



## Threats to oral polio vaccine acceptance in Somalia: Polling in an outbreak



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### ABSTRACT

**Background:** Using a survey conducted during the 2013–2014 polio outbreak in Somalia, this study examines attitudinal and knowledge-based threats to oral polio vaccine acceptance and commitment. Findings address a key gap, as most prior research focuses on endemic settings.

**Methods:** Between November 19 and December 21, 2013, we conducted interviews among 2003 caregivers of children under 5 years in select districts at high risk for polio transmission. Within each district, sample was drawn via a multi-stage cluster design with random route household selection. We calculated the percentage of caregivers who could not confirm recent vaccination and those uncommitted to future vaccination. We compared these percentages among caregivers with varying knowledge and attitudes, focusing on variables identified as threats in endemic settings, using controlled and uncontrolled comparisons. We also examined absolute levels of threat variables.

**Results:** Only 10% of caregivers could not confirm recent vaccination, but 32% were uncommitted to future vaccination. Being unvaccinated or uncommitted were related to multiple threat variables. For example, compared with relevant counterparts, caregivers were more likely to be unconfirmed and uncommitted if they did not trust vaccinators “a great deal” (unconfirmed: 9% vs. 2%; uncommitted: 49% vs. 28%), which is also true in endemic settings. Unlike endemic settings, symptom knowledge was related to commitment while rumor awareness was low and unrelated to past acceptance or commitment. Levels of trust and perceptions of OPV effectiveness were high, though perceptions of community support and awareness of logistics were lower.

**Conclusions:** As in endemic settings, outbreak responses will benefit from communications strategies focused on enhancing trust in vaccinators, institutions and the vaccine, alongside making community support visible. Disease facts may help motivate acceptance, and enhanced logistics information may help facilitate caregiver availability at the door. Quelling rumors early may be important to prevent them from becoming threats.

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**Abbreviations:** OPV, Oral Polio Vaccine; HSPH, Harvard T.H. Chan School of Public Health; NMC, Northern Management Consultants; MoPH, Ministry of Public Health; GPEI, Global Polio Eradication Initiative.

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## 1. Introduction

In 2013–2014, there were outbreaks of poliovirus in seven previously polio-free countries [1]. Such outbreaks pose a critical threat to eradication efforts, and it is essential to learn lessons from these experiences in order to prepare effective response efforts in case of future outbreaks [2,3].

When there is an outbreak, door-to-door provision of oral polio vaccine (OPV) to at-risk children is the cornerstone of response [4]. Multiple rounds of vaccination are required during the outbreak, and after it may appear to be over to the public. Vaccination campaigns require intense operations in areas that are often low-infrastructure and security-compromised, whilst appealing to parents and other caregivers in a way that will motivate vaccine acceptance during the outbreak and continued commitment [4,5]. It is therefore critical to understand attitudinal and knowledge-based threats to caregivers' OPV acceptance and commitment during an outbreak so these learnings can be applied through program design and community engagement in future.

While there is evidence about attitudinal and knowledge-based threats in endemic settings, less is known about them in an outbreak context [6–14]. It is plausible that some threats present in an endemic context are exacerbated during an outbreak. For example, distrust in vaccinators (trained persons or community health workers who deliver OPV) could be higher as caregivers are less familiar with the process [15,16]. Other attitudinal threats – like limited concern – may be reduced because more parents may be concerned about a seemingly new disease [17].

To learn more about these core issues, we consider the 2013–2014 poliovirus outbreak in Somalia. Polio-free for the prior six years, Somalia hosted nearly 200 cases – the largest number among outbreak countries in this time period [3]. Somalia exemplifies the challenges of outbreaks due to its limited health care infrastructure and sizable security issues [18,19].

We examine results from a survey among caregivers of children under 5 living in areas at high risk for polio transmission during the outbreak time period. As far as we are aware, this was the only quantitative survey of caregiver knowledge and attitudes done during this time. We first examine the levels of recent OPV acceptance and commitment to doing so in future. Second, we assess whether previously identified threats to past acceptance and commitment in endemic settings are also threats in an outbreak setting. Third, we examine the levels of these threats. Finally, we discuss implications for communication and community engagement efforts at the time and for future outbreak response.

## 2. Methods

### 2.1. Study design and sample

Data come from a poll among a randomly selected sample of caregivers of children under age 5 within research-accessible districts of Somalia at high risk for polio transmission. Caregivers were primarily parents, but also included other adults in a household with responsibility for decisions about the child's health.

Researchers at the Harvard T.H. Chan School of Public Health (HSPH) and UNICEF staff developed the overarching design, questionnaire and analysis of the poll, together with input at all stages from other polio eradication partners. Fieldwork and data entry were completed by InterMedia (Washington, DC, USA), Oxford Research International (Oxford, UK) and Northern Management Consultants (NMC) (Mogadishu, Somalia). InterMedia and Oxford Research provided implementation support, field team training, and independent quality checks on fieldwork and data (Appendix).

Data management and weighting were done by SSRS (Glen Mills, PA, USA), with final statistical analyses conducted by a consultant. The Ministry of Public Health (MoPH) in each of the three political-geographic zones that existed at the time (South Central, Somaliland and Puntland) approved the study. Because HSPH researchers were not directly involved in data collection and de-identified datasets were used for analysis, the study was declared “not human subjects research” by HSPH's Office of Human Research Administration.

Given the security risks for collecting data, a set of nine districts were purposefully selected and then randomized selection was utilized to draw the sample in each one. To select districts, UNICEF developed a list of districts with the highest number of cases during the outbreak and/or chronically low polio vaccination rates, using input from other partners in the Global Polio Eradication Initiative (GPEI) working in Somalia and each MoPH. Additionally, these districts met feasibility criteria including: free from immediate, major security concerns; semi-urban or urban; supporting UNICEF work for at least one year prior; and accessible by NMC interviewers. Final districts included: Afgooye, Baidoa, Borama, Bosaso, Burao, Galkayo, Garowe, Hargeisa, and Mogadishu. Within Mogadishu, data on polio transmission allowed focus on two sub-districts: Daynile and Hodan.

In the absence of reliable population census data and in consideration of the security risks of household enumeration, sample was drawn within each district via a multi-stage cluster design with random route household selection [20]. To minimize clustering often associated with random route approaches, starting points were selected randomly using squares (250 m by 250 m) in a grid overlaid on a satellite image of each district. Each starting point led to the selection of between seven and ten households to further minimize the impact of clustering (Appendix). In each selected household, one caregiver and one reference child for whom they have responsibility were randomly selected using Kish grids. Trained interviewers from the local regions conducted interviews between November 19 and December 21, 2013. Interviews were conducted in Somali using pencil and paper rather than with tablets due to security concerns and the desire to minimize respondents' perceptions of any socio-economic differences between interviewers and themselves. Data entry utilized Remark Office software to scan specially formatted response sheets and to provide additional quality assurance and speed in the process.

### 2.2. Procedures

The questionnaire included 48 questions covering four areas of threats to vaccination identified in endemic settings: knowledge and perceptions of polio [6–9]; perceptions of OPV (polio drops) and awareness of negative rumors [10,11]; perceptions of vaccination experience [12,13]; and awareness of communications related to logistics of delivery [14]. The questionnaire was translated into Somali, back-translated, refined with considerations of cultural norms by NMC staff, and pre-tested with caregivers (question wording in tables).

### 2.3. Statistical analyses

To compensate for possible non-response biases, data in each district were weighted by sex and age of caregivers using household rosters and by sex of child discussed in the interview using estimates of sex ratios for children under 5 years [21] (Appendix).

For analysis, we first calculated the percentage of caregivers who confirmed their child had received OPV in the last campaign they remembered (“confirmed”) and those who could not confirm

this (“unconfirmed”) because vaccinators came but their child did not receive OPV (or were unsure) or vaccinators did not come (or were unsure), and those who had never heard of polio. We also calculated the fraction who said they intended to accept OPV “every time” vaccinators offered until the child was 5 years old (“committed”) and those who did not (“uncommitted”).

Second, we assessed whether the attitudinal, knowledge- and communications-related variables identified previously as threats to vaccination in an endemic context were associated with unconfirmed vaccination and/or lack of commitment to vaccination here. Using pairwise *t* tests of differences in proportions, we made uncontrolled comparisons of the percentage of unconfirmed caregivers across groups with different knowledge and attitudes, such as those who were “very concerned” their child would get sick with polio and those who were not. We then conducted parallel comparisons using regressions that controlled for differences in demographics (age, sex and education level of caregiver; number of children in household; and age of child). We repeated analyses for the uncommitted metric.

Differences with *p*-values below the 0.05 level were considered statistically significant. All statistically significant differences for uncontrolled comparisons are shown in the tables, while full regression models are shown in the appendix. Only differences that were statistically significant after controlled comparisons and were at least five percentage points were considered to be robust and have practical implications for communications in this outbreak setting and are therefore discussed in the text. Differences meeting both criteria are bolded in the tables for ease of reference.

For groups defined by their responses to attitudinal or knowledge questions on Likert scales, the variable was dichotomized such that analyses focus on differences between caregivers who gave the response at the end of the scale, such as “very concerned”, compared with those who gave all other responses, such as “somewhat concerned”, “not very concerned” or “not at all concerned”. Using responses at the end of the scale has been shown to be a better predictor of behavior than other response combinations in vaccine-related and political science polling literature [22–26].

These latter analyses focused on caregivers who were aware of polio, which included 98% of respondents. Those not aware of polio were not asked subsequent questions about the illness or vaccination in order to prevent respondent confusion and to reduce security risks for interviewers. Thus, they could not be classified as “confirmed” in accepting OPV or “committed” to doing so (Appendix).

Third, we calculated the fraction of caregivers that reported each potential threat. Estimates reflect the average across selected districts. Had reliable population estimates been available, each district’s contribution to the estimate could have been weighted in proportion to its overall population. However, in the absence of such information, each district was treated as an equal entity, and the estimate was an equally weighted average of the corresponding district estimates.

Analyses were conducted in R version 3.1.3 and survey package version 3.30-3. Key features of the sampling design, including weights, were incorporated into all analyses. Variances were estimated with the Taylor linearization method. All tests accounted for variance introduced by weighted data.

### 3. Results

The poll included 2003 interviews with a response rate of 83%.

#### 3.1. Demographics

Approximately two-thirds of caregivers (65%) were female (Table 1), and the vast majority (82%) were parents. Caregivers were evenly divided between age groups of 25–34 (41%) and 35 and older

**Table 1**  
Demographics.

		% (n = 2003)
Sex	Male	35%
	Female	65%
Relationship to child	Parent (mother/father)	82%
	Other	18%
Age of respondent (years)	<25	18%
	25–34	41%
	35+	41%
Education	No formal education	56%
	Primary and intermediate	26%
	Secondary or more	18%
Number of children in household	1–2	35%
	3–4	36%
	5+	29%
Age of reference child (years)	≤2	61%
	3–4	39%

Note: Responses of don’t know or not applicable not shown where 1% or less.

**Table 2**  
Confirmed vaccination and commitment to OPV.

	%
The last time vaccinators were in your neighborhood, did they or did they not come to your home?	(n = 2003)
The last time vaccinators came to your home, did [child] receive polio drops or not?	
Confirmed child received drops during last campaign (“Confirmed”)	88%
Could not confirm child received drops during last campaign (“Unconfirmed”)	10%
Vaccinators did not come during last campaign	3%
Vaccinators have never come to this neighborhood	2%
Don’t know if vaccinators came during last campaign	0%
Vaccinators came during last campaign, but child did not receive drops	3%
Vaccinators came during last campaign, but don’t know if child received drops	1%
Have not heard of polio	2%
By the time [child] reaches [his/her] 5th birthday, how often do you intend to have vaccinators give [child] polio drops?	(n = 2003)
Every time polio drops are offered (“Committed”)	66%
Not every time polio drops are offered (“Uncommitted”)	32%
Most of the times polio drops are offered	18%
Just a few of the times polio drops are offered	9%
Only once	2%
Do not intend to give polio drops ever	2%
Don’t know	2%
Have not heard of polio	2%

(41%), with few younger than 25 (18%). More than half (56%) had no formal education. Approximately a third (35%) had households with 1 or 2 children; similar fractions had 3–4 (36%) or 5 or more (29%). Nearly two-thirds (61%) discussed a child age 2 or under while the remaining fraction (39%) discussed a child age 3–4.

### 3.2. Confirmed vaccination and commitment to OPV

The vast majority of caregivers (88%) confirmed their child received OPV during the last campaign (Table 2). A tenth (10%) were unconfirmed. Two-thirds (66%) were committed to accepting OPV “every time” offered in the future while the remaining third (32%) were not.

### 3.3. Relationship of threat variables to unconfirmed vaccination and lack of commitment

There was a limited relationship between knowledge of polio and confirmed recent vaccination or commitment (Table 3). Those who did not name paralysis as a symptom were more likely to be uncommitted (39% vs. 30%), though not more likely to be unconfirmed, than those who did. Perceptions of polio were associated with lack of commitment though not with unconfirmed vaccination. Those who did not believe polio would be “very serious” or were not “very concerned” were more likely to be uncommitted than their counterparts (44% vs. 32% and 48% vs. 27%, respectively).

**Table 3**

Relationship of threat variables to unconfirmed vaccination and lack of commitment.

	Unconfirmed % (n)	p-value	Uncommitted % (n)	p-value
<b>Knowledge and perceptions of polio</b>				
If [child] were to get sick with polio, what symptoms could [child] get?				
Named paralysis as a symptom	9% (1377)	0.1673	<b>30% (1377)</b>	0.0033
Did not name paralysis as a symptom (Don't know any symptoms; Paralysis is not a symptom)	12% (569)		<b>39% (569)</b>	
Would this [paralysis of the arms and/or legs] be curable or not?				
Paralysis would not be curable	11% (785)	0.0227	32% (785)	0.2033
Paralysis would be curable	7% (544)		28% (544)	
If [child] were to get sick with polio, would that sickness be serious or not serious?				
Very serious	11% (1779)	0.2249	<b>32% (1779)</b>	0.0119
Not “very serious” (Somewhat serious; Not very serious; Not at all serious; Don't know)	7% (167)		<b>44% (167)</b>	
Are you concerned or not concerned that [child] will get sick with polio this year?				
Very concerned	10% (1337)	0.7922	<b>27% (1337)</b>	<0.0001
Not “very concerned” (Somewhat concerned; Not very concerned; Not at all concerned; Don't know)	10% (609)		<b>48% (609)</b>	
<b>Beliefs about oral polio vaccine and awareness of negative rumors</b>				
<i>Effectiveness of oral polio vaccine</i>				
Irrespective of what you replied to the previous questions, how effective or ineffective are polio drops in preventing polio?				
Very effective	<b>9% (1718)</b>	0.0009	<b>30% (1718)</b>	<0.0001
Not “very effective” (Somewhat effective; Not very effective; Not effective at all; Don't know)	<b>20% (228)</b>		<b>55% (228)</b>	
<i>Awareness of negative rumors</i>				
In the last year, what have you heard, read or seen about polio drops?				
Polio drops can make boys unable to father children later in life				
Have not heard, read or seen	10% (1799)	0.5076	33% (1799)	0.4497
Have heard, read or seen	9% (147)		36% (147)	
Polio drops can make girls unable to have children later in life				
Have not heard, read or seen	10% (1795)	0.9898	<b>31% (1795)</b>	<0.0001
Have heard, read or seen	10% (151)		<b>53% (151)</b>	
Polio drops frequently can give a child polio				
Have not heard, read or seen	10% (1861)	0.5643	33% (1861)	0.7585
Have heard, read or seen	13% (85)		31% (85)	
Polio drops can give a child HIV/AIDS				
Have not heard, read or seen	<b>10% (1869)</b>	0.0845	33% (1869)	0.2920
Have heard, read or seen	<b>21% (77)</b>		40% (77)	
Polio drops are not halal				
Have not heard, read or seen	Insufficient sample size among those who had heard rumor			
Have heard, read or seen				
Polio drops are made with urine or blood				
Have not heard, read or seen	Insufficient sample size among those who had heard rumor			
Have heard, read or seen				
<b>Perceptions of vaccination experience</b>				
<i>Perception of polio vaccinators and institutions organizing oral polio vaccine efforts</i>				
Overall, how much did you trust the vaccinators?				
A great deal	<b>2% (1461)</b>	0.0012	<b>28% (1461)</b>	<0.0001
Not “a great deal” (Somewhat; Not very much; Not at all; Don't know)	<b>9% (288)</b>		<b>49% (288)</b>	

(continued on next page)

Table 3 (continued)

	Unconfirmed % (n)	p-value	Uncommitted % (n)	p-value
Were the vaccinator(s) respectful or disrespectful?				
Very respectful	<b>2% (1450)</b>	0.0008	<b>29% (1450)</b>	<0.0001
Not “very respectful” (Somewhat respectful; Not very respectful; Not respectful at all; Don’t know)	<b>9% (299)</b>		<b>46% (299)</b>	
How much did the vaccinator(s) seem to care about the well-being of [child]?				
A great deal	<b>2% (1537)</b>	0.0009	<b>31% (1537)</b>	0.0273
Not “a great deal” (Somewhat; Not very much; Not at all; Don’t know)	<b>11% (212)</b>		<b>40% (212)</b>	
Were the vaccinator(s) knowledgeable or not?				
Very knowledgeable	<b>2% (1254)</b>	0.0009	32% (1254)	0.9433
Not “very knowledgeable” (Somewhat knowledgeable; Not very knowledgeable; Not knowledgeable at all; Don’t know)	<b>7% (495)</b>		32% (495)	
As far as you know, who is responsible for the vaccinators trying to provide polio drops to children in your neighborhood? How much do you trust [institution mentioned by respondent]?				
Trusted at least one institution “a great deal”	<b>6% (1480)</b>	0.0117	<b>29% (1480)</b>	<0.0001
Did not trust at least one institution “a great deal” (Somewhat; Not very much; Not at all; Don’t know for all institutions mentioned)	<b>15% (159)</b>		<b>48% (159)</b>	
<i>Perceptions of prominent community members and peer support for oral polio vaccine</i>				
As far as you know, what do each of the following people think of the idea of giving polio drops to children in your neighborhood? Is it a _____?				
Religious leaders in their neighborhood				
Very good idea	<b>7% (695)</b>	0.0039	<b>26% (695)</b>	<0.0001
Not a “very good idea” (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	<b>12% (1230)</b>		<b>37% (1230)</b>	
Neighborhood leaders				
Very good idea	8% (789)	0.0205	31% (789)	0.1639
Not a “very good idea” (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	12% (1133)		34% (1133)	
Traditional birth attendant				
Very good idea	9% (962)	0.0599	<b>26% (962)</b>	<0.0001
Not a “very good idea” (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	12% (978)		<b>40% (978)</b>	
Neighbors				
Very good idea	9% (1143)	0.0243	<b>30% (1143)</b>	0.0014
Not a “very good idea” (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	13% (786)		<b>38% (786)</b>	
Health workers (doctor, nurse, nurse’s aide or other health professional)				
Very good idea	<b>9% (1721)</b>	0.0099	<b>31% (1721)</b>	<0.0001
Not a “very good idea” (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	<b>17% (223)</b>		<b>48% (223)</b>	
<i>Awareness of communications related to logistics of delivery</i>				
Did you or did you not know [the vaccinators] were coming ahead of time?				
Yes, did know ahead of time	3% (820)	0.0265	<b>24% (820)</b>	<0.0001
No, did not know ahead of time; Don’t know	5% (1032)		<b>38% (1032)</b>	

Note: Bolded data indicates differences that are statistically significant after controlled comparisons and are five percentage points or greater.

Caregivers who did not believe that polio drops are “very effective” were more likely to be unconfirmed (20% vs. 9%) and uncommitted (55% vs. 30%) than their counterparts. Awareness of only one negative rumor was associated with lack of commitment: caregivers who heard that polio drops make girls unable to have children later in life were more likely than those who had not heard this to be uncommitted (53% vs. 31%). All null findings persisted after controlling for demographic differences, with one exception: caregivers who heard that polio drops cause HIV/AIDS were more likely than those who had not heard this to be unconfirmed.

Not trusting the vaccinators was strongly associated with being both unconfirmed and uncommitted. For example, those who did not trust the vaccinators “a great deal” were more likely to be unconfirmed (9% vs. 2%) and uncommitted (49% vs. 28%) than their counterparts. Similar relationships were found for thinking vaccinators were not “very respectful” or did not care “a great deal” about the child. Those who thought vaccinators were not “very knowledgeable” were only more likely to be unconfirmed (7% vs. 2%) than those who did. Not trusting the institution believed to be responsible for vaccinators “a great deal” was associated with being both more likely to be unconfirmed (15% vs. 6%) and uncommitted (48% vs. 29%) compared to those who trusted it “a great deal”.

Not believing that community members support OPV efforts (i.e., thinking they believed giving polio drops to children in the neighborhood is not a “very good idea”) was associated with being unconfirmed and uncommitted. There were associations between being unconfirmed or being uncommitted for all types of community members, except “neighborhood leaders.” For example, caregivers who said religious leaders in their neighborhood did not think giving polio drops is a “very good idea” were more likely to be unconfirmed (12% vs. 7%) and more likely to be uncommitted (37% vs. 26%) than their counterparts.

Finally, logistics communications were also associated with lack of commitment. Those who did not know vaccinators were coming ahead of time were more likely to be uncommitted (38% vs. 24%) than those who did.

### 3.4. Levels of potential threats

Approximately two-thirds of caregivers (68%) named paralysis as a symptom while 30% did not (Table 4). Among those who did, some 42% believed it would be curable. However, few caregivers said polio was not “very serious” or that they were not “very



**Table 4**

Levels of potential threats.

	%
<b>Knowledge and perceptions of polio</b>	
If [child] were to get sick with polio, what symptoms could [child] get?	(n = 2003)
Named paralysis as a symptom	68%
Did not name paralysis as a symptom (Don't know any symptoms; Paralysis is not a symptom)	30%
Have not heard of polio	2%
Would this [paralysis of the arms and/or legs] be curable or not?	(n = 1377) <sup>*</sup>
Paralysis would not be curable	54%
Paralysis would be curable	42%
Don't know	4%
If [child] were to get sick with polio, would that sickness be serious or not serious?	(n = 2003)
Very serious	90%
Not "very serious" (Somewhat serious; Not very serious; Not at all serious; Don't know)	8%
Have not heard of polio	2%
Are you concerned or not concerned that [child] will get sick with polio this year?	(n = 2003)
Very concerned	70%
Not "very concerned" (Somewhat concerned; Not very concerned; Not at all concerned; Don't know)	28%
Have not heard of polio	2%
<b>Beliefs about oral polio vaccine and awareness of negative rumors</b>	
<i>Effectiveness of oral polio vaccine</i>	
Irrespective of what you replied to the previous questions, how effective or ineffective are polio drops in preventing polio?	(n = 2003)
Very effective	86%
Not "very effective" (Somewhat effective; Not very effective; Not effective at all; Don't know)	11%
Have not heard of polio	2%
<i>Awareness of negative rumors</i>	
In the last year, what have you heard, read or seen about polio drops?	(n = 2003)
Polio drops can make boys unable to father children later in life	
Have not heard, read or seen	89%
Have heard, read or seen	8%
Have not heard of polio	2%
Polio drops can make girls unable to have children later in life	
Have not heard, read or seen	90%
Have heard, read or seen	8%
Have not heard of polio	2%
Polio drops frequently can give a child polio	
Have not heard, read or seen	93%
Have heard, read or seen	4%
Have not heard of polio	2%
Polio drops can give a child HIV/AIDS	
Have not heard, read or seen	94%
Have heard, read or seen	4%
Have not heard of polio	2%
Polio drops are not halal	
Have not heard, read or seen	96%
Have heard, read or seen	2%
Have not heard of polio	2%
Polio drops are made with urine or blood	
Have not heard, read or seen	97%
Have heard, read or seen	0%
Have not heard of polio	2%
<i>Perception of polio vaccinators and institutions organizing oral polio vaccine efforts</i>	
Overall, how much did you trust the vaccinators?	(n = 1749) <sup>†</sup>
A great deal	84%
Not "a great deal" (Somewhat; Not very much; Not at all; Don't know)	16%
Were the vaccinator(s) respectful or disrespectful?	(n = 1749) <sup>†</sup>
Very respectful	83%
Not "very respectful" (Somewhat respectful; Not very respectful; Not respectful at all; Don't know)	17%
How much did the vaccinator(s) seem to care about the well-being of [child]?	(n = 1749) <sup>†</sup>
A great deal	87%
Not "a great deal" (Somewhat; Not very much; Not at all; Don't know)	13%

(continued on next page)

Table 4 (continued)

	%
Were the vaccinator(s) knowledgeable or not?	(n = 1749) <sup>†</sup>
Very knowledgeable	70%
Not “very knowledgeable” (Somewhat knowledgeable; Not very knowledgeable; Not knowledgeable at all; Don’t know)	30%
As far as you know, who is responsible for the vaccinators trying to provide polio drops to children in your neighborhood? How much do you trust [institution]?	(n = 1639) <sup>‡</sup>
Trusted at least one institution “a great deal”	89%
Did not trust at least one institution “a great deal” (Somewhat; Not very much; Not at all; Don’t know for all institutions mentioned)	11%
<i>Perceptions of prominent community members and peer support for oral polio vaccine</i>	
As far as you know, what do each of the following people think of the idea of giving polio drops to children in your neighborhood?	(n = 2003)
Religious leaders in their neighborhood	
Very good idea	35%
Not a “very good idea” (Somewhat good idea, Somewhat bad idea, Very bad idea; Don’t know)	61%
Have not heard of polio	2%
Neighborhood leaders	
Very good idea	41%
Not a “very good idea” (Somewhat good idea, Somewhat bad idea, Very bad idea; Don’t know)	55%
Have not heard of polio	2%
Traditional birth attendant	
Very good idea	52%
Not a “very good idea” (Somewhat good idea, Somewhat bad idea, Very bad idea; Don’t know)	46%
Have not heard of polio	2%
Neighbors	
Very good idea	59%
Not a “very good idea” (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	38%
Have not heard of polio	2%
Health workers	
Very good idea	86%
Not a “very good idea” (Somewhat good idea, Somewhat bad idea, Very bad idea; Don’t know)	12%
Have not heard of polio	2%
<b>Awareness of communications related to logistics of delivery</b>	
Did you or did you not know [the vaccinators] were coming ahead of time?	(n = 1852) <sup>§</sup>
Yes, did know ahead of time	44%
No, did not know ahead of time	55%
Don’t know	0%

Note: Responses of not applicable not shown where 1% or less.

\* Respondents who named paralysis as a symptom of polio.

† Respondents who saw vaccinator(s) during last campaign.

‡ Respondents who mentioned at least one institution.

§ Respondents who said vaccinator(s) came to home during last campaign.

concerned” about their child getting sick (8% and 28%, respectively).

Few caregivers (11%) said polio drops were not “very effective” in preventing polio. Reported awareness of individual negative rumors, including the idea that OPV can make boys or girls unable to have children later in life (8% each), were low.

Few caregivers had explicitly negative views of vaccinators’ trustworthiness, respectfulness, display of concern for child or knowledge levels. Among caregivers who saw a vaccinator during the last campaign, 16% did not trust the vaccinators “a great deal” and 17% said vaccinators were not “very respectful.” Nearly the same fraction reported that vaccinators did not care “a great deal” about the well-being of the child (13%). However, nearly a third (30%) said that vaccinators were not “very knowledgeable.” Only approximately a tenth who mentioned at least one organization responsible for vaccinators (11%) did not trust it “a great deal.”

More than half of caregivers said religious leaders in their neighborhood and neighborhood leaders think giving polio drops to children in their neighborhood is not a “very good idea” (61% and 55%, respectively). Similarly, caregivers perceived a substantial lack of support among traditional birth attendants and their neighbors (46% and 38% said each group thinks it is not a “very good

idea”, respectively). However, few (12%) said health workers did not think it is a “very good idea” to give polio drops.

More than half of caregivers (55%) did not know ahead of time that vaccinators were coming.

#### 4. Discussion

Data from this study provide important insights into attitudinal and knowledge-based threats to OPV vaccination during the Somalia polio outbreak and direction for future response.

First, results show that reported OPV acceptance in the 2013–2014 Somalia outbreak was high, but commitment to continued vaccination was lower. This underscores a key challenge in outbreaks and the need to address continued commitment as part of community engagement.

Second, results show there is a strong relationship between both unconfirmed vaccination and lack of commitment and trust-related threats identified in endemic settings: lack of trust in vaccinators, lack of trust in institutions organizing vaccination, limited community support, lack of belief in vaccine effectiveness, and negative perceptions of the illness. These findings suggest

outbreak settings are vulnerable to many of the same threats as endemic settings, and the foundation of communication efforts can be shared.

That said, there are some key differences in this outbreak setting. First, there is some evidence that knowledge of symptoms is important, which may mean providing factual information is helpful when a disease is re-emergent. Further, awareness of rumors, which has been linked to polio vaccine commitment in endemic settings, is not particularly associated with unconfirmed vaccination or lack of commitment in this outbreak setting [9,11]. As awareness levels are low, this may be an indication that in an outbreak stemming from virus transmitted from another country, rumors have not had a chance to spread or become engrained. Data from endemic settings may thus serve as a warning of what can happen over time if rumors go unaddressed and it may nonetheless be important to have strategies to quell rumors from the outset.

Third, the absolute levels of these threats provide additional insights about the possible strengths and challenges of the outbreak response in Somalia. Given the importance of trust, it is notable that in this particular outbreak, trust in vaccinators and institutions behind them was relatively high. This suggests key success points of the Somalia response. Perceived community support for vaccination efforts was moderate compared to trust. This indirectly suggests there are challenges in making caregivers aware of community support within a relatively short amount of time, and targeted efforts may be helpful in future. Similarly, with less than half of caregivers aware of vaccinator visits ahead of time, enhanced connections between campaign operations and communications to facilitate caregiver availability at the door may benefit future response efforts.

The study has limitations. First, interviews were conducted in select districts and findings are not representative of the entire country. Findings might not be relevant to caregivers in other districts or to non-responders within these districts, although this latter fraction is small (17%). Those who were not part of the study could be different, and non-responders particularly could be less likely to accept OPV or commit to doing so. If true, this study might underestimate related measures, although there is no a-priori reason to believe that this would bias the estimated relationships between recent OPV acceptance or commitment and attitudes or knowledge. Third, data are self-reported and may reflect some social desirability bias, which suggests that data may overstate knowledge, awareness, past acceptance and commitment. This should serve as a warning that communication efforts in indicated areas are even more critical, though again there is no reason to believe the relationship between variables is biased. Fourth, the data is cross-sectional, and thus such relationships do not necessarily indicate causality. Finally, these data rely on random route sampling, which could be subject to exclusion biases or unequal selection biases despite efforts to reduce this risk.

Acknowledging these limitations, we believe the overall findings reinforce the key role attitudes and knowledge play during an outbreak and provide important guidance for future response.

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## 6. Author contributions

GKS and RJB led the study design, questionnaire development, data analysis, and manuscript writing. RH, SG, SA and JB con-

tributed to study design, questionnaire development, data analysis, and manuscript revisions. WL and HC contributed to the literature search, data analysis, and manuscript writing. MRW contributed to data analysis and manuscript revisions. DO and CS designed data collection processes and contributed to manuscript revisions. ENB-P managed data and contributed to data analysis and manuscript revisions. All authors approved the final version of the manuscript.

## 7. Conflicts of interest

GKS, RJB, WL, and HC report grants from Robert Wood Johnson Foundation to HSPH and a cooperative agreement between the US Centers for Disease Control and Prevention and HSPH. GKS's husband has done consulting work for Eli Lilly in the past 3 years. SG reports grants from US Centers for Disease Control and Prevention to UNICEF. RH, SA, JB, DO, CS, MRW and ENB-P declare no competing interests.

## 8. Disclaimer for all authors

All authors acted in a personal capacity. The opinions expressed in this article are the authors' own and do not necessarily reflect the view of any portion of UNICEF, the Harvard T.H. Chan School of Public Health, SSRS, InterMedia, Oxford Research International, or any other institutions with which authors have worked.

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## Appendix A. Supplementary material

Supplementary data associated with this article can be found, in the online version, at <https://doi.org/10.1016/j.vaccine.2018.06.003>.

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