Fostering Engagement of Underserved Communities with Credible Health Information on Social Media

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ABSTRACT

The COVID-19 pandemic has necessitated rapid top-down dissemination of reliable and actionable information. This presents unique challenges in engaging hard-to-reach, low-literate communities that live in poverty and lack access to the Internet. Voice-based social media platforms, accessible over simple phones, have shown demonstrable impact in mutually connecting underserved populations and providing them access to instrumental information. We describe the design and deployment of a voice-based social media platform in Pakistan for actively engaging such communities with reliable COVID information. We developed three strategies to overcome the hesitation, mistrust, and skepticism depicted by users in engaging with COVID content. Users were: (1) encouraged to listen to reliable COVID advisory, (2) incentivized to share authentic content with others, and (3) prompted to critically think about COVID-related information behaviors. Using a mixed-methods evaluation, we show that users approached with all three strategies had a significantly higher engagement with COVID content compared to others. We discuss how new designs of social media can enable users to engage with and propagate authentic information.

CCS CONCEPTS

• **Information systems** → **Social networking sites**; • **Human-centered computing** → **Sound-based input / output**.

KEYWORDS

COVID-19, health, voice, social networks, Web4Good, ICT4D.

ACM Reference Format:
Agha Ali Raza, Mustafa Naseem, Namoos Hayat Qasmi, Shan Randhawa, Fizzah Malik, Behzad Taimur, Sacha St-Onge Ahmad, Sarojini Hirshleifer, Arman Rezaee, and Aditya Vashistha. 2022. Fostering Engagement of Underserved Communities with Credible Health Information on Social Media. In *Proceedings of the ACM Web Conference 2022 (WWW '22), April 25–29, 2022, Virtual Event, Lyon, France.* ACM, New York, NY, USA, 10 pages. https://doi.org/10.1145/3485447.3512267

WWW '22, April 25–29, 2022, Virtual Event, Lyon, France

ACM ISBN 978-1-4503-9096-5/22/04…$15.00
https://doi.org/10.1145/3485447.3512267

1 INTRODUCTION

Online health misinformation has caused serious harm to low-income communities in the Global South. Take the case of COVID misinformation in Pakistan which led people to resist vaccines, physically assault health workers, and follow false health advice that led to hospitalizations and deaths [19]. According to a poll by Ipsos [37], 97% of Pakistanis had misconceptions about the coronavirus. These risks are particularly high for millions of low-income, low-literate people who are more likely to believe rumors, hearsay, and unverified information [40].

The presence of health misinformation is deeply concerning not only on mainstream social media platforms like Facebook and Twitter but also on the alternative services that are built for people who lack access to smartphones and the Internet. Over the last two decades, *voice-based* social media platforms have been enabling people who are poor, remote, and low-literate to still get the benefits of the Internet [11, 23, 32, 33, 49, 50]. These platforms allow users to call toll-free phone numbers to record voice messages in their local language, and listen to and react to messages recorded by others. For example, Mobile Vaani connects over five million people to *infotainment* in the media-dark regions in India [38] and CGNet Swara enables rural communities to listen to local news and report grievances [23]. These platforms have shown demonstrable impact in mutually connecting underserved communities and providing them access to instrumental information in diverse domains, including health and civic engagement, among others.

Many scholars have examined the vital role that mainstream social media plays during crises and disasters, for example, by establishing rapid and direct communication channels from authorities, providing support and information to people in need, and bringing to light the challenges on the ground. However, there is a scarcity of research on how voice-based social media platforms are used during public health emergencies by users who are predominantly low-literate and low-income. Prior work shows that voice-based

platforms face major hurdles in actively engaging the target populations with reliable health information [53]. Moreover, the extent to which users are willing to trust the delivered information, engage with it, and spread it in their own networks remains unknown.

To fill this gap, we designed and deployed a voice-based social media platform to provide reliable health information to underserved communities in Pakistan to protect them from the misinformation prevalent during the pandemic. We examined three strategies to foster engagement with and dissemination of trusted information: (1) encourage users to access a curated list of approved health guidelines, (2) provide them incentives to engage with and propagate trusted COVID content, and (3) prompt them to reflect on their COVID-related information behaviors.

Over a six-month deployment, the platform received half a million calls from 12,000 users, who were predominately low-literate, low-income men from all across Pakistan, with 96% having less than ten years of education. These users recorded over 35,000 audio posts, played them over 2.4 million times, voted on them 322,000 times, and shared them with other users over 130,000 times. Using a mixed-methods approach spanning quantitative analysis of 459,430 call logs, content analysis of 20,623 audio posts and 82,975 audio comments containing 773 hours of audio data, and qualitative analysis of 1,000 posts and comments, we analyzed how our platform was used and the extent to which it succeeded in providing users access to credible health information.

We found that users approached with all three strategies showed comparatively higher engagement with authentic COVID information. The engagement was not limited to messages being played by the users, and included users recording their own COVID content and engaging with and sharing credible content widely with their peers. Users adapted the platform to meet their specific informational, emotional, and instrumental needs. Our findings highlight *knowledge engagement* as being more meaningful and relevant for information campaigns compared to *user engagement with the platform and its features*. Our work provides critical insights on how social media platforms can foster user engagement with credible content and, in doing so, makes two important contributions:

(1) A six-month deployment of a voice-based social media platform in Pakistan, providing insights into how low-literate people engaged with credible health information during the pandemic,

(2) A mixed-methods analysis that evaluated the efficacy of three design strategies to foster user engagement with health information.

2 RELATED WORK

We first describe prior work that highlights the promises and pitfalls of using social media during public health crises along with strategies used by platforms to improve engagement with reliable health content. We then present the novel application of voice-based platforms, accessible over simple phone calls, to spread health information to vulnerable communities in the Global South.

2.1 Public Health Crises and Social Media

The role of social media before, during, and after crisis situations is well studied in the field of crisis informatics [28]. Initially, social media was seen as a powerful channel for information seeking and sharing at times of crises [7]. Even public health agencies, such as the Centers for Disease Control, recommended using social media to engage the public during emergency situations [35]. Early research in crisis informatics also hailed social media as a means to transmit credible information with crisis responders providing helpful online resources and expert interpretations of the events [6, 8, 13, 14]. However, there was a notable shift when scholars found malicious, suspicious, and misleading information spreading on social media. For example, an analysis of tweets during the Zika virus outbreak in 2016 found a disconnect between the interests and concerns of the general public and the communication of public health authorities [15] and reported widespread uncertainty and ambiguity [16]. False information resulted in anxiety and panic, further exacerbating the problem [12].

A small, but growing body of research has examined the use of mainstream social media platforms during public health crises in developing regions (e.g., dengue outbreak in Bangladesh [41], Ebola outbreak in Nigeria [26]). Scholars have noted the high prevalence of misinformation on social media [27] and have noted the complexities of communicating credible information during public health crises, highlighting the social, political, and ethical hurdles in doing so [4]. With the COVID pandemic, the challenge of accessing credible health information on social media became even more extenuated, with the World Health Organization coining the term *infodemic* – too much information including false or misleading information in digital and physical environments [55]. In response, social media platforms implemented a series of design changes to facilitate the spread of reliable information and curb the spread of misinformation. Facebook created a dedicated space called the Coronavirus Information Center [21], featuring at the top of the news feed, for people to access up-to-date, reliable information. Similarly, Twitter added a dedicated tab in #Explore called COVID-19 that included public service announcements and tweets from public health experts [18], and also created a dedicated COVID-19 page at the top of the timeline for users in over 30 countries. Facebook and Twitter also created educational pop-up messages to direct users to credible information from health organizations when they engaged with COVID information [10, 18].

As most of these strategies are nascent, there is no evidence of their effectiveness in spreading reliable health information. Our work fills this urgent gap via the deployment of a health service on a popular voice-based social media platform in Pakistan. We attempted specific strategies to engage users with credible health information, and systematically evaluated whether these strategies lead to any change in the spread of and engagement with credible health information by low-literate people.

2.2 Social Media for Underserved Communities

Mainstream social media platforms exclude billions of people in the Global South who lack literacy, digital literacy and access to the Internet. In Pakistan, the region of our research focus, only 17% of the population has access to the Internet [1]. Over the last two decades, several *voice-based* social media platforms have been deployed to connect people who are too poor to afford Internet-enabled devices, too remote to access the Internet, or too low literate to navigate the mostly text-driven Internet [52]. These platforms let users call a toll-free phone number to record voice messages in

their local language and listen to and react to messages recorded by others. For example, CGNet Swara [24] enables rural communities in India to report and listen to locally relevant news, grievances, and cultural content. User-recorded news and messages are fact-checked, published on a website and the platform, and viewed by activists, bureaucrats, and journalists. Since its inception, CGNet Swara has received over 600,000 phone calls, 6,500 reports, and resulted in the resolution of hundreds of grievances. Voice-based platforms like CGNet Swara have demonstrated strong potential to enable information access and connectivity among underserved communities in diverse Web4Good contexts [11, 17, 23, 25, 29].

While several scholars have designed and deployed these platforms to provide health-related information to vulnerable populations in hard-to-reach settings (e.g., maternal care [25, 44], HIV [22], health information for refugees [47], and training of frontline health workers [54]), there is a scarcity of research that explores the potential of these platforms in providing credible health information to underserved communities during public health crises and disasters. We found only one study that used such a platform to spread credible information during crisis. In 2014, Wolfe et al. [53] utilized a peer-to-peer entertainment platform, Polly Sante', to disseminate information about Ebola in Guinea in eleven local languages. They reported several challenges in meaningfully engaging vulnerable groups, including lack of traction of the platform among target users and low engagement with the delivered information, among others. Our work extends this research by deploying a health service on a popular voice-based social media platform in Pakistan, attempting specific strategies to increase engagement of users with credible health information, and using a mixed-methods approach to systematically evaluate the outcomes.

3 SYSTEM DESIGN

We deployed the COVID information hotline over *Baang*, a popular voice-based social media platform in Pakistan [32]. Typical user interaction with Baang begins with a missed call. To use the platform, users place a call on the phone number, quickly hang up as soon as it rings, and then expect a callback. The system then calls back and allows the user to record audio posts or listen to posts sorted by recency, popularity, or trending. After listening to each post, users can vote on, comment on, report, and share the post (by entering the recipient's phone number). The system calls up all recipients and delivers the posts after announcing the pre-recorded names of the senders. After playing the shared post, Baang lets recipients continue browsing other posts and record their own content. Baang was first deployed in Pakistan in 2015 for eight months, during which it virally reached over 10,000 users who placed 269,000 calls and recorded 44,000 audio posts that were played nearly 3 million times. Users also contributed 124,000 audio comments and 343,000 votes on the posts. Most users were low-literate young men from all across Pakistan with a large fraction having no formal education. They included students, teachers, farmers, manual laborers, shopkeepers, and drivers, among others. About 30% of the users were unemployed, more than half had no access to the Internet, and the majority had never used social media.

At the onset of the pandemic, we partnered with Baang to (1) disseminate up-to-date COVID advisory from reliable sources, (2) encourage the users to engage with and propagate reliable COVID content, and (3) curtail the spread of COVID misinformation and misconceptions. We developed three strategies to foster users' engagement with and dissemination of trusted information: (1) nudging users to access a curated list of approved health guidelines, (2) providing incentives to propagate trusted COVID content, and (3) compelling them to think critically about their information behaviors. We now describe these three strategies in detail.

3.1 Nudge Users to Engage with Reliable Posts

To *nudge*[1] users to engage with and propagate reliable COVID advisory, we introduced a new option at the beginning of the main menu of Baang (see Figure 1) that allowed users to listen to and share seven short audio messages created based on the guidance from NIH Pakistan [2] and the government of Pakistan [45]. We refer to these messages as the *official COVID posts*. These posts covered the most essential aspects of the pandemic and its associated risks, the ensuing social responsibilities, the channels of disease spread, advice for healthy and symptomatic individuals, and steps to seeking professional care. Appendix A shows the seven messages that remained live for the entire duration of the deployment, and 16 messages debunking popular myths about the coronavirus. These posts were presented in a round-robin order. As the content was vetted, users could not report it and their posted comments were not made public to prevent potential spread of misinformation.

3.2 Incentives to Spread Reliable Posts

We made Baang toll-free so that people who could not afford airtime could also use it. However, we imposed daily usage quotas to contain the costs. Each user was assigned 30 "Baang-minutes" on their first call to the platform each day, which allowed them to use the platform for 30 minutes without any restrictions. We provided several incentives to motivate users to propagate reliable COVID-related information and bring new users to the platform. The incentives took the form of increased usage quotas that allowed users to spend more time on Baang without any costs. A user earned: (1) 5 Baang-minutes for sharing a post with an existing user, when the recipient answered the delivery call, (2) 10 minutes for bringing a new user to Baang, (3) 30 minutes if the new user remained on the delivery call for more than a minute, and (4) 60 minutes when the new user called the platform again.

3.3 Think About Information Behaviors

To encourage users to scrutinize their information behaviors, we created four thought-provoking posts that users had to listen to. These posts encouraged them to adopt good information behaviors, consider the authenticity of their information sources, and disseminate reliable COVID advisory to their communities (see Appendix B). These messages were "pinned" to the start of all playlists, one at a time, for 48 hours each. Users had to listen to a pinned message up to three times before it was "unpinned" for them.

[1] A small design change that can markedly affect individual behavior [48]

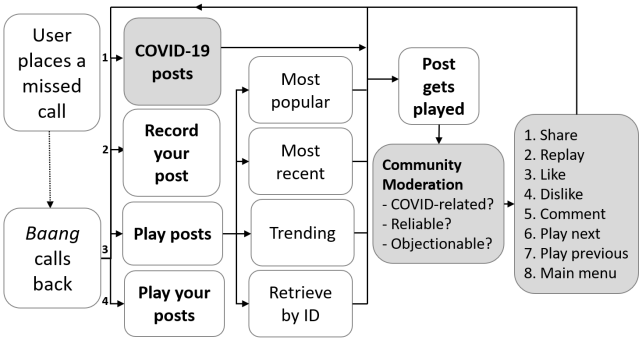

Figure 1: User interface of Baang (modifications in gray)

3.4 Ethical Considerations

We took a number of steps to protect the target communities from any unintended harm. To begin with, a team of six paid content moderators listened to all posts and comments within 4 hours of being posted, and removed any content containing misinformation and hate speech. The team also included a public health expert who conducted training sessions and provided detailed content annotation guidelines to the team. Users were also provided with options to report misinformation and inappropriate content. Users found to be repeatedly posting inappropriate content (0.002% of all users) were permanently suspended.

For the official COVID posts, users were informed about the main information source at the start of the interaction. Most of the content was taken verbatim in Urdu from the source websites and was played to the users following the same relative priority as dictated by the sources. Whenever any part of the advisory needed translation, it was reviewed by a bilingual public health expert to ensure the accuracy of the translation.

Our study was approved by the Institutional Review Boards of all the involved organizations that had access to personally identifiable user data. Through simply-phrased and elaborate disclaimers, users were informed to engage with the platform voluntarily and refrain from sharing personal information, such as phone numbers and addresses. Users were also informed that their recorded content and activity on the platform would be used for research and to help provide them with better services in the future.

4 METHODS

We used a mixed-methods approach spanning content analysis, thematic analysis, and usage analysis, to study the engagement of users with trusted COVID content.

Content Analysis. A team of six annotators performed annotation of 20,623 audio posts (58% of all posts) and 82,975 audio comments (53% of all comments), spanning 773 hours of audio data that was gathered over the final three months of the deployment. This period was selected because all of the user-engagement interventions were rolled out during these three months. After listening to each recording, the annotators assigned a hierarchy of tags, including COVID/Non-COVID, misinformation/reliable, and tags to mark content type. Initially, we assigned 200 posts to each coder to fill the rubric and found satisfactory inter-rater agreement using Cohen's Kappa. We then divided the remaining dataset into multiple non-overlapping partitions and assigned a partition to each coder. The metadata thus generated was central to our analysis to examine the types of content generated and propagated on the platform. Table 1 shows the tags which are discussed further in section 5.2.

Thematic Analysis. We used thematic analysis [9] to examine over 1,000 user posts, representing seven hours of audio data. We subjected the data to open coding and rigorously categorized our codes to examine the attitudes of people around the pandemic, including their responses and sentiments towards COVID-related official and pinned posts. Three authors regularly participated in the coding process and iterated upon the codes until consensus was reached. Over the course of the analysis, they discussed the coding plan, developed and reviewed the codebook, refined codes, and finalized categories and themes. The first-level codes were specific, such as denial of the existence of COVID, high testing costs, and scarcity of beds. After several iterations, the codes were condensed into high-level themes, such as COVID misinformation, feedback on government policies, and personal stories.

Usage Analysis. To support our content and thematic analyses, we examined the usage logs from nearly half a million calls containing fine-grained user interaction data, such as the time users spent on interacting with trusted and user-generated content.

User Demographics. We performed a telephonic survey of 300 stratified users of the platform, with 150 randomly sampled participants, and oversampling for 75 users who posted misinformation, and 75 users who were active users of the platform based on the number of comments they posted. About 93% of the users self-identified as being males. This finding is consistent with analysis of other voice-based platforms that attributed low female participation to disproportionate access to mobile phones and unpleasant experiences [51]. About half of the respondents were between the ages of 30 and 39, nearly 42% were below the age of 29, and the rest were over 40 years old. The users were located all over Pakistan, representing 53 districts. The majority of the users were low-literate, with 96% who did not attend high school, 57% who did not attend middle school, and about 16% who never finished primary school.

Methodological Limitations. We did not have a pure control group and did not use randomized control trials to establish causal relationships between engagement with the three interventions and the COVID content. This was a conscious ethical decision as we could not justify intentionally depriving any group of users of accessing reliable COVID information at the time of a public health crisis. Instead, our work shows that user engagement with the three interventions (official posts, incentives, pinned posts) is a strong predictor of their eventual engagement with (and spread of) reliable COVID content. Also, future studies are needed to isolate the comparative impact of the three interventions.

5 FINDINGS

We first describe user engagement trends (5.1), before outlining the results of the content and thematic analyses of user content (5.2). We then present the extent to which our strategies succeeded in fostering engagement with and propagation of trusted content.

5.1 General Usage

We placed COVID information on Baang on Apr 03, 2020, and it remained live until Sept 30, 2020. During these six months, the platform received nearly half a million calls from 12,000 users who recorded 35,000 posts and 156,000 comments, contributed 322,000 votes, and listened to posts over 2.4 million times. Specific to the official COVID posts, the first seven were played 46,488 times by 4,233 users while the remaining sixteen (myth-busters) were played 8,447 times by 735 users. About half of the users who listened to any user-generated post also listened to at least one official COVID post. These posts were shared 8,629 times by 748 users with 2,951 recipients, liked 2,080 times, and disliked 397 times. Users also posted 1,425 audio comments on these posts. The four pinned posts were played 2,580 times by 1,296 users who shared them 280 times and posted 420 likes, 99 dislikes, and 453 audio comments on them.

We found that 178 users recorded 390 posts related to COVID, of which 41 were found to contain misinformation (nearly 10% of all COVID posts and 0.19% of all tagged posts) and were immediately removed from the platform. The remaining 349 COVID posts were played 24,412 times by 1,111 users who shared them 1,499 times, liked them 2,168 times, disliked them 603 times and posted 1,454 audio comments. There were 536 comments that were about topics related to COVID. The recorded posts spanned 274 hours of audio data, with 5.4 hours of COVID-related content and 21 minutes of content containing misinformation. Similarly, the audio comments spanned 935 hours, with nearly four hours of COVID-related comments, and 30 minutes of comments containing misinformation.

5.2 Qualitative Analysis of Audio Data

Table 1 shows the outcome of the thematic tagging of 20,623 posts and 82,975 comments. Nearly 98% posts pertained to topics unrelated to COVID including religious poetry (18%), audio game shows (radio-like programs spanning multiple posts) (12.5%), discussions, singing, news, personal experiences, etc. Among the posts deleted by the moderators, 0.1% contained sexual harassment and misogynistic comments, 0.07% were abusive, and 4.8% contained hate speech and impolite remarks. In some cases, such remarks were directed towards our team by users whose posts had been removed from the platform. In nearly 3% of posts, users tried to promote responsible posting and sharing habits.

Table 1 also shows the 2.4% of posts pertaining to COVID which were further categorized into 13 topics. We then transcribed, qualitatively coded, and thematically organized these posts into the following themes: (1) comment on government policies, (2) COVID misinformation, and (3) personal stories, precautionary requests, and feedback. The first category contains 46 posts that expressed either dismay or appreciation towards government policies to curb the spread of the virus, the impact of such policies on low-income households and daily-wage workers, and advice for peers to strictly follow government guidelines. The misinformation category contained six posts tagged as COVID myths and 20 that denied the existence of the coronavirus. While only a small number of posts contained outright misinformation, there were many posts that contained valuable health information alongside some factual inaccuracies or traditional healing remedies.

Table 1: Frequency of thematic tags for posts and comments (in the decreasing order of the frequency of audio posts)

Topic (C: COVID, NC: Not COVID)	Frequency (Posts)	%	Frequency (Comments)	%
NC - Religious Poetry Recital	3,903	18.012	961	1.108
NC - Public Game show	2,726	12.580	1102	1.271
NC - Other	2,707	12.493	5031	5.803
NC - Singing/Poetry	2,080	9.599	933	1.076
NC - Personal Comment/Story	1,682	7.762	4166	4.805
NC - Silent	1,598	7.375	3536	4.079
NC - General Comment/Info	1,296	5.981	7333	8.458
NC - Noise	1,181	5.450	2828	3.262
NC - Irrelevant Comment	941	4.343	439	0.506
NC - Profanity/Threats	750	3.461	2109	2.433
NC - Public Moderation	687	3.170	1746	2.014
Unknown Language	482	2.224	925	1.067
NC - Feedback & Invite	293	1.352	53475	61.680
NC - News	279	1.288	118	0.136
NC - Hate Speech	270	1.246	375	0.433
NC - Advertisement	126	0.581	109	0.126
C - Comment on Situation	115	0.531	86	0.099
C - Other	104	0.480	162	0.187
NC - Sexism & Misogyny	90	0.415	591	0.682
C - Prevention & Protection	79	0.365	49	0.057
C - Comment on Govt Policies	48	0.222	35	0.040
C - Personal Story	43	0.198	48	0.055
C - Spread of Virus	37	0.171	9	0.010
C - Real/Perceived Impact of COVID	36	0.166	37	0.043
NC - Incitement to Violence	23	0.106	34	0.039
NC - Sexual harassment	23	0.106	215	0.248
C - Denial of Existence	21	0.097	37	0.043
NC - Profanity	15	0.069	52	0.060
C - Treatment and Cures	12	0.055	2	0.002
C - Feedback & Invite	8	0.037	136	0.157
C - General Misconceptions	7	0.032	6	0.007
C - Creation/Cause Myths	6	0.028	7	0.008
C - Social Stigma	1	0.005	5	0.006

The third category of posts contained personal stories about life during the pandemic. Some users shared stories about how they or their family members got infected and the social stigma they experienced. Others asked for prayers for themselves or their infected family members. There were 67 posts warning listeners to observe adequate precautions and take coronavirus seriously. Most of these posts requested users to wash hands, wear masks, follow social distancing, and wear gloves. A number posts were educational (e.g., how-to guide to keep the masks clean) and appeared to have been shared by medical professionals or referenced from health agencies.

Having described the general usage trends, we now outline to what extent we succeeded in enabling users to engage with and propagate trusted COVID content.

5.3 Nudges for COVID Content Engagement

We now present an analysis of the behavior of users and their engagement with the official COVID posts. To analyze the complete timeline of activities of each user, we only focus on the 6,444 users who started using the platform in the final three months of the deployment – our period of interest as explained in section 4. During this period, seven admin posts remained live and we divide our users into two categories: the 1,796 users who listened to at least one official COVID post, and the remaining 4,648 users who never listened to any official COVID post. As described in section 3.1, all

Table 2: Engagement with COVID content among users who listened (and did not listen) to Official COVID posts

Activity related to COVID posts and comments	Among the 1,796 users who listened to at least one official post			Among the 4,648 users who never listened to official posts		
	# Users who did this activity after listening to their first official post	% users	Activity per user	# Users who performed this activity	% users	Activity per user
Recorded post	40	2.23%	2.55	8	0.17%	1.13
Recorded comment	29	1.61%	2.83	2	0.04%	1.50
Shared post	43	2.39%	1.00	4	0.09%	1.50
Liked post	95	5.29%	3.82	26	0.56%	1.31
Disliked post	28	1.56%	2.29	1	0.02%	1.00
Reported abuse (post)	3	0.17%	1.00	0	0.00%	NA
Reported misinfo (post)	6	0.33%	1.33	0	0.00%	NA
Commented on post	20	1.11%	1.45	2	0.04%	0.00
Listened to post	270	15.03%	12.99	112	2.41%	2.08

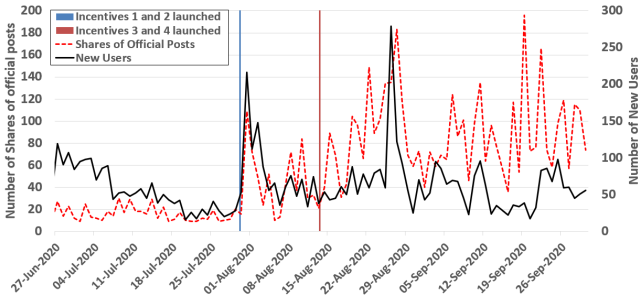

Figure 2: Shares of Official COVID Posts and New Users

users were nudged to listen to the official COVID posts and those who listened to these posts did so willingly.

Table 2 shows the engagement of these two user groups with COVID content. We find that 40 (2.23%) out of the 1,796 users who listened to at least one official COVID post went on to record their own COVID content and recorded 2.55 COVID posts per person. However, only 8 (0.17%) of the remaining 4,648 users ever recorded any COVID posts. And, even these 8 users, collectively recorded only 9 posts related to COVID (1.19 posts per person). These two user groups were found to be significantly different ($\chi^2 = 74.66$, $p < 0.00001$). We saw a similar trend for other forms of engagement with the COVID content (e.g., voting on users' COVID posts, recording COVID comments, sharing users' COVID posts, and helping with content moderation) for the two groups, resulting in significant differences (at $p < 0.0001$). These findings suggest that users who listened to the official COVID posts engaged more with COVID content compared to the users who chose to ignore these posts.

We found the magnitude of the activities between the two groups (in terms of the number of posts, votes, shares per user) to be significantly higher for users who had engaged with the official posts than those who did not (Mann–Whitney U test, $p < 0.0001$, two-tailed with effect sizes, $r \geqslant 0.49$). The 40 users who listened to at least one official post went on to record 102 COVID posts and 82 COVID comments, whereas before listening to any official posts they recorded only four COVID posts and one comment even though they were actively posting other content (31 non-COVID posts and 76 comments within the same time frame). To dismiss the possibility that the group of 4,648 users, who did not listen to official posts, might have been passive users who never engaged with any content on the platform, we analyzed their behavior with respect to non-COVID content and found these users depicting high engagement with the platform in general where they recorded 1,412 posts and 2,929 comments, and shared 3,026 posts. The engagement of users with official COVID posts turned out to be a strong predictor of their subsequent engagement with COVID content.

Next, we analyze the content contributed by users after they listened to the official posts. These users depicted a strong interest in posting COVID-related updates and opinions. Such posts included daily news updates about the lockdown and spread of the coronavirus as well as reporting of local events in their villages. They also actively shared and voted on such content, which accounted for 29% of their COVID-related activities on the platform. Further 22% of all engagement was with general discussions on COVID, including healthy diets to boost immunity, employment situation during the lockdown, complaints about the high cost of COVID tests, and comments on the impact of the pandemic, among others. Another 26% of engagement was with posts about prevention from COVID and feedback on the policies of the government. Users showed a keen interest in posts with personal stories of coping with COVID. Such posts were received warmly with likes and comments containing well wishes for the patients and prayers for the pandemic to end soon. Less than 3% of posts contained denial of the existence of COVID, conspiracy theories about the origin of COVID, and how the government benefits from the situation in terms of political and financial gains. These posts were met with more dislikes than likes and very few shares.

Users recorded over 1,000 comments on the official COVID posts. These comments show that the users intently listened to these posts and formulated their own thoughts about the information provided. While the majority of users trusted the information provided, a subset of users disagreed and shared their reasons for disagreement. Largely, this had to do with a clash between the information provided and their personal beliefs and worldviews.

5.4 Incentives for Spreading Reliable Posts

Next, we analyze the outcomes of the incentives that were offered to users to spread the content to others with a focus on acquiring new users. As the platform was closely moderated, our aim was to grow the network of users and expose a greater number of people to reliable COVID information. With the launch of the incentives, the number of shares of official COVID posts tripled from 0.099 shares per person per day (where 164 users shared these posts with 259 recipients of whom 60 were new to the platform) to 0.31 shares per person per day (275 users, 1,819 recipients, 1,300 new users). Figure 2 shows an increase in the number of successful shares of official posts and new users[2] after the launch of the forwarding incentives. On average, the number of official posts shared per day grew from 28.26 to 79.19 after the first two incentives were launched.

The 1,300 users acquired through forwarded official posts engaged with Baang via 4,078 phone calls and in turn created 173 posts (12% related to COVID), 735 comments (3% about COVID) and also engaged with COVID content with votes, shares and listens. Almost all of these users called the platform more than once and 596 users (46%) had interactions with the platform that lasted more

[2]The spike in the number of shares around Aug 27 in figure 2 is an artifact of a number of delayed sharing requests being sent out at once.

Table 3: Engagement with COVID content among users who listened (and did not listen) to pinned posts

Activity related to COVID posts and comments	Among the 582 users who listened to at least one pinned post			Among the 5,862 users who never listened to pinned posts		
	# Users who did this activity after listening to their first pinned post	% users	Activity per user	# Users who performed this activity	% users	Activity per user
Recorded post	41	7.04%	2.15	13	0.22%	1.77
Recorded comment	21	3.61%	2.33	7	0.12%	1.71
Shared post	88	15.12%	3.61	28	0.48%	1.61
Liked post	25	4.30%	2.32	3	0.05%	1.00
Disliked post	40	6.87%	8.48	7	0.12%	2.71
Reported abuse (post)	3	0.52%	1.00	0	0.00%	NA
Reported misinfo (post)	4	0.69%	0.25	1	0.02%	1.00
Commented on post	14	2.41%	2.57	6	0.10%	1.17
Listened to post	265	45.53%	11.86	115	1.96%	4.85

than a minute (these were among the goals of the incentives). The total time spent by these users on Baang was 9,959 minutes.

5.5 Think About COVID Information Behaviors

Next, we analyze the association between the engagement of users with the pinned posts and their subsequent engagement with COVID content. We restrict this analysis to users who joined in the final three months of the deployment (N=6,444 users). Of these, 582 users listened to at least one pinned post, while the remaining 5,862 did not listen to any pinned post. Table 3 shows the number and fraction of users from these groups who engaged with the COVID content and the magnitude of their activities.

We find that users who were never compelled to listen to the pinned posts depicted very little interest in recording, sharing, and posting comments and votes on COVID posts. In contrast, a significantly higher fraction of users from the group that had been compelled to listen to the pinned posts engaged with COVID content. The fractions of users from both groups were compared pairwise for significance using a Pearson CHI square test, and the results were found to be significant at $p < 0.0001$. The amount of content that these users contributed, shared, and evaluated was also found to be significantly higher than those who were not compelled to listen to the pinned posts ($p < 0.001$, using Mann Whitney U tests, two-sided, with effect sizes $\geqslant 0.46$ except for the number of listens per person, where the effect size is 0.29).

6 DISCUSSION

This paper presents the deployment of a health information hotline for underserved populations in partnership with a popular voice-based social media platform in Pakistan. The modalities of voice and simple phones extended the reach of the information campaign to people who are not active users of the Internet due to connectivity, skill, and affordability barriers. We discovered novel challenges and opportunities due to both the unique modality and the target demographics. In this section, we discuss these findings and also map our lessons to mainstream social media platforms.

6.1 Engagement with COVID-19 Content

We found three meaningful ways in which low-literate users of Baang engaged with the COVID content.

Platform adaptation to the information needs of the community. The primary reason for partnering with Baang to launch a COVID information platform was to allow low-literate communities to meaningfully engage with COVID content on an inclusive platform that is accessible to them. Through the qualitative analysis of the content, we find that the platform was successful in achieving this goal. More importantly, we discovered new and interesting ways in which users utilized the platform features that aligned well with the goals of the campaign. Users rapidly identified the information needs of the community and came up with ways to utilize the platform to respond to these needs. For instance, some users of Baang took it upon themselves to share daily statistics on the number of cases and deaths due to COVID, akin to popular websites (e.g. the landing page of the New York Times [3]). As a result, this data, while easily available to sighted, literate, affluent people, was now available to low-literates who do not have access to the Internet. We find another instance of such adaption where, just as mainstream social media users attempt to increase trust by embedding actual news footage from credible sources, we observed instances of Baang users recording actual news content from television as their posts. We also found instances of user-generated content that provided updates about official announcements regarding imposition and lifting of lockdowns in their localities, and closure and reopening of schools and businesses. Users also specifically requested others to share information and updates about topics of interest, including lockdown timings and rules, hospital availability, among others.

Platform adaptation to the emotional needs of the community. Social media is not just a source of news and information, but also a platform to aid the processing of and coping with information. The pros and cons of the role of mainstream social media in emotional support and coping have been studied in the case of Internet users [39, 42, 43, 46]. However, it is not clear how these findings translate to voice-based social media platforms for underserved populations. The pandemic and its outcomes in the form of lockdown, loss of employment and business, financial and social setbacks have led to a myriad of mental health issues [31]. Even in a patriarchal society, due to the "male ethic of self-reliance" [36], it is often hard for men to vent about their problems and expose their emotional vulnerabilities [5]. However, we find that given the opportunity to do so in an anonymous manner on a voice-based platform, male users opened up and shared their worries in their recorded posts, as they discussed personal devastation due to the pandemic. From sorrowful posts about lost income and the subsequent worries to anxiety about not being able to financially support their families, to fear about expected COVID test results; we found users rapidly adapted the platform to form community support circles. They reached out to others for prayers and support, and others reciprocated with supportive remarks. As such, the platform became a means for people to cope with the challenges of life in the pandemic. Coping was not just limited to venting. It took the shape of gratitude as well; users returned to thank others who prayed for them when they felt that they most needed it. This depicted instances of a sense of community starting to take shape that was empathetic to communal needs. Future work needs to investigate the use of voice-based social platforms as safe spaces for emotional support and bonding. This is critical in societies with limited access to formal and professional mechanisms of support and counseling, and where stresses due to poverty are high.

Platform adaptation to voice grievances. Lastly, we find that users adapted the platform to voice their grievances and requested others (including the platform admins) to convey them to the government. This is very similar to the use case of CGNet Swara [23]. While a number of people supported the government in their actions to curtail the spread of COVID, many mentioned their sufferings from the impacts of such measures. From economic costs to mental health issues to educational harms, the platform was used to air such grievances. This opens up the possibility of the use of voice-based social media platforms by public health authorities in emergencies to discover problems and also to rapidly receive on-ground feedback on their policies and decisions, especially from communities that are inaccessible via Internet-based outreach efforts.

Misinformation and content moderation. The fraction of users who actively spread conspiracy theories and falsehoods related to the pandemic was very small. However, we found several posts that appeared well-intended yet either contained a mixture of reliable information and inaccuracies or suggested remedies from alternate forms of medicine that could not be verified. Examples include posts where users cautioned others about the hazards of not following government directives of wearing masks and social distancing, but at the same time also recommended over-the-counter pain medications for people experiencing symptoms, in the same recording. The removal of several such well-meaning posts led to confused and upset users who had championed our COVID information campaign and had endorsed the official posts. This presented unique challenges of moderation, but more importantly of educating the users and conveying to them the real reasons for the removal of their posts. Such cases were rare on Baang and future studies are needed to look into more holistic interventions with increased transparency, where users are clearly informed about the reasons for the removal of their posts and the rationale behind such decisions.

6.2 Implications for Mainstream Social Media

All three interventions described in the paper resulted in higher user engagement with reliable COVID content. Users who chose to engage with official posts and had to listen to the pinned posts, also depicted higher engagement with COVID content in terms of listening to posts, voting on them with likes and dislikes, posting audio comments on them, and sharing them with others. Further, users who engaged with the pinned posts also recorded richer content and responded actively to our appeals of sharing personal stories, news sources, and local updates. Users provided with incentives showed a high tendency to share reliable posts with others and brought in a large fraction of new users. The senders *endorsed* the official messages by sending their recorded names along with the shared posts. Such peer endorsement has been shown to inculcate higher trust in the recipients compared to expert-endorsed messaging [30]. A fraction of these new users also engaged with COVID content and shared it further, making the reliable posts go *viral*.

Our study was not designed to measure causality. We show that user engagement with the three interventions (official posts, incentives, pinned posts) is a strong predictor of eventual engagement with (and spread of) reliable COVID content. It is true that users who chose to engage with official posts might have been predisposed towards such content types. However, such strong associations can help with the design of information engagement campaigns in multiple ways. A useful application is to nudge, incentivize, and compel users towards increased engagement with reliable content. Another use case is to employ such techniques for screening purposes. With limited resources like airtime and server bandwidth, information campaigns especially at times of emergencies end up imposing usage restrictions on the number of users or extent of usage [34, 53]. Predictors of users more likely to engage with reliable messages can help apply such restrictions in a more meaningful and equitable manner and make the information available to the users who are most inclined to benefit from it.

For mainstream social media platforms, the incentives could take the form of soft incentives like medals, tags, verified status, titles, or actual financial incentives like limited-time access to premium services including ad-free usage after a user adopts the desired behavior. Each of our incentives comprised multiple rewards that were built on top of one another. The users continued receiving higher rewards when the recipients of the messages attended the calls, stayed on for more than a minute, and came back to the platform later. Therefore, each incentive comprised instant gratification for minimal action and delayed (and higher) rewards for more meaningful outcomes. Similarly, on mainstream platforms, the incentives could comprise instant gratification using soft incentives (e.g., badges, titles) and delayed rewards in the form of premium services when the goals of the desired behavior are met.

The compelled exposure to particular messages could be replicated on mainstream social media by anchoring these messages at particular places in the news feed. This could be done with higher levels of persuasion where users are required to watch, read or listen to the entire message before moving on. The nudges could be implemented with messages that pop up at a time when users are expected to be easily persuaded towards the desired behavior, for example, a message "Have you verified the information that you are about to post?" displayed to a user when they are about to share content may nudge them towards posting reliable and trusted information [20]. Users who end up acting upon the nudge could even be relied upon as champions to spread the trusted content to others with their endorsements.

7 CONCLUSION

This paper presents a mixed-methods analysis of three strategies to foster engagement of underserved communities with credible health information on a voice-based social media platform in Pakistan. These strategies included nudging users to listen to reliable COVID advisory, incentivizing them to share reliable content with others, and prompting them to think about COVID-related information behaviors. Compared to users who were not exposed to these interventions, we found the engagement of these groups of users to be significantly higher both in terms of fraction of users who engage with the trusted COVID content as well as the magnitude of their interactions. Through thematic analysis of the contributed content, we found that users adapted the platform to meet their informational, emotional, and instrumental needs. We also discuss actionable recommendations for mapping our strategies to promote responsible information behaviors among users of mainstream social media platforms.

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A OFFICIAL COVID POSTS

Post #	Topic
General Vital Information about COVID-19	
1	What is coronavirus?
2	How does COVID-19 spread?
3	Advice for healthy people
4	Social distancing: Why and how?
5	Who is at a higher risk?
6	What to do if you are experiencing symptoms?
7	When and how to seeking medical care?
Responses to Popular Misconceptions	
8	Only old people are susceptible to COVID-19
9	Once contracted, COVID-19 has 100% fatality rate
10	Shaking hands does not lead to spreading COVID-19
11	Wearing masks in public is an unnecessary precaution
12	Closing down public spaces (e.g. mosques, schools, markets) is unnecessary
13	Eating garlic protects from COVID-19
14	Drinking hot water protects from COVID-19
15	A hot water bath protects from COVID-19
16	Rinsing the nostrils with salty water protects from COVID-19
17	Consuming vinegar, and various steroids and hormones protects from COVID-19
18	Gargling with a solution of bleach and water protects from COVID-19
19	Medicines are available for curing COVID-19
20	Antibiotics can treat COVID-19
21	Only China and US are preparing COVID-19 vaccines
22	COVID-19 only affects people of Chinese and the European origins
23	COVID-19 is man-made and its origin is well-known

B PINNED POSTS

Message content
Please record your COVID-19-related experiences and stories as posts and comments. Share reliable content with friends, especially the ones impacted by the pandemic.
Please record your COVID-19-related news and information sources and also comment on their reliability. Share reliable content with friends, especially the ones who would also like to share their thoughts.
Please record your views and opinions (and those of your friends and relatives) about COVID-19. Share reliable content with friends, especially the ones who would like to share their thoughts about COVID.
Please record your thoughts and opinions about COVID-19. Share reliable content with friends, especially the ones who would like to hear such content.