Patterns of demand for non-Ebola health services during and after the Ebola outbreak: panel survey evidence from Monrovia

Appendix

Timeline of Ebola outbreak in Monrovia, Liberia:

The first cases of EVD in Liberia were confirmed in Lofa County on March 29, 2014, an area that borders Guinea, where the outbreak is believed to have originated and had first been officially declared about a week beforehand.[1] An early response was mounted, with initial cases referred to an ETU run by local government. By April 9, a total of 12 cases had been detected and from then until the end of May, there were no reported cases of the virus in Lofa County or elsewhere in Liberia and it was believed that the outbreak had been contained in Liberia[2,3]

Another Liberian case was detected on May 25, again in Lofa County, which marked the start of the second wave of the outbreak. The first case of Ebola virus in Monteserrado County (population 1.5 million inhabitants) was reported in mid-June 2014. [4] Reported cases grew progressively over the next two months, however, the reporting of new cases may have been limited by the ability of the health system to detect and diagnose new cases during this time period. The first ETU in Monrovia did not open until July 20, two more opened a month later, and the fourth opened in mid-September. [4] Other ETUs eventually opened in Liberia in October or later, but few of these ETUs treated many confirmed EVD patients. During August and early September it is believed that the number of new cases in Monteserrado County exceeded the number of new beds and during this time period patients were turned away.

It is now believed that the epidemic peaked in Monteserrado in mid to late September and dropped off rapidly in the month of October. [4] At its peak there were upwards of 350 new cases reported per week in this County alone. By early December, when the first round of this survey was conducted, the epidemic had been contained to a few clusters and while the epidemic was still ongoing, it was past peak in Monteserrado.

By early 2015, there was essentially one known cluster of EVD cases in all of Liberia, which has been identified to have started with a single patient in late December 2014 and led to 21 known cases before it came to an end in mid-February.[5] From February 19 through early March, there were no other known clusters of the outbreak in all of Liberia.[5] On March 20, 2015 a single additional case was detected in a woman in Monrovia, likely spread via sexual transmission with an Ebola survivor.[6] No further cases from this case were subsequently discovered, and Liberia was initially declared Ebola by the World Health Organization on May 9, 2015. One more isolated cluster of Ebola was detected in Liberia on June 29, 2015 when a teenaged boy who had died with EVD like symptoms subsequently tested positive for the virus. [7] It is not yet known how this cluster recurred, but the cluster has effectively been contained.

The epidemic in Liberia was characterized by intense transmission in urban settings, in particular in Monrovia, multiple community outbreaks, and spread through the health system. Approximately half of all EVD cases in Liberia would eventually be reported in Monteserrado County, ranking it among the most affected counties in Liberia.[8]

References

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4 Nyenswah TG, Westercamp M, Ashraf Kamali A, *et al.* Evidence for declining numbers of Ebola cases--Montserrado County, Liberia, June-October 2014. *MMWR Morb Mortal Wkly Rep* 2014; **63**: 1072–6.

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6 Christie A, Davies-Wayne GJ, Cordier-Lasalle T, *et al.* Possible sexual transmission of Ebola virus - Liberia, 2015. *MMWR Morb Mortal Wkly Rep* 2015; **64**: 479–81.

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8 Incident Management System Ebola Epidemiology Team,, Guinea Interministerial Committee for Response Against the Ebola Virus, World Health Organization, *et al.* Update: ebola virus disease epidemic - West Africa, December 2014. *MMWR Morb Mortal Wkly Rep* 2014; **63**: 1199–201.

Respondent selection procedures

The selection of survey respondents for the December survey followed a three-stage sampling procedure. In the first stage, 78 enumeration areas (EAs) were randomly selected from all of Monrovia's 15 administrative wards in proportion to their population size, as enumerated in the 2008 census. In the second stage, 20 households were randomly selected within each community following a random-walk procedure. Following an introduction, a single adult respondent was randomly selected for the survey from the population of adults in the selected household. Random selection within the household was done by recording each adults name on a piece of paper, folding each to conceal the name, and shuffling. After this, a volunteer from the household would select one name from the pile without looking.

Data was reviewed daily or bi-daily to check for completeness and accuracy. In addition, survey timestamps and GPS coordinates were referenced against the field manager's field reports.

Surveys were conducted on the spot or scheduled for within 48 hours. If the selected respondent was not available within 48 hours, the household was replaced.

Enumerator safety precautions

The research team worked through its in-country partner, Parley Liberia, to develop a set of safety protocols to minimize risk to Parley enumerators. First, the enumeration team avoided any community with active cases or contacts. Within communities, enumeration teams used community guides and did not visit or survey any household with an Ebola victim (past or present), suspected Ebola victim (past or present), or sick person (in the present).

Enumerators were trained to avoid physical contact and maintain a two-foot distance when interacting with respondents and community guides. Enumerators also monitored their temperatures daily, and were provided with rubber boots and hand sanitizer.

No adverse events to Parley staff or respondents occurred during survey enumeration.

Variable construction

Appendix Table 1: Variable Construction

	Description	Construction
Outcome variables		
child_sick	Sick child in HH in past 2 weeks	Coded as 1 if yes to "Have any of the children under 5 in your household had fever or cough in the past two weeks?", otherwise 0 or NA if no children under 5 in household
child_sick_care	% of sick children in HH who accessed care	In December, coded as 1 if the respondent answered affirmatively to the follow-up question "Did you go to a hospital, clinic, or other health facility?, otherwise 0 or NA if NA. In March and June, it is the average of these responses across all sick children in the household
hhmem_sick	Sick adult in HH in past 3 months	Coded as 1 if yes to "In the past 3 months, have you or anyone else in your household felt sick enough to need medical treatment?", otherwise coded as 0 or NA if NA.
hhmem_sick_care	Sick adult accessed care	Coded as 1 if yes to "did you/they seek care outside of your home for this illness?", otherwise 0 or NA if NA.
Independent variables		
known_ebola_victim_num	# of EVD victims known	The sum of known ebola victims from July to December, measured as "In JULY/AUGUST/.../DECEMBER, did any of your friends, neighbors, family, co-workers, or other people you know get Ebola or were suspected? [ENUMERATOR: IF NO, PUT 0. IF YES, ASK HOW MANY]." Capped at 99th percentile
delayed_body_removal_num	# of delayed body retrievals	Number of delayed dead body removals in community reported by respondent. Coded as 0 if No to "Since July 26 day this year, did it ever happen that dead bodies had to wait for long in your community before health workers arrived to pick them up?", if yes, coded as numeric response to "How many times did this happen?". Capped at 99th percentile.

dtig_index_01	Distrust in Government Authority	Negative affect towards government, measured as using principal components factor analysis on the following variables: "Right now, how much do you think the people in government have the heart to provide high quality HEALTH CARE to citizens, even if they have hard time to do it?" Response Options: 0-No at all; 1-A little bit; 2-Somewhat; 3-Greatly have the heart; NA-Don't know; NA-Refuse to answer | "Right now, how much do you think the people in government have the heart to provide high quality SECURITY to citizens, even if they have hard time to do it?" Response Options: 0-No at all; 1-A little bit; 2-Somewhat; 3-Greatly have the heart; NA-Don't know; NA-Refuse to answer | "Right now, how much do you think the people in government have the heart to provide high quality EDUCATION to citizens, even if they have hard time to do it?" Response Options: 0-No at all; 1-A little bit; 2-Somewhat;3-Greatly have the heart; NA-Don't know; NA-Refuse to answer | "Right now, how much do you trust the government?" Response Options: 0-Not at all; 1-Just a little; 2-Somewhat;3-A lot; NA-Don't know; NA-Refuse to answer | "Right now, how much do you trust the Ministry of Health and government health workers?" Response Options: 0-Not at all; 1-Just a little; 2-Somewhat;3-A lot; NA-Don't know; NA-Refuse to answer | "Right now, how much do you trust the Liberian National Police?" Response Options: 0-Not at all; 1-Just a little; 2-Somewhat; 3-A lot; NA-Don't know; NA-Refuse to answer; | "The Liberian government is corrupt or eating money. Agree or disagree?" Response Options: 0-Strongly disagree; 1-Disagree; 2-Agree; 3-Strongly agree; NA-Don't know; NA-Refuse to answer | "The Ministry of Health is corrupt or eating money. Agree or disagree?" Response Options: 0-Strongly disagree; 1-Disagree; 2-Agree; 3-Strongly agree; NA-Don't know; NA-Refuse to answer; | "The Liberian National Police are corrupt or eating money. Agree or disagree?" Response Options: 0-Strongly disagree; 1-Disagree; 2-Agree; 3-Strongly agree; NA-Don't know; NA-Refuse to answer;
sgovt_outreach	Exposure to government outreach	Standardized additive index of "Since July 26 day this year, how often did it happen that government workers came here to spread the word about Ebola or do other outreach?" with response option and numeric codings: 0-Never; 1-Monthly; 2-Weekly; 3-Daily; NA-Do not know.
Control variables		
female	Female	Coded from "What is your gender?"
edu_level	Education level	Response to "What is the highest level of education that you have completed?" coded as follows: 0-None; 1-Some ABC; 2-Completed ABC; 3-Some junior high; 4-Completed junior high; 5-Some high school; 6-Completed high school; 7-Some university; 8-Completed university; 88-Other
log_income7dnormal	Log of pre-Ebola income	Log +1 of "Before Ebola, in a normal week, how much money do you typically make?"
cnear_healthfac_dist_km	Distance to health clinics	Measured as straightline distance from the center of the EA to the nearest health facility (data on health facilities access at https://data.hdx.rwlabs.org/dataset/health-facilities-in-guinea-liberia-mali-and-sierra-leone on 8/01/2015).
age1825	Age 18-25	Coded from response to: How old are you? [Enumerator: If don't know, estimate]
age2635	Age 26-35	Coded from response to: How old are you? [Enumerator: If don't know, estimate]
age3645	Age 36-45	Coded from response to: How old are you? [Enumerator: If don't know, estimate]
age4655	Age 46-55	Coded from response to: How old are you? [Enumerator: If don't know, estimate]
age5665	Age 56-65	Coded from response to: How old are you? [Enumerator: If don't know, estimate]
age65	Age 65 or above	Coded from response to: How old are you? [Enumerator: If don't know, estimate]

hhsize	Household size	Coded from "The place where you sleep at night, how many people eat from your pot and sleep under your roof?"
Muslim	Muslim religion	Coded from "What is your religion?"
sdistrust_in_ngo_index		Negative affected towards INGOS, measured as the standardized additive index of the following questions and codings (which are recoded as necessary to indicate negative affect): “International NGOs are corrupt or eating money. Agree or disgree?” Response Options: 0-Strongly disagree; 1-Disagree; 2-Agree; 3-Strongly agree; NA-Don't know; NA-Refuse to answer; | “Right now, how much do you trust international NGOs?” Response Options: 0-Not at all; 1-Just a little; 2-Somewhat; 3-A lot; NA-Don't know; NA-Refuse to answer;

Other variables

sprob	Probability of being in the sample.	Equal to 1 for all December respondents. Equal to 1-Pr(Attrition | X) for March and June.
_hhmem_sick_care_clinic	Adult sought care: Clinic	1 if responded "Govt health center", "Govt health clinic", "Private doctor","Mobile clinic" to "What type of health provider did you visit? [select all that apply]"
_hhmem_sick_care_hospital	Adult sought care: Hospital	1 if responded "Govt hospital" or "Private hospital" to "What type of health provider did you visit? [select all that apply]"
_hhmem_sick_care_other	Adult sought care: Other facility	1 if responded "Other public sector" or "10-Other private medical sector" to "What type of health provider did you visit? [select all that apply]"
_hhmemsick_care_pharmacy	Adult sought care: Pharmacy	1 if responded "Pharmacy" to "What type of health provider did you visit? [select all that apply]"
_child_sick_care_clinic	Child sought care: Clinic	% of children who accessed "Govt health center", "Govt health clinic", "Private doctor",or "Mobile clinic" to "Where did you get advice or treatment for [CHILD]?"
_child_sick_care_hospital	Child sought care: Hospital	% of children who accessed"Govt hospital" or "Private hospital" to "Where did you get advice or treatment for [CHILD]?"
_child_sick_care_other	Child sought care: Other facility	% of children who accessed "Other public sector" or "10-Other private medical sector" to to "Where did you get advice or treatment for [CHILD]?"
_child_sick_care_pharmacy	Child sought care: Pharmacy	% of children who accessed "Pharmacy" to "Where did you get advice or treatment for [CHILD]?"

Extended summary statistics

Outcome variables

Appendix Table 2: Summary of health outcomes and providers used across periods

	December 2014			March 2015			June 2015		
VARIABLES	Mean	SD	N	Mean	SD	N	Mean	SD	N
Adult in HH sick in past 3 months	20%	40%	1,572	17%	38%	604	20%	40%	612
Adult sick and accessed care	47%	50%	317	96%	19%	105	94%	23%	126
Sought care: Clinic				28%	45%	101	29%	46%	119
Sought care: Hospital				57%	50%	101	56%	50%	119
Sought care: Other facility				18%	39%	101	6%	24%	119
Sought care: Pharmacy				19%	39%	101	14%	35%	119
1 or more child in HH sick in past 2 weeks	33%	47%	1,114	21%	41%	492	34%	47%	475
% of sick children in HH who accessed care	48%	50%	368	85%	36%	105	83%	37%	162
Sought care: Clinic				10%	18%	89	15%	20%	133
Sought care: Hospital				16%	22%	89	17%	22%	133
Sought care: Other facility				8%	15%	89	4%	13%	133
Sought care: Pharmacy				20%	40%	89	12%	32%	133

Independent variables

Appendix Table 3: Extended summary statistics

	December 2014			March 2015			June 2015		
	Mean	SD	N	Mean	SD	N	Mean	SD	N
Female	56%	50%	1,572	57%	50%	604	56%	50%	612
Secondary school or above education	20%	40%	1,572	21%	41%	604	21%	41%	612
Income in normal week pre-Ebola (USD)	51	73	1,572	50	69	604	52	72	612
Age	37	13	1,572	36	12	604	37	12	612
Household size	7.6	4.4	1,572	7.6	4.2	604	7.4	4.1	612
# of delayed body retrievals	0.58	1.55	1,572	0.63	1.64	604	0.57	1.57	612
# of EVD victims known	1.40	3.57	1,572	1.43	3.42	604	1.54	3.62	612
Distance to health center (km)	0.45	0.33	1,572	0.46	0.33	604	0.45	0.34	612
Working less than normal	65%	48%	1,572	76%	43%	604	68%	47%	612
Other HH member working less than normal	59%	49%	1,572	69%	46%	604	61%	49%	612
Experienced Government outreach during crisis	40%	49%	1,188	42%	49%	450	41%	49%	445
Experienced INGO outreach during crisis	66%	47%	1,188	68%	47%	450	68%	47%	445
Trusts Government	24%	43%	1,572	25%	44%	604	24%	43%	612
Trusts MOHSW	26%	44%	1,572	34%	47%	604	26%	44%	612
Trusts LNP	20%	40%	1,572	19%	39%	604	14%	34%	612
Believes Government is earnest in provision of health	15%	36%	1,572	18%	39%	604	13%	34%	612
Believes Government is earnest in provision of security	19%	40%	1,572	21%	41%	604	17%	38%	612
Believes Government is earnest in provision of education	13%	33%	1,572	26%	44%	604	18%	39%	612
Believes Government is capable in provision of health	28%	45%	1,572	52%	50%	604	44%	50%	612
Believes Government is capable in provision of security	41%	49%	1,572	53%	50%	604	46%	50%	612
Believes Government is capable in provision of education	35%	48%	1,572	53%	50%	604	45%	50%	612
Believes Government is corrupt	72%	45%	1,572	65%	48%	604	69%	47%	612
Believes MOHSW is corrupt	67%	47%	1,572	54%	50%	604	61%	49%	612
Believes LNP is corrupt	75%	43%	1,572	68%	47%	604	73%	44%	612
Trusts INGOs	72%	45%	1,572	17%	38%	604	70%	46%	612
Believes INGOs are corrupt	19%	39%	1,572	3%	18%	604	14%	35%	612

Replication data

Rawdata from the survey is available at: https://data.hdx.rwlabs.org/dataset/data-for-ebola-recovery. Replication data and accompanying STATA files will be made available publication through the Harvard Dataverse.

Supplemental analyses

Determinants of attrition

Appendix Table 5 displays the correlates of attrition using logistic regression. It indicates that low education and age cohort 18-25 positively predict attrition, but few other socio-demographic variables are statistically significant predictors (Appendix). These regressions are used to predict a respondent's probability of being surveyed in March and June, respectively. To account for differential attribution probabilities, weights for June and March observations are equal the inverse of the probability of successful follow-up. This ensures that they are representative of the December sample. However it weights all follow-up observations as greater than 1 (the default weight for the December sample). To correct for this, follow-up weights are rescaled to have a mean of 1. The use of weights or no weights has no material effect on the results.

Appendix Table 5: Determinants of attrition

	(1)	(2)
VARIABLES	Attrition in March	Attrition in June
edu_level	1.13	1.14
	[0.03]***	[0.04]***
Log of preEbola HH income+1	0.92	1.03
	[0.05]	[0.05]
age2635	0.91	1.45
	[0.25]	[0.27]*
age3645	1.56	1.59
	[0.44]	[0.328]**
age4655	1.17	1.73
	[0.44]	[0.430]**
age5665	0.66	1.71
	[0.27]	[0.604]
age65	0.73	2.06
	[0.34]	[0.89]*
Household size	1.03	0.98
	[0.02]	[0.02]
Muslim	0.73	0.87
	[0.14]	[0.17]
Constant	2.31	0.88
	[0.86]**	[0.27]
Observations	774	928

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1 Logistic regression with Odds Ratios reported (OR). Standard errors clustered by enumeration area. Estimates weighted by inverse attrition probabilities. Variation in sample size across models is due to either applicability or non-response (See Appendix for details)

Robustness of Table 2 in main article to alternative models

Appendix Table 5 shows that the estimates are consistent across models. For each outcome and independent variable, we present specifications with 1) no fixed effects and no individual-level controls, 2) Ward fixed effects and no individual-level controls, and 3) Ward fixed effects and controls. Below, we draw on Oster (2015) to show how this is indicative of results that are robust to omitted variables bias.

Appendix Table 5: Experiences during the EVD outbreak and usage-Alternative models

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	% of sick children in HH who accessed care			% of sick children in HH who accessed care			% of sick children in HH who accessed care			% of sick children in HH who accessed care		
Late Crisis Period												
Distrust in Govt Authority (std)	-0.11	-0.103	-0.1									
	[0.025]***	[0.026]***	[0.027]***									
# of delayed body retrievals				-0.032	-0.03	-0.028						
				[0.008]***	[0.010]***	[0.010]***						
# of EVD victims known							-0.016	-0.015	-0.012			
							[0.005]***	[0.005]***	[0.006]**			
Exposure to Govt Outreach (std)										0.162	0.156	0.143
										[0.029]***	[0.030]***	[0.032]***
Post Crisis Period												
Distrust in Govt Authority (std)	-0.018	-0.004	-0.003									
	[0.032]	[0.031]	[0.031]									
# of delayed body retrievals				0.001	0	-0.002						
				[0.011]	[0.010]	[0.011]						
# of EVD victims known							-0.002	0	-0.001			
							[0.006]	[0.006]	[0.007]			
Exposure to Govt Outreach (std)										0.004	0.005	-0.006
										[0.026]	[0.025]	[0.025]
Observations	611	606	606	635	630	630	635	630	630	461	456	456
Round fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ward Fixed Effects	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
Control variables	N	N	Y	N	N	Y	N	N	Y	N	N	Y
R-squared	0.173	0.208	0.259	0.156	0.195	0.248	0.156	0.195	0.246	0.246	0.268	0.327

Appendix Table 5 (continued): Determinants of health service usage during the late and post crisis periods - Robustness to alternative models

	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Adult sick and accessed care			Adult sick and accessed care			Adult sick and accessed care			Adult sick and accessed care		
Late crisis period												
Distrust in Government	0.75	0.72	0.77									
	[0.102]**	[0.101]**	[0.156]									
# of delayed body retrievals reported				0.75	0.74	0.75						
				[0.060]***	[0.070]***	[0.100]**						
# of EVD victims known							0.92	0.92	0.89			
							[0.031]**	[0.029]***	[0.049]**			
Experienced Government outreach during crisis										2.79	2.73	2.94
										[0.567]***	[0.667]***	[1.018]***
Post-crisis period												
Distrust in Government	0.68	0.67	0.49									
	[0.207]	[0.263]	[0.259]									
# of delayed body retrievals				0.85	0.74	0.58						
				[0.163]	[0.121]*	[0.176]*						
# of Ebola victims known							0.92	0.93	0.9			
							[0.068]	[0.059]	[0.072]			
Experienced Government outreach during crisis										1.9	2.64	3.64
										[1.130]	[1.930]	[2.990]
Observations	528	528	407	548	548	425	548	548	425	395	386	296
Round fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ward fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Control variables	N	Y	Y	N	Y	Y	N	Y	Y	N	Y	Y
Enumeration area fixed effects	N	N	Y	N	N	Y	N	N	Y	N	N	Y

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1 Logistic regression with Odds Ratios (OR) reported. OR standard errors clustered by enumeration area. Estimates weighted by inverse attrition probabilities. Variation in sample size across models is due to either applicability or non-response.

Alternative determinants of health seeking behavior

Appendix Table 6 shows that alternative determinants of health seeking behavior, including distance to health centers pre-Ebola income, trust in INGOs, or generalized trust, have modest and inconsistent associations with usage across periods and outcomes. The regression model is the same as that reported in Table 2 in the main article.

Appendix Table 6: Alternative determinants of usage during the late and post crisis periods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	% of sick children in HH who accessed care						Adult sick and accessed care					
Late-crisis period												
Education level	1.01						1.05					
	[0.050]						[0.062]					
Log of preEbola household income		1.15						0.91				
		[0.132]						[0.121]				
Log of income past 7 days + 1			0.96						0.87			
			[0.092]						[0.098]			
Distance to health center (km)				0.75						0.25		
				[0.247]						[0.172]**		
Distrust in INGOs					0.82						1.22	
					[0.137]						[0.232]	
Experienced INGO outreach during crisis						1						1.36
						[0.152]						[0.255]*
Post-crisis period												
Education level	0.99						1.06					
	[0.093]						[0.122]					
Log of preEbola household income		1.08						0.78				
		[0.207]						[0.129]				
Log of income past 7 days + 1			1						1.2			
			[0.103]						[0.249]			
Distance to health center (km)				0.98						10.22		
				[0.687]						[22.806]		
Distrust in INGOs					0.73						0.89	
					[0.166]						[0.659]	
Experienced INGO outreach during crisis						1						0.46
						[0.272]						[0.238]
Observations	635	635	635	635	635	450	548	548	548	548	548	386
Control variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Ward fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Round fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1 Logistic regression with Odds Ratios (OR) reported. OR standard errors clustered by enumeration area. Estimates weighted by inverse attrition probabilities. Variation in sample size across models is due to either applicability or non-response

Experiences during the outbreak and trust in government during the outbreak

Appendix Table 7 shows that exposure to the Ebola outbreak, as measured by observing dead bodies or knowing victims, negatively associates with trust in government, but only in the late-crisis period. Similarly, government outreach associates positively with trust, primarily in the crisis period. We interpret this as suggestive that these experiences affected utilization of health services partially through their impact on trust in government.

Appendix Table 7: Experiences during the outbreak and trust in government

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Distrust in Govt Authority (std)			Distrust in Govt Authority (std)			Distrust in Govt Authority (std)		
# of delayed body retrievals x Late Crisis	0.119	0.126	0.121						
	[0.014]***	[0.015]***	[0.016]***						
# of delayed body retrievals x Post Crisis	0.014	0.02	0.015						
	[0.016]	[0.016]	[0.017]						
# of EVD victims known x Late-Crisis				0.044	0.046	0.042			
				[0.008]***	[0.008]***	[0.007]***			
# of EVD victims known x Post-Crisis				0.008	0.009	0.006			
				[0.010]	[0.010]	[0.010]			
Exposure to Govt Outreach (std) x Late-Crisis							-0.198	-0.206	-0.177
							[0.029]***	[0.029]***	[0.029]***
Exposure to Govt Outreach (std) x Post-Crisis							-0.052	-0.066	-0.063
							[0.038]	[0.036]*	[0.037]*
Constant	0.097	0.088	-0.249	0.106	0.097	-0.184	0.193	0.188	-0.062
	[0.027]***	[0.028]***	[0.175]	[0.028]***	[0.028]***	[0.177]	[0.029]***	[0.030]***	[0.207]
Observations	2,674	2,640	2,640	2,674	2,640	2,640	2,007	1,973	1,973
Ward Fixed Effects	N	Y	Y	N	Y	Y	N	Y	Y
Control variables	N	N	Y	N	N	Y	N	N	Y
R-squared	0.065	0.08	0.145	0.06	0.074	0.139	0.071	0.092	0.159

*** $p<0.01$, ** $p<0.05$, * $p<0.1$. Estimates via OLS. Explanatory variables measured in late-crisis period. Standard errors clustered by respondent. Estimates weighted by inverse probability of attrition. Variation in sample size across models is due to either applicability or non-response.

Balance tests

Appendix Table 8 shows the determinants of EVD experiences and exposure to government outreach to assess whether they appear to be balanced on observable variables. Broadly, these experiences appear relatively balanced, albeit with a few exceptions. Knowing Ebola victims was more common among those with higher education; females were less likely to report knowing about delayed retrieval of dead bodies or experiencing outreach. In Table 2 in the article, we control for these sources of imbalance. In the next section, we assess whether unobserved omitted variables are confounding .

Appendix Table 8: Balance

	(1)	(2)	(3)
	Knows EVD victims (# of people)	Delayed body retrieval (# of occurrences)	Standardized values of (govt_patrol)
Female	-0.039	-0.269	-0.313
	[0.274]	[0.101]***	[0.091]***
edu_level	0.146	0.014	-0.027
	[0.073]**	[0.031]	[0.023]
Log of preEbola HH income+1	0.051	0.067	0.016
	[0.183]	[0.056]	[0.037]
Distance to health center (km)	-0.836	-0.358	-0.111
	[0.861]	[0.330]	[0.189]
age1825	0.519	-0.014	-0.115
	[0.799]	[0.375]	[0.219]
age2635	0.403	0.084	-0.273
	[0.702]	[0.350]	[0.180]
age3645	-0.264	0.033	-0.102
	[0.776]	[0.385]	[0.187]
age4655	-0.247	0.386	-0.092
	[0.974]	[0.567]	[0.209]
age5665	0.78	-0.231	-0.056
	[1.071]	[0.500]	[0.242]
age65	0.193	0.043	-0.236
	[1.065]	[0.323]	[0.246]
Household Size	0.044	0.012	-0.005
	[0.044]	[0.015]	[0.014]
Muslim	1.029	0.256	-0.16
	[0.996]	[0.246]	[0.204]
Constant	1.14	0.744	0.458
	[1.012]	[0.359]**	[0.268]*
Observations	945	945	690
R-squared	0.063	0.105	0.108

*** p<0.01, ** p<0.05, * p<0.1. Estimates via OLS. Sample includes respondents who reported a sick member in any survey round. Standard errors clustered by neighbourhood; ward fixed effects included but not shown. Variation in sample size across models is due to applicability; non-response; or in the case of outreach; questions were not included until 10 days after the survey began.

Sensitivity to unobserved omitted variables

This section uses selection on observables to assess the potential bias from unobserved omitted variables, following (Oster, 2015). The idea is to use the bias eliminated by observed covariates to assess the potential bias of unobserved, omitted variables.

Consider the following linear regression models:

$$Y = \beta X + \gamma W_1 + \alpha W_2 + \epsilon \qquad (1)$$

$$Y = \tilde{\beta} X + \tilde{\gamma} W_1 + \epsilon \qquad (2)$$

$$Y = \dot{\beta} X + \epsilon \qquad (3)$$

where β, the effect of some treatment X, is the coefficient of interest, W_1 is a matrix of observed control variables, and W_2 is a set of unobserved control variables. Equation refers to the true model and returns an unbiased estimate of β. Equation (2) consists of the full set of observed control variables. Estimates of $\tilde{\beta}$ will be biased unless W_2 is uncorrelated with either X, Y, or both. Equation (3) is a naive model. Estimates of $\dot{\beta}$ will be more biased than those of $\tilde{\beta}$.

The Oster approach uses coefficient movements between the naive estimate ($\dot{\beta}$) and the controlled estimate ($\tilde{\beta}$) combined with movements in R-squared values to gauge the degree of potential omitted variables bias. Heuristically, estimates that move little with the inclusion of control variables that cause substantial increases in R-squared are indicative of limited omitted variables bias. The approach relies on two assumptions. The first assumption is the so-called ``coefficient of proportionality", δ, which is degree to which the observed controls (W_1) determine treatment relative to the unobserved (W_2). δ =1 allows the unobserved controls to be as influential as the observed controls. This assumption is likely to hold when the observed controls are among the strongest determinants of treatment.

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The second assumption is the maximum R-squared value (R^2_{max}) from the hypothetical estimation of Equation (1), the true model. R^2_{max} and $R^2_{controlled}$ (from Equation (2)) determine the explanatory power of unobserved omitted variables after accounting for the observed control variables. In the presence of measurement error or idiosyncratic variation in the outcome, $R^2_{max} < 1$.

Oster (2015) shows that with assumptions about R^2_{max} and δ it is possible to use coefficient movements in β between the naive and controlled regressions to calculate the potential bias from omitted variables. This results in an identified set, bounded on one side by the controlled estimate and on the other by the bias-adjusted estimate, which contains the unbiased estimate. A result is deemed robust if the identified set excludes zero.

Note that using coefficient stability between Equations (2) and (3) to argue for causality is equivalent to arguing treatment is *unconditionally* exogenous: $\dot{\beta}$ varies little from $\tilde{\beta}$ because W_1 does not confound. And because W_1 does not confound, W_2 is also unlikely to confound (especially when we believe W_1 constitutes the strongest determinants of treatment). The framework can easily be extended to the case where treatment is believed to be exogenous only after conditioning on a set of control variables, M. In this case, the variables in equations (1)-(3) are first residualized with respect to M (equivalently, M is included in equations (1)-(3)).

How to select conservative values for R^2_{max} and δ ? (Oster, 2015) re-analyzes experimental studies to identify conservative values of R^2_{max} and δ under which a non-zero bias-adjusted effect would be consistent with exogenous treatment assignment. These parameter values are then recommended as a robust reporting standard. The intuition of this test follows from the discussion above: observational studies implicitly argue that the treatment is exogenous. Including controls should not change the coefficient because there is no confounding. In experimental studies, this assumption is known to hold. Control variables will still influence the coefficient estimate due to idiosyncratic imbalance across groups. Thus it is possible to use the stability of treatment estimates in randomized data as a guide to how much stability would be expected in observational data if the treatment were assigned exogenously. To do so, Oster (2015) draws on a large sample of randomized studies published in *American Economic Review*, *Quarterly Journal of Economics*, Journal of Political Economy, *Econometrica* and the *American Economic Journal – Applied Economics* from 2008 through 2013.

Oster 2015 assumes the effects estimated in randomized data are causal and that they should therefore survive the bias-adjustment procedure. Robustness cutoff values are based on the value of R^2_{max} and δ under which the bias-adjusted effect is distinct from zero in 90\% of experimental studies. This leads to the values of $R^2_{max} = 1.3 * R^2_{controlled}$ and $\delta = 1$, Substantively, this assumes un-observables explain as much of the variation in treatment as the observables and explain 30% of the variation in the outcome explained by the included controls. For full details, see Oster (2015).

In our set-up, we're interested in the potentially causal varibales from Table 2: knowing ebola victims, observing dead bodies, and exposure to government outreach. W_1 includes the full set of covariates reported in Table 2, including village ward effects, W_2 is the set of all unobserved confounders, and M includes indicators for each survey round. Our test is conservative in that we exceed Oster's recommended standards for robustness by setting $R^2_{max} = 2 * R^2_{controlled}$ and δ =1 (rather than $R^2_{max} = 1.3 * R^2_{controlled}$ and $\delta = 1$). Substantively, this sets unobservables to be as influential as the full set of control variables (including fixed effects) in explaining both the outcome and treatment.

The results of this sensitivity analysis are presented below. The first column shows the baseline effect of the variables in Table 2 on the outcome, estimated from a regression of the outcome on the variable of interest and survey round indicators. The second column presents estimates of the fully controlled effect, reported in Table 2 in the main article. The third and fourth columns show the bias-adjusted effect and identified set under Oster (2015)'s recommended standards for robustness ($R^2_{max} = 1.3 * R^2_{controlled}$ and $\delta = 1$). Under this level of confounding, the identified sets exclude zero. The fifth and sixth columns show the bias adjusted effect and identified set assuming $R^2_{max} = 2 * R^2_{controlled}$ and $\delta = 1$. Even under this level of confounding, the identified sets exclude zero. Substantively, the results of this exercise indicate that omitted unobservables would have to be substantially more confounding than observables to reduce effect sizes to zero.

References

Oster, E. (2015). Unobservable Selection and Coefficient Stability: Theory and Evidence. *Brown University Working Paper*

Appendix Table 9: Sensitivity to Unobserved Omitted Variables Bias via Oster 2015

Effect	Baseline effect (Std. Error) [R^2]	Controlled effect from Table 2 (Std. Error) [R^2]	Robust Effect R^2_{max} = 1.3 x controlled R^2	Identified Set R^2_{max} = 1.3 x controlled R^2	Robust Effect R^2_{max} = 2 x controlled R^2	Identified Set R^2_{max} = 2 x controlled R^2
# of delayed body retrievals on *% of sick children who access care*	-0.032 (0.008) [0.156]	-0.029 (0.01) [0.238]	-0.027	[-0.029,-0.027]	-0.021	[-0.029,-0.021]
# of delayed body retrievals on *Adult sick and accessed care*	-0.043 (0.008) [0.314]	-0.048 (0.008) [0.407]	-0.053	[-0.048,-0.053]	-0.069	[-0.048,-0.069]
# of EVD victims known on *% of sick children who access care*	-0.016 (0.005) [0.156]	-0.012 (0.006) [0.235]	-0.010	[-0.012,-0.01]	-0.003	[-0.012,-0.003]
# of EVD victims known on *Adult sick and accessed care*	-0.016 (0.005) [0.302]	-0.016 (0.005) [0.39]	-0.016	[-0.016,-0.016]	-0.017	[-0.016,-0.017]
Govt Outreach (std) on *% of sick children who access care*	0.162 (0.029) [0.246]	0.144 (0.032) [0.317]	0.124	[0.144,0.124]	0.066	[0.144,0.066]
Govt Outreach (std) on *Adult sick and accessed care*	0.221 (0.027) [0.4]	0.189 (0.032) [0.475]	0.137	[0.189,0.137]	0.002	[0.189,0.002]

Notes: The first columns show the baseline effect from a regression of the outcome on the explanatory variable of interest and round fixed effects only. The second column presents estimates of the fully controlled effect, reported in Table 2 in the main article. The third and fourth columns show the bias-adjusted effect and identified set under the standards for robustness (R_max^2=1.3*R_controlled^2 and δ=1) derived in Oster 2015's validation exercise. The fifth and sixth columns show the bias adjusted effect and identified set assuming R_max^2=2*R_controlled^2equal to 2 times the fully controlled R^2and δ=1. This degree of robustness substantially exceeds that of the validation exercise.