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Oral cholera vaccination coverage in an acute emergency setting in Somalia, 2017

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ABSTRACT

The first oral cholera vaccination (OCV) campaign in Somalia was implemented between March and October 2017. It was the first time the Ministry of Health had introduced and used OCV as part of the cholera prevention and control strategies. The Ministry of Health aimed to cover 1.1 million people ≥ 1 year with 2 doses of the OCV in 11 high-risk districts. Overall, 2-dose administrative OCV coverage in all targeted districts was 95.5%. Following the campaign, a random sample survey was conducted in 9 out of 11districts to evaluate coverage, awareness, reasons for non-vaccination, the water and sanitation status of households, and any resulting adverse events. The survey was conducted in 2 phases. Of the 3,715 eligible individuals in the first phase, 92.5% (95% CI 91.4–93.6%) received 2 doses of the OCV and 7.0% (95% CI 6.0–8.2%) 1 dose. In the second phase, of 1,926 individuals, 94.1% (95% CI 92.9–95.1%) received 2 doses and 2.6% (95% CI 2.0–3.4%) 1 dose. Despite challenges, this experience shows that OCV campaigns can be implemented in acute humanitarian settings through existing immunization structures.

1. Introduction

Somalia is one of the countries in sub-Saharan Africa where cholera is a major public health problem [1]. The country has experienced seasonal and recurring cholera outbreaks for the past 2 decades often in major urban centers, camps for internally displaced people, and in communities living along the banks of rivers Jubba and Shabelle [2]. During 2016/17 drought season, cholera outbreak was declared in 55 districts of Somalia as a result of depleted water sources and displacement of over 3 million Somalis to camps where access to safe water and proper sanitation was limited [3]. From January 2017 to late November of that year, 79,172 suspected cholera cases and 1,159 deaths [case fatality rate (CFR) 1.5%] were reported from 55 districts across the country [4]. During the outbreak, a total of 345 stool specimens from 20 districts were tested at the National Public Health Laboratory in Mogadishu and 38% were confirmed to have *Vibrio cholerae* O1 Ogawa. The lowest district-level CFR was 0.5% recorded in Awdal region while the highest district-level CFR was 4.3% recorded in Bakool region [3]. As part of the cholera response plan, Oral cholera Vaccination was introduced to contain the outbreak and limit the spread of the epidemic as recommended by the World Health Organization (WHO) [4–7]. Federal Ministry of Health submitted the first application to the Global Task Force on Cholera Control (GTFCC) for a preventive OCV campaign to target 449,110 people aged 1 year in 7 high-risk districts in December 2016. Another request for a reactive OCV campaign to target 570,000 people in another high-risk 4 districts was submitted to the International Coordination Group (ICG) in May 2017. After the approval of the two requests by GTFCC and ICG, the OCV campaigns targeting 11 districts (Fig. 1) were implemented in 2 phases between May and October 2017.

1.1. Organization of the OCV campaigns

The Federal Ministry of Health received 2,124,417 doses of Euvichol® from the global OCV stockpile for a targeted population

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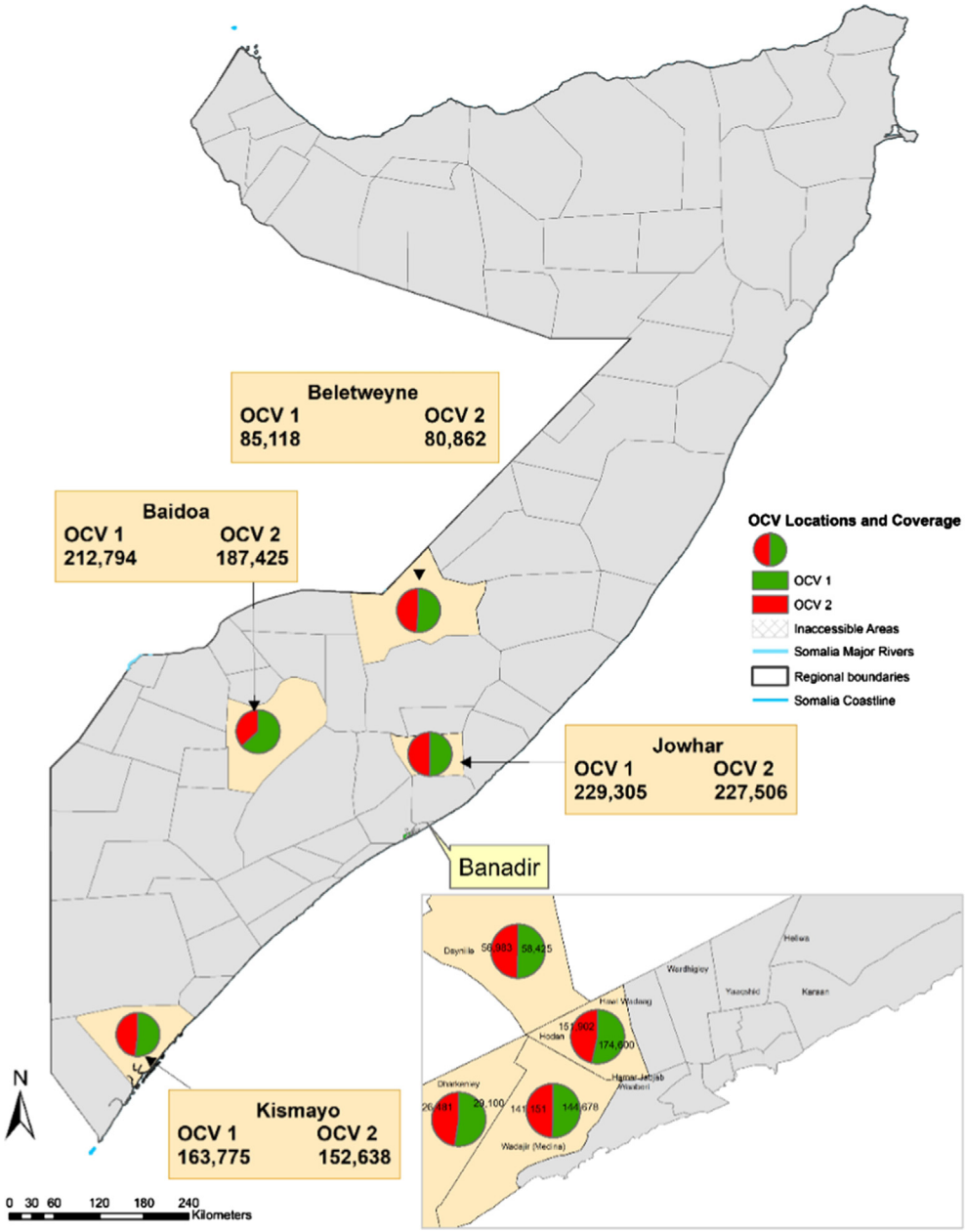

Fig. 1. Adminstrative (OCV) coverage map (numbers vaccinated) for rounds 1 and 2 of the campaign by site, 2017.

of 1,023,022 people ≥ 1 year of age. A microplanning exercise was done by different programs within the Ministry of Health led by the Disease Surveillance and Emergency Unit and the Expanded Programme on Immunization (EPI) and the Polio Eradication Initiative (PEI) with the support of the WHO, UNICEF and other non-governmental organizations. Two rounds of OCV campaigns were conducted in all 11 target districts on different dates between March and October 2017. A mixed vaccination strategy of door to door campaign and fixed posts in health centers, schools and other public places was used to implement OCV. Over 3,000 vaccinators, recorders, social mobilizers, cold-chain technicians, independent monitors, and supervisors were trained by the national trainers for 2 days before each OCV campaign. The existing national and regional cold-chain systems for the EPI/PEI programs were used to store over 2 million doses. Intensive social mobilization campaigns were conducted by local health authorities with the support of national organizations operating in the target districts two days prior to the vaccination and throughout the vaccination period. The campaign was monitored by supervisors from health authorities and international partners using standard monitoring checklists.

1.2. Coverage survey

A coverage survey was conducted following the OCV campaigns by an independent consultant recruited by the Federal Ministry of Health and WHO. The main objective was to evaluate the vaccine coverage, OCV campaign awareness, reasons for non-vaccination, the water and sanitation status of households, and any adverse events that occurred after OCV. The survey of the first phase was carried out between May 14 and 30, 2017 in the 7 districts of the first OCV campaign and the second phase between July 14 and 28, 2017 for 2 of the 4 districts of the second OCV campaign. Time constraints and insecurity did not allow the survey to be conducted in the other 2 districts.

The purpose of this paper is to present the findings of the OCV coverage survey, the challenges faced in implementing Somalia's first series of OCV campaigns targeting high-risk districts.

2. Methods

2.1. Coverage survey design

The survey was a cross-sectional study that aimed to estimate the proportion of the population in selected districts which received OCV during the mass campaigns, the reasons for non-vaccination, the water and sanitation status of the household, adverse events following immunization, and awareness of the OCV campaign.

We designed the coverage surveys to estimate the proportion of people vaccinated during the OCV campaigns in 9 districts out of the 11 targeted for the campaigns. The survey was done in 2 phases or stages, and the first phase covered 7 districts while the second covered 2 districts. In each phase, we aimed to include a representative sample of households that would provide the household level indicators and individual' OCV coverage. In both phases, we assumed a 2-dose coverage of 50%, a design effect of 2 and that 5% of households would refuse to participate in the survey. In order to achieve a coverage estimate with a precision of ±4.7% around the point estimate and an alpha level of 0.05, we estimated that 805 households would need to be enrolled in the first phase of the survey covering 7 districts and 420 households covering 2 districts. The sample size for each phase was calculated independently because we decided to include a second phase to the study which covers two additional districts after the sample size calculation of 7 districts was completed.

Under the 2-phase survey within each district, the sample size yielded an estimated precision of ±8.0%. A design effect of 2 due household clustering was based on an estimated intraclass correlation coefficient of 0.2 and an average household size of 6.

The samples were allocated equally to each of the selected districts to allow comparison of results within the high-risk districts. Thus 115 households were sampled in each district for the first campaign in 7 districts and 210 households in the second campaign in the 2 other districts.

In each district, the number of households were selected according to the population size of the settlements in the district and randomly sampled. The EPI method of household selection, where listings of households is not available, was employed [8]. A central location near the approximate geographical center of the village or town was a chosen, such as a market or a mosque, and then the enumeration team randomly selected a direction by spinning a bottle on even ground and walked in that direction counting the number of houses until the edge of the village was reached. A number between 1 and the total number of houses counted along the directional line was randomly selected and this became the first selected household to visit. The second household was the one nearest to the first, and so on in any direction. The nearest household was the one whose front door was closest to the front door of the household just visited.

We defined a household as a set of relatives or group of people who live under one roof and eat together. They could be living in a tent or huts. A residential structure can contain multiple households. People who usually lived in one household but were temporarily staying in another household were included in the household where they usually lived. In each household, all eligible and available people $\geq$ 1 year were selected for interview. For children who could not answer for themselves, data were collected from parents or the primary caregiver. Vaccination cards were used as the source of immunization data, or the parent or caregiver was asked about immunization if the child's OCV card was not available. In every household selected, the interviewer collected information from the household head or the caregiver on household characteristics, OCV campaign awareness, and water and sanitation status.

In the first 7 districts, all data were collected on questionnaires and entered into EpiData, version 4.0 (EpiData Software, Odense, Denmark). In the remaining 2 districts, data were collected using smartphones on KoBoCollect 1.4.8 (KoBoToolbox, Cambridge, MA). In both cases, data were exported to Excel 2013 (Microsoft Corporation, Redmond, WA) and Stata 13.0 (StataCorp LLC, College Station, TX) for data cleaning and analysis.

2.2. Data analysis

We used Stata 13.0 to analyze the data. Data were weighted to ensure that each individual in the sampling frame had equal probability for selection.. We accounted for the probability of selection by taking the inverse of the sampling rate that was used in the calculation of weighted estimates.

3. Results

The coverage surveys were conducted from May 14–30, 2017 in the first 7 districts (Dharkenley, Hodan, Koshin, Xaawo Taako, Calanley, and Fanole) and from July 14–28, 2017 in the second 2 districts (Baidoa and Jowhar). In total, 805 households and 3,715 individuals were included in the first survey of covering 7 districts while 420 households and 1,926 individuals were included in second survey covering 2 districts. Due to time constraints and insecurity, OCV coverage survey was not conducted in Wadajir and Dayniile. Table 1 is presented the details of the OCV campaigns including comparison of the administrative and coverage survey, while Fig. 1 shows the locations of the target districts.

3.1. Characteristics of households

Of the 805 heads of households who were interviewed in the first 7 districts, most were women (71%), had had no education (62%), lived in urban areas (99%) and were married (88%). As regards occupation, 39% were housewives and 34% had their own business. Similar findings were found in other 2 districts: 70% of the respondents were female, 71% had had no education, 100% lived in urban areas, 88% were married, and 56% were housewives. Only 13% of the households lacked access to an improved secondary water sources in phase 1 compared with 22% in phase 2. In addition, only 3% lacked access to improved sanitary facilities in the first 7 districts and 15.4% in the other 2 districts. Table 2 gives a summary of demographic characteristics of OCV recipients in the 9 high-risk districts in Somalia.

3.2. OCV coverage by district and age group

Of the 3,715 individuals interviewed from the 7 districts in the first campaign, 3,436 (92.5%) received 2 doses of OCV while 7.0% received only 1 dose. The highest vaccination coverage with 2 doses of the vaccine in the 7 districts was in Koshin and Xaawo Taako districts (100%), and the lowest coverage of 85.9% was in Hodan district. The highest proportion of people who received only 1 dose of OCV was also in Hodan district (14.1%). Of the 1,926 individuals interviewed from Baidoa and Jowhar districts in the second campaign, vaccination coverage was 94.1% overall; only 1.2% and 4.5% received only 1 dose of

Table 1
Details of oral cholera vaccination campaigns in Somalia by target locations, dates, and administrative/survey coverage.

Location town/district/region	Target pop. (no.)	Doses Rec'd	Doses used	1st round dates (2017)	2nd round dates (2017)	1st round coverage	2st round coverage	Survey coverage result for 2 doses*
Hodan/Hodan/Mogadishu	174,600	349,200	326,502	15–19 March	18–24 April	100%	87%	85.9% (95% CI: 83.1–88.3)
Dharkenley/Dharkenley/Mogadishu	29,100	58,200	55,581	15–19 March	18–24 April	100%	91%	93.9% (95% CI: 91.7–95.5)
Wadajir/Wadajir/Mogadishu	149,870	299,740	285,829	20–26 September	22–28 October	97%	94%	–
Dayniile/Dayniile/Mogadishu	58,425	116,850	115,408	20–26 September	22–28 October	100%	98%	–
Xaawo Taako/Beledweyne/Hiiraan	35,284	70,568	69,149	15–19 March	18–24 April	100%	96%	100.0%
Koshin/Beledweyne/Hiiraan	49,834	99,668	96,831	15–19 March	18–24 April	100%	94%	100.0%
Alanley/Kismayo/Lower Juba	75,660	151,320	135,692	15–19 March	18–24 April	91%	88%	97.5% (95% CI: 95.5–98.7)
Farjano/Kismayo/Lower Juba	45,784	91,568	103,402	15–19 March	18–24 April	126%	100%	96.2% (95% CI: 93.9–97.7)
Fanole/Kismayo/Lower Juba	43,650	87,300	77 319	15–19 March	18–24 April	84%	93%	91.3% (95% CI: 88.5–93.4)
Baidoa/Baidoa/Bay	217,280	434,560	400,219	2–8 May	21–25 May	98%	86%	93.7% (95% CI: 91.9–95.0)
Jowhar/Jowhar/Middle Shabelle	231,830	463,660	456,811	2–8 May	21–25 May	99%	98%	94.6% (95% CI: 93.0–95.9)
Total	1,111,317	2,222,634	2,122,743					

CI: confidence interval.
* OCV coverage survey was not conducted in Wadajir and Dayniile districts.

Table 2
Characteristics of the heads of the households and the households targeted for OCV in 9 high-risk districts in Somalia, March and May 2017.

Characteristic	First 7 districts (n = 804)		Second 2 districts (n = 420)	
	No.	Weighted estimate, %	No.	Weighted estimate, %
Sex				
Male	231	29	296	70
Female	573	71	125	30
Level of education				
None	496	62	299	71
Primary	165	21	83	20
Secondary	118	15	33	8
Tertiary	24	3	5	1
Settlement				
Urban	796	99	420	100
Rural	8	1	0	0
Marital status				
Married	710	88	372	88
Separated	33	4	3	1
Divorced	33	4	5	1
Widowed	19	2	36	9
Single	9	1	5	1
Occupation				
Business	269	34	61	15
Housewife	312	39	237	56
Employed	168	21	30	7
Farmer	15	2	58	14
Herdsperson	8	1	5	1
Others	31	4	30	7
Water source				
Unimproved primary water source	33	4	94	22
Unimproved secondary water source	72	13	94	22
Sanitary facility				
Unimproved	24	3	65	15
No hand washing facility	199	25	142	34

OCV in Baidoa and Jowhar respectively (Table 3). In the sample from the 7 districts of the first OCV campaign, 0.5% received no vaccination and in the sample from 2 districts of the second OCV campaign, 3.3% received no vaccination.

Of the males surveyed in the 7 districts of the first OCV campaign, 91.8% received 2 doses of OCV and 7.8% received only 1 dose, whereas 93.3% and 6.2% of the females surveyed received 2 doses and 1 dose respectively (Table 4).

3.3. Adverse events following immunization

Only 0.6% (95% CI 0.4–0.96%) and 0.7% (95% CI 0.42–1.3%) of the sampled individuals who received the OCV in the first and second OCV campaigns respectively reported an adverse event within 14 days of receiving either the first or second dose of the vaccine. Table 5 reports the adverse events reported in the first and second OCV campaigns.

Table 3
Oral cholera vaccination coverage in 9 high-risk districts in Somalia, March–May 2017.

Region	No.	Weighted estimate, % (95% CI)		
		2 Doses	1 Dose only	0 Dose
First OCV Campaign				
Dharkenley	240	93.9 (91.7–95.5)	6.1 (4.5–8.2)	0
Hodan	1,437	85.9 (83.1–88.3)	14.1 (11.7–16.9)	0
Koshin	410	100	–	0
Xaawo Taako	290	100	–	0
Calanley	618	97.5 (95.5–98.7)	2.5 (1.3–4.4)	0
Fanole	353	91.3 (88.5–93.4)	4.2 (2.8–6.4)	4.5 (3.6–6.7)
Farjano	367	96.2 (93.9–97.7)	3.3 (2.0–5.5)	0.5 (0.3–1.7)
Total Phase 1	3,716	92.5 (91.3–93.6)	7.0 (6.0–8.2)	0.5 (0.4–0.7
Second OCV Campaign				
Baidoa	1,105	93.7 (91.9–95.0)	1.2 (0.7–2.2)	5.1 (3.2–6.8)
Jowhar	821	94.6 (93.0–95.9)	4.5 (3.4–6.1)	0.9 (0.5–1.2)
Total Phase 2	1,926	94.1 (92.9–95.1)	2.6 (2.0– 3.4)	3.3 2.7–4.3)

CI: confidence interval.

Table 4
OCV coverage by age category in 9 high-risk districts in Somalia, March–May 2017.

Age group	Males		Females	
	No. vaccinated	Weighted estimate, % (95% CI)	No. vaccinated	Weighted estimate, % (95% CI)
First OCV Campaign				
Overall				
2 doses	1677	91.8 (90.0–93.3)	1762	93.3 (91.6–94.6)
1 dose	143	7.8 (6.3–9.6)	117	6.2 (4.9–7.8)
0 Dose	7	0.4 (0.1–3.4)	9	0.5 (0.3–1.9)
1–4 years				
2 doses	250	89.8 (84.0–93.7)	271	94.4 (89.8–97.0)
1 dose	28	10.2 (6.3–16.0)	14	4.8 (2.3–9.4)
0 Dose	0	0	2	0.8 (0.0–1.8)
5–14 years				
2 doses	598	92.6 (89.6–94.7)	573	91.7 (88.5–94.1)
1 dose	45	7.0 (4.9–10.0)	47	7.5 (5.1–10.7)
	3	0.4 (0.0–1.4)	5	0.8 (0.3–1.6)
≥ 15 years				
2 doses	828	91.8 (89.2–93.9)	916	93.9 (91.6–95.7)
1 dose	69	7.6 (5.6–10.2)	57	5.8 (4.1–8.2)
0 Dose	5	(0.0–1.5)	3	0.3 (0.0–1.3)
Second OCV Campaign				
Overall				
2 doses	848	94.8 (93.1–96.1)	964	93.5 (91.8–94.8)
1 dose	14	1.6 (1.0–2.6)	36	3.5 (2.6–4.8)
0 Dose	32	3.6 (2.9–4.8)	31	3.0 (2.2–4.3)
1–4 years				
2 doses	149	97.2 (92.8–99.0)	163	96.3 (92.3–98.2)
1 dose	2	1.3 (3.2–5.1)	5	3.1 (1.4–6.7)
0 Dose	2	1.5 (0.4–2.7)	1	0.6 (0.3–1.6)
5–14 years				
2 doses	349	94.6 (91.7–96.6)	361	94.1 (91.3–96.1)
1 dose	9	2.4 (1.2–4.6)	12	3.0 (1.7–5.1)
0 Dose	11	3.0 (1.7–5.2)	12	2.9 (1.6–5.0)
≥15 years				
2 doses	348	93.9 (90.8–96.0)	439	91.9 (89.1–94.1)
1 dose	4	1.0 (0.4–2.7)	20	4.1 (2.7–6.2)
0 Dose	20	5.1 (3.0–6.7)	20	4.0 (2.4–6.0)

CI: confidence interval.

Table 5
Adverse events following immunization during the 2 OCV campaigns in 9 high-risk districts in Somalia, March–May 2017. None of the reported adverse events were severe.

Adverse event	First OCV campaign		Second OCV campaign	
	No. (n = 35)	Weighted average, % (95% CI)	No. (n = 13)	Weighted average, % (95% CI)
Nausea	3	9.1 (3.2–23.3)	4	33.2 (11.2–66.1)
Vomiting	10	27.9 (13.5–49.0)	3	21.0 (5.6–54.4)
Fever	7	18.8 (9.0–35.1)	1	8.3 (0.8–49.0)
Diarrhea	6	15.9 (6.1–35.5)	3	22.9 (6.2–57.2)
General weakness	4	11.8 (4.6–26.9)	0	0
Abdominal pain	5	11.7 (4.0–29.8)	2	8.3 (0.8–49.0)

CI: confidence interval.

3.4. Cholera-associated information and sources of information

During the OCV campaigns in the target districts, hand washing messages were the most received of the awareness efforts. The use of Oral Rehydration Salts for the treatment of diarrhea was the least received message during both campaigns (Table 6). Community health workers were the main source of information during the second OCV campaign in Baidoa and Jowhar districts (65.1%), closely followed by the radio (63.9%) (Table 6). In the first OCV campaign in the 7 districts, local nongovernmental organizations were contracted for the social mobilization, while in the second campaign, social mobilization was done by community health workers under the Federal Ministry of Health.

3.5. Reasons for non-vaccination

In the first OCV campaign in the 7 districts, 32 people who were not vaccinated in the first 7 districts reported that they were not home (42%). Other reasons were failure by the vaccinator to visit the home (26.0%) and being sick at the time of the vaccination (12.2%). Similar reasons were cited during the campaign in Baidoa and Jowhar while vaccine not being available constituted a reason for non-vaccination (Table 7).

4. Discussion

In this paper, we describe the implementation of the largest OCV campaign in the complex humanitarian setting of Somalia. For the first time, the global stockpile of OCV was utilized in Somalia. The aim of the campaign was to protect populations at high risk of cholera in 11 districts of Somalia who had limited access to safe water and proper sanitation resulting from drought. The risk of cholera transmission is higher in congested settlements with limited access to safe water and proper sanitation.

The Ministry of Health in collaboration with UN agencies and nongovernmental organizations successfully implemented one of the largest OCV campaigns in sub-Saharan Africa. The distribution of over 2.1 million doses of OCV was one of the largest to date from the global OCV stockpile for outbreak and humanitarian response. The management, the preparation, implementation, and monitoring of the OCV campaigns in all target districts were tasked to EPI/PEI staff at all levels. Despite the many challenges, the experience of the campaigns highlights the feasibility of implementing OCV campaigns in protracted complex emergencies that are compounded by an active cholera epidemic.

The results of independent monitoring show a high coverage of the vaccination in 9 districts which is comparable to other vaccination campaigns done elsewhere in Africa [7,9,10]. The high vaccination coverage may also be attributed to the fact that majority of the respondents were located in urban areas having migrated from rural areas during drought. The use of the existing national EPI/PEI structures to conduct house-to-house campaigns in all target districts that had earlier contributed to high OPV coverage rates in similar districts also contributed to the success of the OCV campaigns in Somalia, as it was the case in other countries in sub-Saharan Africa [11,12]. Strong political commitment from policy-makers and effective collaboration and coordination between health authorities, local communities, and health and WaSH partners contributed to the positive outcomes of the OCV campaigns.

Furthermore, social mobilization using the experienced polio mobilizers and local nongovernmental organizations played an important role in informing the target population of the need to receive the 2 doses. As observed in the Iraq OCV campaign in 2015 as well [7], community health workers and mobile radios were the most common sources of information during the campaign. This could be attributed to the extensive use of community health workers for mobilization in previous polio campaigns in Somalia.

The implementation of the OCV campaign in a phased approach also contributed to the high levels of acceptability and coverage because all vaccination teams concentrated on particular areas before moving to new locations. Being the first of its kind in Somalia, the teams acquired skills and confidence during the first few campaigns which were useful during subsequent campaigns. Even when insecurity may have been perceived as a major obstacle to implementation of the campaign in Somalia, the use of accepted community volunteers and community leaders within areas that were not accessible to humanitarian agencies, the vaccinators targeting IDP camps where majority of the target population lived having been displaced by drought, helped achieve the high coverage rates. The length of the campaign was increased from 5 to 7 days, including mop-up campaigns in densely populated settlements, in order to cover as many people as possible. Contrary to popular beliefs that access to safe water and proper sanitation was limited in the camps for internally displaced people in Somalia, the study found that most of the people interviewed had access to safe water and proper sanitation. This was due to the strengthening of water and sanitation interventions in these camps by the local authorities and WaSH partners before the campaigns.

Survey limitations include the exclusion of Daynile and Hodan districts due to security concerns may have led to under estimation of the study outcome; the difference in time between the completion of the OCV campaigns and the survey may have caused recall

Table 6
Cholera-associated messages received by households during the 2 OCV campaigns and the sources of the information in 9 high-risk districts in Somalia, March–May 2017.

	First OCV campaign		Second OCV campaign	
	No.	Weighted average, % (95% CI)	No.	Weighted average, % (95% CI)
Messages received	*n* = 554		*n* = 338	
Wash hands with soap	351	63.4 (58.4–68.1)	317	93.7 (90.6–95.9)
Cook food thoroughly	123	22.2 (18.1–26.8)	139	41.2(36.0–46.8)
Wash vegetables and fruits	46	8.3 (6.0–11.2)	70	20.7 (16.5–25.6)
Boil water	12	2.1 (1.2–3.5)	55	16.2 (12.6–20.9)
Dispose of human waste properly	7	1.2 (0.6–2.6)	92	27.1 (22.4–32.3)
Use oral rehydration salts when you get diarrhea	0	0.1 (0.0–0.7)	46	13.7 (10.3–18.1)
Sources of messages	*n* = 605		*n* = 344	
Community health worker/mobilizers	119	19.6 (15.8–24.0)	224	65.1 (59.7–70.0)
Radio	354	58.5 (53.7–63.2)	213	63.9 (58.6–68.9)
Television	87	14.4 (11.4–18.0)	14	4.3 (2.5–7.4)
Posters	11	1.8 (0.8–4.2)	10	3.1 (1.6–5.9)
Text message (SMS)	10	1.6 (0.9–2.8)	8	2.4 (1.2–5.0)
Neighbors	24	4.0 (2.3–6.9)	44	13.1 (9.7–17.4)

CI: confidence interval.

Table 7
Reasons for non-vaccination during the 2 OCV campaigns in 9 high-risk districts in Somalia, March–May 2017.

Reasons for non-vaccination	First OCV campaign in 7 districts		Second OCV campaign in 2 districts	
	No. (n = 32)	Weighted average, % (95% CI)	No. (n = 53)	Weighted average, % (95% CI)
Not at home/absent	14	42.2 (24.4–62.2)	21	37.2 (25.2–51.0)
Vaccinator did not come	8	26.0 (13.2–44.9)	19	35.6 (23.7–49.6)
Was sick	4	12.2 (3.4–35.0)	1	1.8 (0.2–12.8)
Decision-maker was absent	3	10.2 (3.1–28.9)	1	1.8 (0.2–12.8)
Against my faith	2	5.8 (1.3–21.9)	0	0.0
Vaccine not available	1	3.7 (0.5–23.9)	6	11.2 (5.0–23.3)
Was not aware/had no information/did not know when and where to go	0	0.0	1	1.4 (0.1–10.1)
Bad taste	0	0.0	2	3.7 (0.8–14.3)
Busy/no time	0	0.0	2	3.3 (0.8–13.0)

CI: confidence interval.

bias, especially where a vaccination card could not be produced; and the use of spin bottle method to select households to include in the interview may have contributed to selection bias as only convenient households may have been chosen by the investigators. Another limitation of this study was the movement of people from the districts to other settlements, especially the internally displaced population; this altered the composition of the population during the campaign. It is also important to note that the study cannot provide aggregated data for the 9 districts for the vaccination indicators because the samples from first and second campaigns were derived independently.

The Somalia experience has shown that large-scale OCV campaigns can be implemented in acute and protracted crisis and can have high levels of acceptance by the people even in areas that are perceived to be insecure. Although those people in the target districts who received 2 doses of the cholera vaccine during the mass vaccination campaigns will likely be protected from cholera, nonetheless clean water, adequate sanitation, and appropriate hygiene remain cornerstones for cholera control [6,9]. The WaSH conditions in most of the districts that were targeted for the OCV campaigns are insufficient and if the situation persists, the prospect of reintroducing cholera infection is possible, considering the population movement and presence of unvaccinated people. Likewise, the demand for more cholera vaccine in Somalia is likely to be higher and it is advisable to expand the coverage of the OCV to other high-risk districts in the country if long lasting protection is to be achieved. If there are not enough doses in the global stockpile, a single-dose strategy should be considered because some studies have shown the effectiveness of a single dose of the OCV in the prevention of cholera [13–15].

Ethical considerations

The purpose of the study was explained to all eligible participants from the districts. Verbal consent was obtained from all adults, while parents or care givers of eligible children gave permission. Consent was obtained before interviews were conducted. This survey was a part of program of evaluation activities approved by the Federal Ministry of Health and WHO.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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