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## Preventing erosion of oral polio vaccine acceptance: A role for vaccinator visits and social norms



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### ABSTRACT

**Background:** With continued challenges to the timeline for polio transmission interruption in Pakistan, including COVID-19, there is a risk of oral polio vaccine campaign fatigue among caregivers of young children. Renewed efforts to minimize oral polio vaccine acceptance erosion may be needed. This study examines the possible role of social norms in protecting against acceptance erosion and the role of vaccinators in promoting these social norms.

**Methods:** Data were analyzed from a poll conducted by local interview teams between February 23 and April 5, 2016, among 4,070 parents and other caregivers of children under age 5 living in areas at high-risk for polio transmission in Pakistan. The sample was drawn via a stratified multistage cluster design utilizing random route methods at the household level. We calculated the prevalence of subjective and descriptive social norms around vaccine acceptance; vaccine acceptance and commitment to vaccinate in future; and experiences and views of polio vaccinators across the population. We examined the relationship between these social norms and vaccination behaviors as well as the relationship between experiences with and views of vaccinators and social norms using uncontrolled comparisons (t-tests of proportion) and logistic regressions to control for demographics.

**Results:** Both descriptive and subjective positive social norms were associated with vaccine acceptance and future commitment. Positive experiences with and views of vaccinators (trust, perceived technical knowledge, compassion, and overall pleasantness of the interaction) were associated with both descriptive and subjective positive social norms.

**Conclusions:** These data support the idea that positive social norms could be protective against erosion of oral polio vaccine acceptance and that positive experiences with, and views of, vaccinators could help promote these positive social norms. Creative community engagement efforts may be able to leverage positive experiences with vaccinators to help foster social norms and protect against the risk of acceptance erosion.

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**Abbreviations:** OPV, Oral Polio Vaccine; UCs, union councils; HSPH, Harvard T H Chan School of Public Health.

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## 1. Introduction

Pakistan plays a critical role in global polio eradication efforts as one of only two countries where polio remains endemic. Eradication efforts in Pakistan are supported by the Government of Pakistan, alongside the Global Polio Eradication Initiative (GPEI), a public–private partnership that sustains polio eradication efforts across countries. The GPEI is made up of the World Health Organization (WHO), the US Centers for Disease Control and Prevention (CDC), UNICEF, Rotary International, Bill & Melinda Gates Foundation, and Gavi, the Vaccine Alliance. The backbone of vaccination efforts in Pakistan lie in door-to-door campaigns that aim to reach every child under age 5 years with oral polio vaccine (OPV) or “polio drops”. In these campaigns, OPV is administered by “vaccinators,” who are lay persons trained to deliver the drops. Because a child must receive multiple doses to generate a sufficient immune response, Pakistan holds multiple campaigns a year, with a greater number of campaigns in the areas at highest risk for transmission. In those areas, a family can experience as many as 12 campaigns per year [1].

Despite immense progress in years past, multiple threats have slowed success more recently. The caseload from wildtype polio virus was less than 10 in 2017, but rose to 147 in 2019, in part fueled by a surge in disinformation about vaccine harms fueled by social media in Spring 2019 [2,3]. Further, as rising cases began to threaten the timeline for transmission interruption, COVID-19 added new obstacles with disruptions to the door-to-door vaccination campaigns in 2020 [3–7].

When the timeline for transmission interruption is prolonged, there is concern that caregivers who have been accepting oral polio vaccine (OPV) until now will tire of or become frustrated with the frequent door-to-door vaccination campaigns, particularly in high-risk communities that lack other essential health services [8]. Receiving polio drops when other health concerns feel more pressing can be very frustrating for families. In turn, these caregivers may begin to turn down OPV broadly or refuse until other basic needs, including health care, are met [9]. Thus, communication and community engagement efforts need to focus not only on persuading the small fraction of parents and other caregivers who are not accepting OPV today, but also on preventing erosion of OPV acceptance among caregivers who have been accepting it previously.

Social norms may be an important protective factor against “campaign fatigue” and erosion of OPV acceptance during this stage of polio eradication efforts in Pakistan. Evidence from other contexts suggests that people are more likely to get vaccinated themselves or have their children vaccinated if they believe others in their social group do the same or believe their peers expect them to do so [10–13]. In the OPV context, this would mean that the perception that most neighbors accept OPV during the campaigns may help encourage parents to vaccinate their own children. This logic may be particularly applicable in Pakistan because the experience of vaccination is socially mediated. Neighbors may be aware of each other’s experiences because vaccinators move from door-to-door and visibly mark their visits on doorways with chalk. Further, social norms may be particularly important when there are relatively few cases of the illness and the immediate risk of a given disease does not feel pressing, which is the case in Pakistan [14].

If positive social norms are protective against vaccination decline in Pakistan, then developing communication campaigns that support these norms may help prevent OPV acceptance erosion. One possible strategy to enhance social norms may be through the vaccinators. The broader vaccination literature suggests that positive experiences with and perceptions of a provider, and particularly trust in providers, are critical in motivating vaccination acceptance [15,16]. Direct conversation with a provider may

be useful in generating trust that motivates acceptance [16], but plausibly these interactions also reinforce positive social norms around acceptance, as caregivers project their own views and experiences onto their peers. That is, neighbors might reasonably assume that if they have positive experiences with the vaccinator and accepted the vaccine, their neighbors also have accepted the vaccine. If this kind of thinking does happen, enhancing interactions with vaccinators could be an effective strategy not only for increasing vaccine acceptance at the moment of the visit, but also for promoting the social norms that could prevent acceptance erosion going forward.

To date, there has been little examination of the role of social norms in Pakistan’s polio vaccination efforts in the peer-reviewed literature. Research in other countries does suggest that neighbor support for giving OPV to children is associated with commitment to vaccinate [15–17], and this may be considered evidence for the role of subjective norms – that is, the belief that peers support vaccination broadly [18]. However, there has been no research about the role of descriptive norms – that is, the belief that peers are commonly vaccinating their children – in Pakistan or in other countries with polio transmission. Further, evidence is quite limited when it comes to understanding factors that may help promote positive subjective or descriptive norms. While it is often suggested that communication approaches should include messages about positive social norms [19], there is limited evidence about effective channels for promoting such norms or a role for vaccinators. Evidence about positive social norm promotion is missing not only in the case of polio vaccination in Pakistan, but also in the literature around vaccination.

In this study, we explore evidence about these two key issues: 1) the possible role of positive subjective and descriptive social norms in protecting against OPV acceptance erosion in Pakistan, and 2) the role of vaccinators in promoting these social norms. We utilize data from a poll of parents and caregivers of children under age five living in areas of Pakistan at high-risk for polio transmission.

## 2. Materials and methods

### 2.1. Study design and sample

The study utilizes data from a poll among a randomly selected sample of caregivers of children younger than 5 years within union councils (UCs) at high risk for polio transmission in Pakistan. Caregivers were primarily parents, but also included other adults in the household with responsibility for decisions about a 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 polls, together with input at all stages from other polio eradication partners in Pakistan. Fieldwork and data entry were completed by the Pakistan Institute of Public Opinion (Islamabad, Pakistan) with implementation support, field team training and independent quality checks on data and fieldwork provided by InterMedia (Washington, DC, USA) (Appendix). Data management and weighting were done by SSRS (Glen Mills, PA, USA), with final statistical analyses conducted by an independent consultant.

The study was approved by the National Emergency Operations Center in Islamabad, which is under the Ministry of National Health Services, Regulations and Coordination. The study was also reviewed by the HSPH’s Office of Human Research Administration, and was determined not to be human subjects research for HSPH teams because HSPH researchers were not directly involved in data collection and de-identified datasets were used for analysis.

The study targeted UCs at highest risk of polio transmission within the 13 highest-risk districts, as defined by GPEI partners in Pakistan. Interview teams for this study were able to reach 11 of the 13 districts, but security concerns prevented access to two: North and South Waziristan. Security-based access for research was determined by the field team per their internal assessments of risks for their field teams of interviewers. Final districts were Killa Abdullah, Pishin and Quetta (Balochistan); Bannu, FR Bannu, Khyber, Peshawar and Tank (Khyber Pakhtunkhwa); and Karachi Baldia and Karachi Gadap (Sindh) (Appendix).

The sample was drawn via a stratified multistage cluster design. The sampling frame consisted of villages (and urban circles) within the high-risk UCs of the selected districts. Interviews were allocated disproportionately at the district level to ensure sufficient sample sizes for analyses within districts (not part of these analyses). Within districts, sample was also allocated disproportionately by vaccinator program type (traditional or those with enhancements called “Continuous Community Protected Vaccination”) to ensure sufficient coverage across types of vaccinator efforts. Within each stratum, UCs were selected randomly with probability proportional to size, except where less than 20 existed and could all be included. Interviews were then allocated proportional to size. Villages were selected with equal probability, and a roughly equal number of interviews were conducted per village. Within each village, starting points were selected randomly from a list of major landmarks, and random route techniques to select each household. In each household, one caregiver and one reference child for whom they have responsibility (under age 5) were selected using a Kish grid. A random route approach was used because no list of households existed and because household enumeration was not possible due to security concerns and constraints of the proposed polio eradication timeline (Appendix). During fieldwork, four of 221 UCs were replaced with randomly selected alternatives due to flooding.

Interviews were conducted in Urdu and Pashto between February 23, and April 5, 2016, by gender-matched interviewers from the relevant province. Security concerns necessitated that only male interviewers undertake interviews in FR Bannu and Khyber. Respondents in these areas are therefore predominantly male because of cultural norms related to gender interactions. In all areas, intensive quality control measures were utilized, including pre-field interviewer training; in-person and phone-based back checks on individual interviews during fielding; and data quality checks in the final dataset (Appendix).

## 2.2. Procedures

The questionnaire consisted of 61 questions informed by studies of barriers to acceptance of OPV and other vaccines as well as by experiences of those working in Pakistan’s Polio Programme [20–30]. The questionnaire included questions about acceptance of OPV (“polio drops”) and intent to accept OPV in future; descriptive and subjective social norms related to acceptance; and experiences with and views of vaccinators, including trust. The questionnaire was translated into Urdu and Pashto, back-translated, and refined with considerations of cultural norms by independent in-country translators and pre-tested with caregivers (question wording is shown in tables).

## 2.3. Statistical analysis

Data were weighted to account for disproportionate sampling across districts using total population size as a proxy for caregiver population size. To compensate for possible non-response biases, data were also weighted by sex and age of caregivers using household rosters (i.e., an interviewer-generated listing of all caregivers

in the household), and by sex of child discussed in the interview using estimates of sex ratios for children younger than 5 years (Appendix) [31].

The data were analyzed in two steps [Fig. 1]. First, we examined the possible role of positive descriptive and subjective social norms in protecting against OPV acceptance erosion. We hypothesized that positive social norms are positively associated with high past vaccination and strong commitment to future vaccination. To do this, we calculated the prevalence of OPV acceptance (defined as accepting OPV “every time” it was offered in the past year or not) and commitment (defined as expecting to accept OPV “every time” it is offered until a child is 5 or not). We also calculated the prevalence of descriptive social norms (positive defined as stating “all” neighbors accept the vaccine every time it is offered and negative defined as not believing this) and subjective norms (positive defined as believing neighbors or friends think it is a “very good” idea to vaccinate children in the neighborhood and negative as not believing this). We then examined the associations between social norms and vaccination. We conducted uncontrolled comparisons using t-tests of differences in proportions as well as parallel comparisons using logistic regressions that controlled for differences in demographics (age, sex and education level of caregiver; number of children in household; and age of child).

Second, we examined the possible role of vaccinators in supporting social norms. We hypothesized that positive vaccination experiences are positively associated with positive social norms. To do this, we examined experiences with and perceptions of vaccinators. Only those who saw or talked to vaccinators in the last door-to-door campaign could answer these questions in the poll, and thus this part of the analysis was focused on this population (Appendix). Measures included perceived overall trust (defined as having “a great deal” or not); perceived compassion (defined as appearing to care for child “a great deal” or not); perceived technical competence (defined as being “very knowledgeable” or not); and overall experience (defined as being “very pleasant” or not). We then examined the associations between views of and experiences with vaccinators and social norms. We conducted uncontrolled comparisons using t-tests of differences in proportions and parallel comparisons using logistic regressions that controlled for differences in the same demographics.

Variables utilizing Likert scales were dichotomized for analyses such that analyses focus on differences between caregivers who gave the response at the end of the scale, such as “very good idea”, compared with those who gave all other responses, such as “somewhat good idea”, “somewhat bad idea”, or “very bad idea”. Responses at the positive end of the scale have been shown to better predict behavior than other response combinations in vaccine-related polls and the broader political science polling literature [32–35].

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. 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.

## 2.4. Role of the funding source

The polls were conducted through a program cooperation agreement between HSPH and UNICEF. The organizations collaborated on study design, instrument design, and analysis of de-identified data. Neither organization played a direct role in data collection.

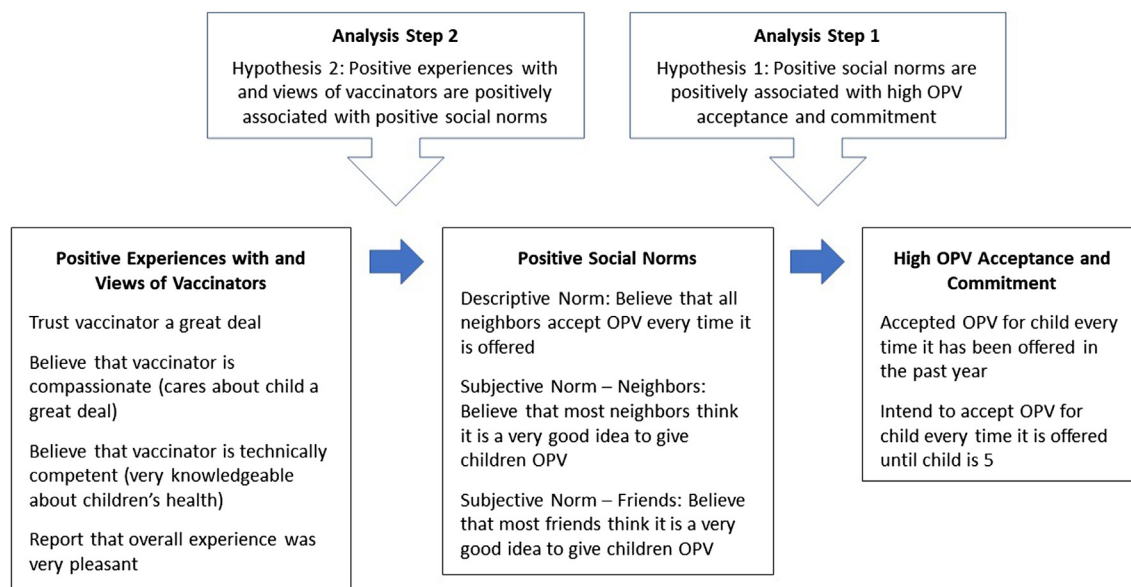


Fig. 1. Analytic steps and hypotheses.

### 3. Results

The response rate was 93%, which resulted in a total sample of 4070 caregivers (Appendix).

#### 3.1. Demographics

Caregivers were split between females and males (53% and 47% respectively) (Table 1). A relatively small fraction (10%) were under age 25, with the remainder split between those 25–34 (41%) and 35 or older (49%). More than a third were illiterate and could not read at all (37%). Approximately a quarter (25%) had 1–2 children in the household, while 42% had 3–4 and a third (33%) had 5 or more. About half (54%) provided answers in reference to their child age 2 or under, and the remainder (46%) provided answers in reference to their child age 3–4.

#### 3.2. Prevalence of OPV acceptance and commitment

Nearly all caregivers said they had accepted OPV for their child every time it was offered in the past year (93%) (Table 2). Nearly

Table 1  
Demographics. n = 4070.

Variable	Characteristic	Percent
Gender	Male	47%
	Female	53%
Age of respondent (years)	<25	10%
	25–34	41%
	35+	49%
Literacy level	Cannot read at all	37%
	Can read parts of simple sentences	13%
	Can read full simple sentences	50%
Number of children in household	1–2	25%
	3–4	42%
	5+	33%
Age of reference child (years)	≤2	54%
	3–4	46%

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

the same share said they intended to accept OPV for their child “every time it is offered” until they reached age 5 (97%).

#### 3.3. Prevalence of social norms

About two-thirds of caregivers held positive descriptive social norms, saying that “all” of their neighbors accepted OPV (“polio drops”) every time it was offered (66%) (Table 2). The remaining third (34%) held a negative descriptive norm, saying that not all of the neighbors accepted OPV every time it was offered.

More than half (56%) of caregivers held positive subjective social norms, saying that they thought their neighbors thought giving OPV to children in the neighborhood was a “very good” idea. A similar fraction (62%) said they believed their friends thought it was a “very good” idea.

#### 3.4. Relationship of social norms to OPV acceptance and commitment

Caregivers who held positive social norms were more likely to say their child received the vaccine every time it was offered in the past year as compared to those who held negative norms (96% vs. 88%) (Table 3). The same pattern held true in regards commitment to vaccinate. Those who held positive social norms were more likely to say they intend to accept OPV for their child every time it is offered until the child is five years old as compared to those who held negative social norms (98% vs. 94%).

#### 3.5. Prevalence of experiences with and views of vaccinators

Among caregivers who saw or talked to vaccinators in the last campaign, about two-thirds (68%) said they trusted the vaccinator(s) “a great deal,” while most others (30%) said they trusted them “somewhat” (Table 4). The pattern was similar for perceiving the vaccinator(s) cared “a great deal” about the child (67%) and thinking the visit was “very pleasant” (65%). A smaller fraction (52%) said that vaccinators were “very knowledgeable”, a quarter (25%) said they were “somewhat” knowledgeable, and the remainder said they were “not very” or “not at all” knowledgeable (9% and 11%, respectively).

**Table 2**  
Prevalence of Acceptance, Commitment and Social Norms n = 4070.

Concept and Question	Response Category	Percent
<b>Acceptance</b> <i>Thinking about all visits within the past year, did [child] receive polio drops every time, most of the times, just a few of the times, only once, or never?</i>	Every time (“Accepted”)	93%
	Not “every time” (“Did not accept”)	6%
	Most of the times	4%
	Just a few of the times	1%
	Only once	<0.5%
	Never	<0.5%
	Don’t know	1%
<b>Commitment</b> <i>By the time [child] reaches [his/her] 5th birthday, how often do you intend to have polio vaccinators give [child] polio drops?</i>	Not asked <sup>†</sup>	1%
	Every time polio drops are offered (“Committed”)	97%
	Not “every time polio drops are offered” (“Uncommitted”)	3%
	Most of the times polio drops are offered	2%
	Just a few of the times polio drops are offered	1%
	Only once	<0.5%
	Never	<0.5%
<b>Descriptive Social Norm</b> <i>How many of your neighbors do you think give polio drops to their children every single time polio vaccinators go to their home?</i>	Don’t know	<0.5%
	Have not heard of polio	<0.5%
	All of your neighbors do (“Positive Descriptive Social Norm”)	66%
	Not “all of your neighbors do” (“Negative Descriptive Social Norm”)	34%
	Most of your neighbors do	28%
	Not very many of your neighbors do	3%
	None of your neighbors do	0%
	Don’t know	2%
	Have not heard of polio	<0.5%
	Very good idea (“Positive Subjective Social Norm – Neighbors”)	56%
<b>Subjective Social Norm - Neighbors</b> <i>As far as you know, what do each of the following people in your neighborhood think of the idea of giving polio drops to children in your neighborhood? What do most of your neighbors think?</i>	Not a “very good idea” (“Negative Subjective Social Norm – Neighbors”)	43%
	Somewhat good idea	30%
	Somewhat bad idea	10%
	Very bad idea	1%
	Don’t know	3%
	Have not heard of polio	<0.5%
	Very good idea (“Positive Subjective Social Norm – Friends”)	62%
	Not a “very good idea” (“Negative Subjective Social Norm – Friends”)	37%
<b>Subjective Social Norm - Friends</b> <i>As far as you know, what do each of the following people in your neighborhood think of the idea of giving polio drops to children in your neighborhood? What do most of your friends think?</i>	Somewhat good idea	33%
	Somewhat bad idea	2%
	Very bad idea	<0.5%
	Don’t know	1%
	Have not heard of polio	<0.5%

<sup>†</sup> Those not asked the question include those who said polio vaccinator(s) have never come to their home, polio vaccinator(s) have not come to their home in the past year, or they have not heard of polio.

**3.6. Relationship between experiences with or views of vaccinators and social norms**

Three of the four measures of views of and experiences with vaccinators were associated with the descriptive social norm (Table 5). Those who trusted the vaccinators “a great deal” were more likely to say they thought all their neighbors accept OPV every time offered as compared to those who had less trust in the vaccinators (71% vs. 60%). Similar patterns were true for measures of compassion and the overall tone of the visit. Believing the vaccinator was “very” knowledgeable was not statistically significantly related to holding the positive descriptive social norm.

All four measures of views of and experience with vaccinators were associated with the subjective social norms. For example, those who trusted the vaccinators “a great deal” were more likely to say they thought all their neighbors accepted the OPV (“polio drops”) every time offered as compared to those who had less trust in their vaccinators (63% vs. 37%).

All differences remained statistically significant after controlling for demographic characteristics.

**4. Discussion**

This is the first study to examine social norms around OPV vaccination in Pakistan in recent years. These data collectively suggest the utility of considering social norms as a marker for risk in OPV acceptance erosion and as a possible tool in protecting against acceptance erosion. The data further suggest the possibility of leveraging vaccinators as a means to reinforce and promote positive social norms.

First, the data here suggest that social norms possess characteristics that could make them a useful lever in strategies to protect against OPV acceptance erosion. For one, the data support our first hypothesis: positive social norms are positively associated with vaccine acceptance and commitment to vaccinate in future. The association is not large, mostly likely because there is limited vari-

**Table 3**  
Association Between Social Norms and Vaccine Acceptance and Commitment. n = 4070.

	% Accepted	p-value	% Committed	p-value
<b>Descriptive Social Norm</b>				
<i>How many of your neighbors do you think give polio drops to their children every single time polio vaccinators go to their home?</i>				
All of your neighbors do (“Positive Descriptive Social Norm”)	<b>96%</b>		<b>98%</b>	
Not “all of your neighbors do” (“Negative Descriptive Social Norm”) (Most of your neighbors do; Not very many of your neighbors do; None of your neighbors do; Don’t know)	88%		94%	
<b>Subjective Social Norm - Neighbors</b>				
<i>As far as you know, what do each of the following people in your neighborhood think of the idea of giving polio drops to children in your neighborhood? What do most of your neighbors think?</i>				
Very good idea (“Positive Subjective Social Norm – Neighbors”)	<b>95%</b>		<b>98%</b>	
Not a “very good idea” (“Negative Subjective Social Norm – Neighbors”) (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	91%		95%	
<b>Subjective Social Norm - Friends</b>				
<i>As far as you know, what do each of the following people in your neighborhood think of the idea of giving polio drops to children in your neighborhood? What do most of your friends think?</i>				
Very good idea (“Positive Subjective Social Norm – Friends”)	<b>95%</b>		<b>99%</b>	
Not a “very good idea” (“Negative Subjective Social Norm – Friends”) (Somewhat good idea; Somewhat bad idea; Very bad idea; Don’t know)	90%		94%	

Note: Bolded data indicates differences that are statistically significant after controlled comparisons.

**Table 4**  
Prevalence of Experiences with and Views of Vaccinators. n = 2565.

Variable	Response	Percent
<b>Trust</b> <i>Overall, how much did you trust the polio vaccinator(s)?</i>	A great deal	68%
	Not “a great deal”	32%
	Somewhat	30%
	Not very much	0%
	Not at all	0%
<b>Perceived Compassion</b> <i>How much did the polio vaccinator(s) seem to care about the well-being of [child]?</i>	Don’t know	2%
	A great deal	67%
	Not “a great deal”	33%
	Somewhat	28%
	Not very much	2%
<b>Perceived Technical Competence</b> <i>Were the polio vaccinator(s) knowledgeable about children’s health or not?</i>	Not at all	1%
	Don’t know	2%
	Very knowledgeable	52%
	Not “very knowledgeable”	48%
	Somewhat knowledgeable	25%
<b>Assessment of Experience</b> <i>Overall, how pleasant or unpleasant was this last visit when the polio vaccinator(s) offered drops?</i>	Not very knowledgeable	9%
	Not knowledgeable at all	11%
	Don’t know	3%
	Very pleasant	65%
	Not “very pleasant”	35%
	Somewhat pleasant	32%
	Somewhat unpleasant	1%
Very unpleasant	<0.5%	
Don’t know	2%	

ation in the vaccination rate at this point in the Programme’s progress, but the association between social norms and vaccination is in the expected direction and is consistent with the literature [12]. Reasonably then, positive social norms may protect against OPV acceptance erosion in this context. Moreover, social norms are more variable in the population than reported acceptance or commitment. That is, fewer people say that all their neighbors accept OPV every time than say they themselves accept OPV every time. Thus, this measure of social norms could be a useful marker for risk of acceptance erosion when acceptance and commitment are so high. Further, the discrepancy between the fraction of caregivers who think that their neighbors accept the vaccine and those who personally do suggests more people could be made aware of the norm of high acceptance in their community. Communication efforts could create related messages that would be shared through

social and mass media approaches. Communication strategies may also effectively include layered approaches that incorporate direct communication, as the vaccinator may explicitly share messages about how high vaccination rates are in the community. A focus on social norms thus provides an opportunity for a communication strategy in a context where other communication strategies for vaccination may feel tapped out.

Second, the data also support our second hypothesis: positive experiences with vaccinators are associated with both descriptive and subjective positive social norms. That is, caregivers who felt positively about their own vaccinator experience also thought their neighbors accepted the vaccine and thought their peers encouraged them to do so. Communication tactics beyond messaging about social norms directly may therefore also be useful, and more attention may need to be paid to the relationship with vaccinators

**Table 5**  
Relationship between Experiences With or Views of Vaccinators and Social Norms. n = 2565.

	% Holding Positive Descriptive Social Norm	p-value	% Holding Positive Subjective Social Norm - Neighbors	p-value	% Holding Positive Subjective Social Norm - Friends	p-value
<b>Trust</b>						
<i>Overall, how much did you trust the polio vaccinator(s)?</i>						
A great deal	<b>71%</b>		<b>63%</b>		<b>66%</b>	
Not "a great deal" (Somewhat; Not very much; Not at all; Don't know)	60%		36%		44%	
<b>Perceived Compassion</b>						
<i>How much did the polio vaccinator(s) seem to care about the well-being of [child]?</i>						
A great deal	<b>72%</b>		<b>63%</b>		<b>66%</b>	
Not "a great deal" (Somewhat; Not very much; Not at all; Don't know)	57%		37%		45%	
<b>Perceived Technical Competence</b>						
<i>Were the polio vaccinator(s) knowledgeable about children's health or not?</i>						
Very knowledgeable	69%		<b>60%</b>		<b>63%</b>	
Not "very knowledgeable" (Somewhat knowledgeable; Not very knowledgeable; Not knowledgeable at all; Don't know)	65%		49%		55%	
<b>Assessment of Experience</b>						
<i>Overall, how pleasant or unpleasant was this last visit when the polio vaccinator(s) offered drops?</i>						
Very pleasant	<b>73%</b>		<b>64%</b>		<b>67%</b>	
Not "very pleasant" (Somewhat pleasant; Somewhat unpleasant; Very unpleasant; Don't know)	56%		36%		44%	

Note: Bolded data indicates differences that are statistically significant after controlled comparisons.

and the vaccinator experience. Enhancing the vaccinator experience by increasing trust, the degree to which parents feel the vaccinator genuinely cares about the child, the perceived competence of the vaccinator, and the "pleasant" features of the visit could help bolster social norms that protect against acceptance erosion. To enhance the vaccinator experience, there are multiple aspects of the visits to consider, including adaptive timing and sequencing of campaigns so as to be least disruptive to families. One may also consider adjusting the demographic profile of the vaccinators to help enhance trust. This may include taking measures to ensure vaccinators reflect characteristics more likely to be trusted in a given community (e.g., older women or men) or that vaccinators come from the community rather than traveling from different villages or cities [15,36,37]. Further, it may be important to consider ways in which the vaccinators themselves are supported. Vaccinators in Pakistan, and elsewhere, have sometimes faced serious challenges, including harassment and assault [3]. With this in mind, attention to the needs of vaccinators, including not only security, but also their sense of being valued through training, mentorship and pay, becomes paramount. While many of these features have been explored and addressed by the Polio Programme in past, the data here reinforce the importance of these efforts and encourage continued consideration and full application, particularly as campaign timelines stretch.

There are limitations to the data in these analyses. First, the data are self-reported and thus true vaccination and commitment rates may be lower than those reported here due to social desirability bias. In particular, even though the survey teams explicitly explain that they are independent of the Polio Programme and individual responses would be kept confidential, caregivers may report higher vaccination rates because they nonetheless believe that the interviewers are supportive of polio vaccination or that interviewers will report caregivers' answers to the Polio Programme and create negative consequences for their family [38,39]. There is no reason to think this would distort the relationship between social norms and acceptance, however. In this way, the risk of social desirability does not threaten the major findings in our study, though it does reinforce the importance of addressing

acceptance more fundamentally. Second the data are cross-sectional, which limits causal interpretation of the data. Although this means there cannot be formal proof that enhanced vaccinator experience causes caregivers to have positive social norms or that these cause higher vaccination acceptance, the findings are consistent with a broader literature that suggests the relationship with a provider taps into multiple dimensions that can help foster trust. Third, the measures of social norms are based on only a handful of questions. Such clear relationships with these measures are encouraging, and future research could explore the particular dimensions of social norms in more detail. Finally, the findings may not apply to those who did not participate in the study, including the small fraction of non-responders within these high-risk districts and those living in the two research-inaccessible districts.

Despite these limitations, these data provide initial evidence about the utility of leveraging positive experiences with and views of vaccinators as a means to promote social norms and protect against the risk of OPV vaccination erosion in the last stages of polio eradication efforts in Pakistan. Findings provide support for several recommendations for the Polio Programme to consider including a more direct focus on high community acceptance rates in messaging, whether through mass and social media, community engagement efforts, or personal communications by vaccinators. Further, the Programme may consider ways to enhance the vaccinator and caregiver interaction through consideration of timing and vaccinator profile as well as through direct support of the vaccinators, in training, compensation and security.

Although these data provide many avenues for development, we acknowledge that even such diverse efforts may not be sufficient alone. For example, program reviews suggest that repeated rounds of OPV in the absence of other service provision may be viewed negatively and thus integration of OPV with other health programming may also be important in bolstering on-going community acceptance [40]. Further, though vaccinators have been leveraged for COVID-19 social mobilization, the impact of COVID-19 on community perceptions of OPV is not well understood and may be perceived as even less important. That said, findings from



our analyses complement these considerations. Creative community engagement strategies that focus on combined services related to COVID-19 and polio may be able to leverage findings here about social norms and provider experience to protect against vaccination acceptance erosion during the remaining timeline for polio transmission interruption and eradication certification.

Finally, the importance of social norms, and the role that providers may play in bolstering those norms, may be useful considerations in contexts outside the Polio Programme in Pakistan as there are other contexts of repeated vaccinations where the imminent threat of the illness may feel low and there is the threat of acceptance erosion over time. This could be true in other countries with frequent polio campaigns – whether that be in Afghanistan, where the virus is also endemic and campaigns have historically been frequent – or in countries where reintroduction of polio or vaccine-derived polio outbreaks require an intensive series of campaigns relative to what the country is used to. It is also reasonable to consider whether these findings are relevant in contexts where there is a schedule of multiple vaccines, even if they are not individually repeated. That is, in other vaccination efforts, it may be possible for frontline workers to motivate vaccine uptake by explicitly discussing social norms or implicitly projecting support for vaccination as a social norm. In this way, results here help point the way toward areas of exploration that may be fruitful for many different vaccination efforts.

#### 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 views of any portion of the Government of the Islamic Republic of Pakistan, UNICEF, the Harvard T H Chan School of Public Health, SSRS, InterMedia or any other institutions with which authors have worked.

#### Author contributions

GS, HC, and RB contributed to the study design, questionnaire development, data analysis and interpretation, and manuscript writing. RM and JR contributed to study design, questionnaire development, data analysis and interpretation, and manuscript revisions. DC, LD, JA, RMS and PR contributed to data analysis and interpretation as well as manuscript revisions. BG and DO contributed to questionnaire development, data collection, and data analysis and interpretation. MW and EB contributed to data analysis and interpretation, as well as manuscript revisions. All authors approved the final version of the manuscript.

#### Declaration of Competing Interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: GKS, HC, and RJB report grants from Robert Wood Johnson Foundation to HSPH, a contract from the US Centers for Disease Control and Prevention to HSPH, and a subcontract from the Association of State and Territorial Health Officials. GKS's husband has done consulting work for Eli Lilly in the past 3 years. RM, RMS, LD, DC, JA, JR, PR, DO, BG, MRW and ENB-P declare no competing interests.

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#### Appendix A. Supplementary material

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