2 and 3).

Table 5 includes interactions between the FCC treatment variables and Cyclone Idai exposure. Again, I wanted to identify if the effect of the FCC treatments on the three outcome variables were dependent on cyclone exposure. In this case, I find a negative correlation between the FCC-enrolled treatment and the COVID-19 knowledge index (see column 2). On average, FCC-enrolled households scored 3.1 percentage points lower than control households on the COVID-19 knowledge index. This is offset by cyclone exposure, as an increase of 1 knot of predicted wind speed results in a 0.1 percentage point increase in the knowledge index for FCC-enrolled households or an increase of cyclone exposure by one standard deviation results in a 3.1 percentage point increase in the COVID-19 knowledge index, completely offsetting

Table 4: Effect of Varying FCC Treatments on COVID-19 Outcomes with COVID-19 Interactions

	<i>Dependent variable:</i>		
	Last Week HH Income	Knowledge Index	Social Distancing
	(1)	(2)	(3)
FCC-enrolled	1.513 (1.806)	-0.005 (0.013)	-0.004 (0.024)
FCC-ambient	-1.170 (1.796)	0.006 (0.009)	-0.003 (0.022)
Cyclone Idai Expsoure	-0.014 (0.019)	0.0002 (0.0001)	0.001*** (0.0003)
COVID-19 Cases	-0.011 (0.014)	0.0003*** (0.0001)	0.00002 (0.0002)
FCC-enrolled x COVID-19 Cases	0.009 (0.025)	0.0002 (0.0002)	-0.0005 (0.0003)
FCC-ambient x COVID-19 Cases	0.015 (0.020)	-0.0001 (0.0001)	0.0001 (0.0004)
Constant	16.134*** (3.017)	0.741*** (0.011)	0.034** (0.016)
Observations	2,092	2,190	2,190
R ²	0.014	0.050	0.024
Adjusted R ²	0.004	0.042	0.015
Residual Std. Error	26.914 (df = 2071)	0.117 (df = 2171)	0.263 (df = 2171)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticaais but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaais per USD as of August 26, 2020. The Knowledge Index is measured as the percent of COVID knowledge questions (out of 20 questions) the primary respondent answered correctly. Social distancing is a binary variable that takes the value of 1 if the primary respondent claims that they are social distancing according to themselves and others, and 0 if they are not social distancing according to themselves and others. FCC-enrolled and FCC-ambient are binary variables that take the value of 1 for direct FCC treatment and indirect FCC treatment, respectively, and 0 for households in control communities. Cyclone Idai Exposure is the predicted wind speed for each local school. COVID-19 Cases is measured at the district level.

the effect of the FCC-enrolled treatment. I lose the effect of Cyclone Idai exposure on the knowledge index, indicating that cyclone exposure of FCC-enrolled households was driving the cyclone effect in the previous tables. The effect of Cyclone Idai exposure on social distancing and the effect of COVID-19 cases on the knowledge index remain the same (see columns 2 and 3).

Lastly, Table 6 includes all four interaction terms presented in Tables 4 and 5. Again, I find that FCC-enrolled households score 3.2 percentage points lower on the COVID-19 knowledge index than control households. This effect is offset by Cyclone Idai exposure, where a one standard deviation increase in predicted wind speed during the cyclone led to a 3.1 percentage point increase in the COVID-19 knowledge index for FCC-enrolled households. COVID-19 also has a positive effect on the knowledge

Table 5: Effect of Varying FCC Treatments on COVID-19 Outcomes with Cyclone Interactions

	<i>Dependent variable:</i>		
	Last Week HH Income	Knowledge Index	Social Distancing
	(1)	(2)	(3)
FCC-enrolled	-1.386 (2.590)	-0.031* (0.016)	0.030 (0.030)
FCC-ambient	-0.303 (1.456)	0.001 (0.007)	0.007 (0.021)
Cyclone Idai Exposure	-0.021 (0.021)	0.0001 (0.0001)	0.001*** (0.0003)
COVID-19 Cases	-0.004 (0.009)	0.0003*** (0.0001)	-0.00001 (0.0002)
FCC-enrolled x Cyclone Idai Exposure	0.059 (0.036)	0.001** (0.0003)	-0.001** (0.0005)
FCC-ambient x Cyclone Idai Exposure	-0.015 (0.031)	0.0001 (0.0002)	-0.0003 (0.0004)
Constant	16.445*** (3.112)	0.746*** (0.010)	0.028* (0.015)
Observations	2,092	2,190	2,190
R ²	0.014	0.052	0.024
Adjusted R ²	0.005	0.044	0.016
Residual Std. Error	26.907 (df = 2071)	0.117 (df = 2171)	0.263 (df = 2171)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticalis but presented in USD using the nominal exchange rate of 70.74 Mozambican meticalis per USD as of August 26, 2020. The Knowledge Index is measured as the percent of COVID knowledge questions (out of 20 questions) the primary respondent answered correctly. Social distancing is a binary variable that takes the value of 1 if the primary respondent claims that they are social distancing according to themselves and others, and 0 if they are not social distancing according to themselves and others. FCC-enrolled and FCC-ambient are binary variables that take the value of 1 for direct FCC treatment and indirect FCC treatment, respectively, and 0 for households in control communities. Cyclone Idai Exposure is the predicted wind speed for each local school. COVID-19 Cases is measured at the district level.

index, where a one standard deviation increase in COVID-19 cases results in a 1.4 percentage point increase in the knowledge index.

These results are consistent with [Yang et al. \(2023\)](#), which finds that the FCC program had significant negative effects on HIV testing rates driven by misinformation about HIV transmission methods and worsened HIV-related stigmatizing attitudes. FCC-enrolled households also had less accurate knowledge about the transmission of the COVID-19 virus, suggesting that the FCC program had misinformation spillover effects to the COVID-19 pandemic.

The primary channel through which this misinformation spillover took place is the distrust of healthcare workers. The main component of the FCC program was home visits by FCC community workers to OVC households in treatment communities. These home visits served as an opportunity for the community workers to

Table 6: Effect of Varying FCC Treatments on COVID-19 Outcomes with Interactions

	<i>Dependent variable:</i>		
	Last Week HH Income	Knowledge Index	Social Distancing
	(1)	(2)	(3)
FCC-enrolled	-1.489 (2.624)	-0.032* (0.017)	0.035 (0.032)
FCC-ambient	-0.826 (1.892)	0.004 (0.009)	0.002 (0.024)
Cyclone Idai Expsoure	-0.021 (0.021)	0.0001 (0.0001)	0.001*** (0.0003)
COVID-19 Cases	-0.009 (0.014)	0.0004*** (0.0001)	-0.00000 (0.0002)
FCC-enrolled x Cyclone Idai Exposure	0.059 (0.037)	0.001* (0.0003)	-0.001* (0.001)
FCC-ambient x Cyclone Idai Exposure	-0.015 (0.031)	0.0001 (0.0002)	-0.0003 (0.0004)
FCC-enrolled x COVID-19 Cases	0.001 (0.025)	0.0001 (0.0002)	-0.0004 (0.0003)
FCC-ambient x COVID-19 Cases	0.014 (0.020)	-0.0001 (0.0001)	0.0001 (0.0004)
Constant	16.597*** (3.136)	0.744*** (0.011)	0.030** (0.015)
Observations	2,092	2,190	2,190
R ²	0.015	0.053	0.025
Adjusted R ²	0.004	0.044	0.016
Residual Std. Error	26.918 (df = 2069)	0.117 (df = 2169)	0.263 (df = 2169)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticaís but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaís per USD as of August 26, 2020. The Knowledge Index is measured as the percent of COVID knowledge questions (out of 20 questions) the primary respondent answered correctly. Social distancing is a binary variable that takes the value of 1 if the primary respondent claims that they are social distancing according to themselves and others, and 0 if they are not social distancing according to themselves and others. FCC-enrolled and FCC-ambient are binary variables that take the value of 1 for direct FCC treatment and indirect FCC treatment, respectively, and 0 for households in control communities. Cyclone Idai Exposure is the predicted wind speed for each local school. COVID-19 Cases is measured at the district level.

encourage HIV testing by reducing stigma concerns and sharing information about HIV/AIDS. However, [Yang et al. \(2023\)](#) suggests that the information provided at these home visits may have inadvertently led people to believe in transmission myths or increased the salience of HIV-related stigmatizing attitudes by highlighting HIV-positive households. Thus, the FCC program may have led to a general distrust in healthcare workers or the disease-related information shared by these workers. This distrust likely carried over to the COVID-19 context, where households in treated communities were more likely to believe myths about COVID-19 and disregard the relevant information shared by healthcare workers.

Even more interesting is that exposure to Cyclone Idai seems to offset the negative

effect of the FCC program on COVID-19 knowledge. While it is unlikely that Cyclone Idai had a direct effect on COVID-19 knowledge, there are several channels through which cyclone exposure could lead to more accurate COVID-19 knowledge. The primary channel is increased trust in healthcare systems and healthcare workers.

Areas impacted by the cyclone saw an immediate response from the Mozambique government and the international community. The United States and European Union responded by providing financial and in-kind support to the government of Mozambique and other intergovernmental and humanitarian aid organizations ([USAID, 2019a](#); [European Commission, 2019](#)). Médecins Sans Frontières worked with the Ministry of Health to rehabilitate damaged facilities, run mobile health clinics, shipped medical and logistical supplies, and address cholera outbreaks ([Médecins Sans Frontières, 2019](#)). UNICEF also launched the Communications for Development (C4D) initiative ([UNICEF, 2020](#)). The goal of the initiative was to help facilitate community outreach in the most devastated areas of Mozambique. It was used to provide lifesaving messages about health, nutrition, and safe sanitation and hygiene practices. C4D even played a significant role in the containment of cholera after the cyclone. The presence of foreign healthcare workers may have played a role in rebuilding trust between households and the health community. So, when the pandemic reached Mozambique, households were more trusting of the COVID-19 information and advice provided by healthcare experts. This mechanism likely drives the positive affect of Cyclone Idai exposure on the probability of a household social distancing as well.

It is also important to note that the majority of the health problems addressed after Cyclone Idai were not highly-stigmatized. As misinformation coincided with increased HIV-related stigmatizing attitudes, the presence of healthcare workers in a non-stigmatizing setting may have also helped rebuild trust in the health community.

6 Conclusion

This paper looks at the effect of the FCC program on household-level outcomes during the COVID-19 pandemic. I find that households that received FCC-enrolled treatment had less COVID-19 knowledge than control households. This aligns with the prior research on the FCC program, which found that it lowered HIV testing rates via increased HIV/AIDS misinformation and worsened stigmatizing attitudes ([Yang et al., 2023](#)). This suggests that there were medium-term persistent effects of the FCC program and spillover effects from the context of HIV/AIDS to COVID-19. I propose that the mechanism driving this effect is a decrease in trust in healthcare workers. On the other hand, I found that exposure to Cyclone Idai in the year prior to the outbreak of COVID-19 led to higher COVID-19 knowledge scores, offsetting the effect of the FCC program. While Cyclone Idai could not have directly improved COVID-19 knowledge, I suggest that an increased presence of foreign healthcare workers in a non-stigmatizing setting may have rebuilt the trust between households and the

health community.

The results in this paper suggest a direction for future research on health information programs. Whether driven primarily by distrust in healthcare workers or another mechanism, it is important to understand how the persistent effects of a program spillover across domains. Future studies should also look at the effect of the FCC or other health programs on different types of health and non-health contexts to understand the extent to which these spillovers impact people's lives. Health and social programs can be incredibly influential on individual and household well-being, especially in developing countries. Thus, it is crucial that we understand the less-obvious persistent and spillover effects of these programs to accurately assess costs and benefits.

Additionally, future research should tend toward understanding the various mechanisms that either boosted or hindered recovery from COVID-19. The challenges that Mozambique faced prior to the pandemic created unique policy challenges in mitigating the effects of the virus. It is important that policymakers have access to the necessary knowledge and tools to effectively respond to negative health shocks within varying contexts.

References

- Allen IV, J., Freitag, P., Lessitala, F., Mahumane, A., IV, J. R., Rosenblat, T., Yang, D., and Yu, H. (2020). Combatting COVID-19 in Mozambique: Round 1 Summary Report. <https://fordschool.umich.edu/sites/default/files/2021-04/covid-mozambique-round1.pdf>.
- BBC (2020). Mozambique jihadists seize key town in Cabo Delgado. <https://www.bbc.com/news/world-africa-52005899>.
- Bursztyjn, L., Rao, A., Roth, C. P., and Yanagizawa-Drott, D. H. (2020). Misinformation During a Pandemic. Working Paper 27417, National Bureau of Economic Research.
- Carlsson, F., Jaime, M., and Villegas, C. (2021). Behavioral spillover effects from a social information campaign. *Journal of Environmental Economics and Management*, 109:102325.
- Chaudhuri, A. (2005). Direct and Indirect Effects of a Maternal and Child Health Program in Rural Bangladesh. *Journal of Developing Societies*, 21(1-2):143–173.
- Egger, D., Miguel, E., Warren, S. S., Shenoy, A., Collins, E., Karlan, D., Parkerson, D., Mobarak, A. M., Fink, G., Udry, C., Walker, M., Haushofer, J., Larreboure, M., Athey, S., Lopez-Pena, P., Benhachmi, S., Humphreys, M., Lowe, L., Meriggi, N. F., Wabwire, A., Davis, C. A., Pape, U. J., Graff, T., Voors, M., Nekesa, C., and Vernot, C. (2021). Falling living standards during the COVID-19 crisis: Quantitative evidence from nine developing countries. *Science Advances*, 7(6):eabe0997.
- European Commission (2019). Cyclone Idai: 12 million EU assistance in Mozambique, Zimbabwe and Malawi. https://ec.europa.eu/commission/presscorner/detail/en/IP_19_2065.
- IMF (2021). Policy tracker. <https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19M>.
- Jimenez, M. A. and Daniel, E. (2020). Mozambique's response to COVID-19: Challenges and questions. <https://www.theigc.org/blogs/covid-19/mozambiques-response-covid-19-challenges-and-questions>.
- KFF (2023). The U.S. President's Emergency Plan for AIDS Relief (PEPFAR). <https://www.kff.org/global-health-policy/fact-sheet/the-u-s-presidents-emergency-plan-for-aids-relief-pepfar/>.
- Médecins Sans Frontières (2019). Cyclone Idai.

<https://www.doctorswithoutborders.org/what-we-do/focus/cyclone-idai>.

UNICEF (2019). Cyclone Idai and Kenneth.

UNICEF (2020). Cyclone Idai: Integration of multisectoral C4D interventions into the humanitarian response in Malawi, Mozambique and Zimbabwe.

<https://www.unicef.org/esa/media/7641/file/Cyclone-Idai-Integrating-multisectoral-C4D-interventions.pdf>.

USAID (2019a). 5 Ways the U.S. is Responding to Cyclone Idai.

<https://medium.com/usaid-2030/5-ways-the-u-s-is-responding-to-cyclone-idai-80058c153c3e>.

USAID (2019b). Mozambique: Global Health.

<https://www.usaid.gov/mozambique/global-health>.

World Bank (2023). GDP Growth (Annual %)-Mozambique.

<https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=MZ>.

Yang, D., Allen, J., Mahumane, A., Riddell, J., and Yu, H. (2023). Knowledge, stigma, and HIV testing: An analysis of a widespread HIV/AIDS program.

Journal of Development Economics, 160:102958.

Appendix

Table A1: Treatment-Related Selection Bias

	<i>Dependent variable:</i>		
	Last Week HH Income	Knowledge Index	Social Distancing
	Missing	Missing	Missing
	(1)	(2)	(3)
FCC-enrolled	-0.012 (0.017)	-0.005 (0.004)	-0.005 (0.004)
FCC-ambient	-0.006 (0.016)	-0.015 (0.012)	-0.015 (0.012)
Cyclone Idai Exposure	0.0002 (0.0002)	0.00005 (0.0002)	0.00005 (0.0002)
COVID-19 Cases	0.0003* (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
Baseline HH Income	0.00000 (0.00002)		
Baseline HH Income Missing	0.062*** (0.011)		
Baseline OVC Controls Missing	0.092*** (0.018)	0.105*** (0.011)	0.105*** (0.011)
Constant	-0.022 (0.016)	0.006 (0.008)	0.006 (0.008)
Observations	2,306	2,306	2,306
R ²	0.039	0.055	0.055
Adjusted R ²	0.031	0.048	0.048
Residual Std. Error	0.286 (df = 2287)	0.213 (df = 2289)	0.213 (df = 2289)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticaais but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaais per USD as of August 26, 2020. Last Week HH Income Missing, Knowledge Index Missing, and Social Distancing Missing are binary variables that take the value of 1 if there was no value recorded and 0 if there was a value recorded. FCC-enrolled and FCC-ambient are binary variables that take the value of 1 for direct FCC treatment and indirect FCC treatment, respectively. Cyclone Idai Exposure is the predicted wind speed for each local school. Baseline HH Income Missing takes the value of 1 for households that did not reported last month's income and 0 for those that did report in the baseline survey. COVID-19 Cases are measured at the district level. Baseline OVC Controls Missing is a binary variable that takes the value of 1 if all OVC controls were missing and 0 if all controls were present. There are no cases were only some OVC controls were missing.

Table A2: Treatment-Related Selection Bias with Interaction terms

	<i>Dependent variable:</i>		
	Last Week HH Income Missing	Knowledge Index Missing	Social Distancing Missing
	(1)	(2)	(3)
FCC-enrolled	-0.041*** (0.014)	-0.004 (0.010)	-0.004 (0.010)
FCC-ambient	-0.015 (0.024)	-0.019 (0.019)	-0.019 (0.019)
Cyclone Idai Exposure	0.0002 (0.0002)	0.00003 (0.0002)	0.00003 (0.0002)
COVID-19 Cases	0.0001 (0.0002)	-0.0001 (0.0001)	-0.0001 (0.0001)
FCC-enrolled x Cyclone Idai Exposure	0.0001 (0.0002)	-0.00003 (0.0002)	-0.00003 (0.0002)
FCC-ambient x Cyclone Idai Exposure	0.0001 (0.0004)	0.0003 (0.0002)	0.0003 (0.0002)
FCC-enrolled x COVID-19 Cases	0.001* (0.0004)	0.0001 (0.0001)	0.0001 (0.0001)
FCC-ambient x COVID-19 Cases	0.0002 (0.0003)	-0.00004 (0.0002)	-0.00004 (0.0002)
Baseline HH Income	0.00000 (0.00002)		
Baseline HH Income Missing	0.062*** (0.011)		
Baseline OVC Controls Missing	0.098*** (0.021)	0.110*** (0.014)	0.110*** (0.014)
Constant	-0.019 (0.016)	0.004 (0.009)	0.004 (0.009)
Observations	2,306	2,306	2,306
R ²	0.041	0.055	0.055
Adjusted R ²	0.032	0.047	0.047
Residual Std. Error	0.286 (df = 2283)	0.213 (df = 2285)	0.213 (df = 2285)

Note: *p<0.1; **p<0.05; ***p<0.01

Standard errors are clustered at the community level and are presented in parentheses. HH income was measured in Mozambican meticaais but presented in USD using the nominal exchange rate of 70.74 Mozambican meticaais per USD as of August 26, 2020. Last Week HH Income Missing, Knowledge Index Missing, and Social Distancing Missing are binary variables that takes the value of 1 if there was no value recorded and 0 if there was a value recorded. FCC-enrolled and FCC-ambient are binary variables that take the value of 1 for direct FCC treatment and indirect FCC treatment, respectively. Cyclone Idai Exposure is the predicted wind speed for each local school. Baseline HH Income Missing takes the value of 1 for households that did not report last month's income and 0 for those that did report in the baseline survey. COVID-19 Cases is measured at the district level. Baseline OVC Controls Missing is a binary variable that takes the value of 1 if all OVC controls were missing and 0 if all controls were present. There are no cases were only some OVC controls were missing.