# Pharmacists and COVID-19 vaccination – Considering mobile phone caller tunes as a novel approach to promote vaccine uptake in low- and middle-income countries

Q4 Bernard Appiah[a,b,*] beappiah@syr.edu, Lucy Asamoah-Akuoko[b,c] lucyasamoah@yahoo.com, Christopher France[d] france@ohio.edu, Antonio Rene[e] cmraar@gmail.com, Nathan Amanquah[f] namanquah@ashesi.edu.gh, Imelda Bates[g] imelda.bates@lstmed.ac.uk Q1

[a]Department of Public Health, Falk College, Syracuse University, 150 Crouse Drive, 435A White Hall, Syracuse, TX, USA

[b]Centre for Science and Health Communication, PMB M71, Accra, Ghana

[c]National Blood Service Ghana, Research and Development, P.O. Box KB 78, Korle-Bu, Accra, Ghana

[d]Department of Psychology, College of Arts and Sciences, Ohio University, Athens, OH, 45701-2979, USA

[e]Department of Environmental and Occupational Health, Texas A&M University, College Station, TX, 77843, USA

[f]Faculty of Engineering & Computer Science, Ashesi University, 1 University Avenue, Berekuso, Eastern Region, Ghana

[g]Liverpool School of Tropical Medicine, Pembroke Pl, Liverpool, L3 5QA, United Kingdom

*Corresponding author. Department of Public Health, Falk College, Syracuse University, 150 Crouse Drive, 435A White Hall, Syracuse, TX, USA.

## Abstract

***[Instruction: TO DC: remove "As several low: -"]As several low*: -** ~~and middle-income countries~~As several low- and middle-income countries roll out their COVID-19 vaccination programmes, COVID-19 vaccines hesitancy could threaten the success of such programmes. But pharmacists can play a leading role in addressing COVID-19 vaccine hesitancy by using a critical mobile phone-based technology. This technology, known as caller tunes or ringback tones, is flourishing in low- and middle-income countries such as those in Africa and Asia where it is used to promote popular songs and religious messages. With this technology, callers to mobile phones hear a message or a song instead of the typical ringing sound. There is a need for pharmacists associations to collaborate with the creative arts industry and telecommunication companies to have caller tunes on COVID-19 vaccines. ~~As pharmacists download~~As pharmacists and others download COVID-19 vaccine caller tunes onto their mobile phones, their callers will hear COVID-19 vaccines messages or songs. This could help combat disinformation and hesitancy, and promote widespread vaccination as availability increases.

**Keywords:**

No keywords are available

As of July 2, 2021, most low- and middle-income countries lag behind high-income countries in vaccinating their populations, with most African countries having cumulative COVID-19 vaccinations of just 2.68 per 100 people compared with UK and US figures of 66.49 and 54.31 respectively.[1] Because vaccine hesitancy could threaten the success of COVID-19 vaccination globally, hospital and community pharmacists should consider a mobile phone-based technology with the potential to address vaccine misinformation. This technology, known as caller tunes or ringback tones, is flourishing in low- and middle-income countries in Africa and Asia where it is used to promote popular songs and religious messages. With this technology, callers to mobile phones hear a message or a song instead of the typical ringing sound.

But how are caller tunes different from ringtones? Caller tunes, ringback tones and ringtones are sounds that emanate from mobile phones. What distinguishes them is the person who hears the sound. A caller tune is a sound that is heard by a caller when they have placed an outgoing call to another entity.[2] Telecommunication companies have several names for caller tunes including ringback tones, ringback tunes, Hello Tunes or SKIZA tunes (Table 1). Caller tunes ~~contrasts~~contrast with a ringtone, which is the sound heard by an entity when they are receiving in incoming call.[2,3] In other words, the directionality of the caller, and the originator of the sound, are key to understanding caller tunes and ringtones.

alt-text: Table 1

**Table 1**

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Selected countries, telecom companies, and their public caller tunes/ring back tunes information.

| Country | Telecom Company | Caller Tune (or ring back tunes) information available on websites |
|---|---|---|
| Bangladesh | Airtel | “Airtel Tune is a Caller Ring Back Tone service that allows you to set a song, tone, music, funny messages or sounds as a Ring-Back Tone for your callers. You can set a Caller Tune for all your callers, while they wait for you to pick up the call” (https://www.bd.airtel.com/en/personal/vas/airtel-tune) |
| Ghana | Vodafone | “Entertain your callers with amazing tunez before you answer their calls. You can assign as many tunez for your callers to listen to while they wait for their calls to be answered” (https://vodafone.com.gh/personal/mobile/vas/caller-tunez/) |
| India | Jio | “You'd be forgiven for not having heard of Caller Tunes, this smartphone feature has yet to catch on in the UK, but internationally, Caller Tunes are booming. Caller Tunes give subscribers a more personalized mobile phone service by allowing your callers to hear a chosen song whenever they call you instead of them just hearing the standard ringing tone. This service has grown in popularity in emerging markets such as Africa, Bangladesh and particularly in India” (https://www.horusmusic.global/caller-tunes-can-help/) |
| Kenya | Safaricom | “You can now entertain your callers with your favorite SKIZA tune at only Ksh 1 daily for Local and International tunes ... If you like your friend's SKIZA tune when you call them, you can get it by dialing 11 while the song is playing!” (https://www.safaricom.co.ke/get-more/entertainment/skiza) |
| Nigeria | Airtel | “Hello Tunes is the audible ringing tune that you hear between the time you make a call and the time the call is answered. With the Airtel Hello Tunes every call is a rhythm; you can now replace the standard tune with a wide variety of Tunes for your callers to enjoy. The service also allows you to select a personalized tune depending on the person calling, time of day, season, mood etc” (https://www.airtel.com.ng/vas/music/hellotunes) |
| Nigeria | MTN | “Callertunez allows you to change the boring “ring-ring” tone heard when people call you with a personalized tune of your choice” (https://www.mtnonline.com/play/callertunez/) |
| Uganda | Uganda Telecom | “Get rid of the boring ‘ring ring’ tone when people call you. Choose what people hear when they call you with UTL Caller Tunes” (https://www.utl.co.ug/personal/value-added-services/caller-tunes/) |

The COVID-19 pandemic reminds us of the need to marshal all available tools to defeat the virus, and there is no one-size-fits-all approach to changing people's behaviors. Existing mobile phone-based strategies, such as the use of text messaging and direct phone calls, may be too expensive and time consuming for pharmacists to implement in low- and middle-income countries to promote COVID-19 vaccine uptake. Moreover, text messages will have limited efficacy among populations with low literacy. In this context, mobile phone caller tunes, which can be produced in diverse local languages, may be a cost- and time-effective strategy for pharmacists to aid in the promotion of COVID-19 vaccines uptake.

The use of caller tunes to promote health behaviour is not new. In 2013, the Government of India and the World Health Organization implemented a caller tune initiative to promote the adoption of healthy behaviours.[4] The initiative, called "Donate Your Caller Tune for a Cause" asked mobile phone users to replace their favored caller tunes with those that have celebrity-produced messages or voices on health issues such as cancer, stroke and diabetes.[4] Perhaps due to the success of the caller tune initiative in increasing awareness of health issues, in January 2021 India released a caller tune focused on COVID-19 vaccination, replacing an earlier caller tune that focused on COVID-19 prevention measures such as wearing masks and washing hands.[5]

The UNICEF India has partnered India's Ministry of Health and Family Welfare to develop caller tunes on COVID-19 vaccination in Hindi.[6] Listeners are advised to trust the vaccine and desist from believing COVID-19 misinformation. It also has a national helpline for listeners to call for more information.[6]

In Sierra Leone, caller tunes formed part of the African Union Commission's multinational communication campaign that was used to deliver pre-recorded messages on Ebola in 2014.[7] Partnership with Airtel, a telecommunication company, and local businesses was found to be effective for using caller tunes to tackle Ebola.[7]

Beyond the initiatives in India and Sierra Leone, our own research in Ghana indicates that mobile phone customers are eager to use caller tunes to promote a host of health behaviors such as medication adherence[8] and patient reporting on drug safety.[9] As trusted experts in medication delivery and use, it is advisable that hospital and community pharmacists, who are central to combatting the ongoing pandemic,[10–12] consider implementing a caller tunes strategy to promote COVID-19 vaccine uptake in low- and middle-income countries where the technology is popular. To help advance consideration of this approach, we offer the following on caller tunes and brief outline of issues that will need to be considered.

## Q2 1 Caller tunes on COVID-19 vaccines: how it could work

After pharmacists and key content contributors, such as writers, musicians, and actors have collaborated to create short songs or messages on COVID-19 vaccines (i.e., no more than 50 seconds each), telecommunication companies could accept them to be on their networks to be used as caller tunes. Pharmacists, as mobile phone customers of the telecommunication companies, would then be able to activate the caller tunes so that people who call them would hear the COVID-19 vaccine songs or messages. Others who could also have the caller tunes might include non-pharmacists who have received their COVID-19 vaccines or those who are simply keen to educate others about the vaccines, including identified opinion leaders. In India, mobile phone customers are attracted to the health messages that have the voices of their favorite Bollywood stars. The rest of the developing world must follow India's lead, but with cultural adaptations. In countries where the movie industry may not be as influential or popular, we suggest alternative strategies such as caller tunes messages using other types of celebrities (e.g., community leaders, sports figures) and songs (Table 2).

alt-text: Table 2

**Table 2**

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Caller tunes-based strategies and issues for promoting COVID-19 vaccination.

| Strategy | Tactic | Issues to Consider |
|---|---|---|

| | | | |
|---|---|---|---|
| **Songs** | • Produce songs on COVID-19 vaccines to be used as caller tunes.<br>•Use popular musicians to release solo songs on COVID-19 vaccines.<br>•Consider having popular musicians come together as a group to produce songs on COVID-19 vaccines to be used as caller tunes.<br>•Use diverse local languages to cater to the needs of illiterate populations. | •Identify artists who address social issues in their music and are active in promoting public causes as has been used in some public health interventions.<br>•Get buy-in of music producers and artist management.<br>•Copyright needs to be discussed and addressed. |
| **Audio messages** | •Record COVID-19 vaccine messages from a variety of popular figures, including movie stars, sports celebrities, and religious leaders.<br>•Recruit spokespeople with wide appeal across different characteristics.<br>•Use diverse local languages to cater to the needs of illiterate populations.<br>•Involve advertisement agencies in creating the messages | •Record messages based on initial feedback on COVID-19 vaccine issues most important to priority populations.<br>•Ensure that entertainment does not overshadow COVID-19 messaging.<br>•Work with producers and artists with a history of addressing social issues. |

## 2 Form partnerships with the creative arts industry to create caller tunes

Partnerships with the creative arts industry, such as musicians, are key to producing a variety of different caller tunes. For example, associations of pharmacists in low- and middle-income countries might be able to recruit popular musicians to create several songs in diverse local languages. This variety is important to ensure that callers are not repeatedly exposed to the same material. Further, having a range of musicians participating in the project would enhance the download of caller tunes by mobile phone customers who are likely to favour those created by their favorite artists. And, it should be noted, a mobile phone customer can choose to have more than one caller tune on their phone at the same time. In addition, customers can select which caller should receive which caller tune, allowing for a degree of message targeting (e.g., only play for those who have yet to receive their vaccination or those who express skepticism about COVID-19 vaccines).

## 3 Design caller tunes based on social behavioral theories

Studies show that behavioral interventions that are designed with theoretical frameworks are more likely to be effective than those lacking such theories.[13] One such framework is the theory of planned behaviour. According to the Theory of Planned Behaviour, intention is a key determinant of behaviour.[14] However, intention is also influenced by three main factors: attitude, subjective norms and perceived behavioral control. Table 3 highlights these key constructs and

describes how they could be used to implement caller tunes-based public health messaging on COVID-19 vaccination. It is noteworthy that some studies have already explored the use of theory of planned behaviour to predict the intention to get COVID-19 vaccines in countries such as Bangladesh,[15] India,[16] Israel,[17] Nigeria,[18] and the United States.[19,20]

alt-text: Table 3

**Table 3**

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Application of the Theory of Planned Behaviour to promote pharmacist use of caller tunes to support COVID-19 vaccination in their communities.

| Construct | Definition | Application to caller tunes |
|---|---|---|
| **Attitudes** | The extent to which people may either favour or not favour a behaviour of interest | The attitudes of pharmacists and members of the pharmaceutical care team regarding the use of caller tunes to promote COVID-19 vaccination would need to be established. In addition, the attitudes of the general public, particularly those who have already received COVID-19 vaccines, also need to be assessed regarding potential uptake of COVID-19 vaccines caller tunes. |
| **Subjective norms** | This describes the potential approval or disapproval of the intended behaviour of interest by others including peers and others who have influence on the priority population | If those who exert influence in the pharmacy profession including leaders or executives of the pharmaceutical societies download caller tunes on COVID-19 vaccines, other pharmacists are likely to follow. For members of the public, this will require a need to identify community champions including opinion leaders to download the caller tunes on COVID-19 vaccines. Using networks of friends may also be valuable. |
| **Perceived behavioral control** | This describes people's perception that a given behaviour may be easy or difficult to perform. Such a perception may vary based on given situations. | Pharmacists, other members of the pharmaceutical care team, and members of the public may need to be aware that caller tunes are easy to download. However, cost of downloading the caller tunes, if not waived, could discourage people from downloading the caller tunes on COVID-19 vaccines. This is a reason partnership with mobile telecommunication companies could be effective in implementing this strategy as was the case in Sierra Leone on Ebola. |
| **Intention** | This refers to people's likelihood of engaging in a behaviour of interest. The higher the intention, the likelihood of engaging in that behaviour. | Explore the likelihood of pharmacists, other members of the pharmaceutical care team, and members of the public downloading caller tunes on COVID-19 vaccines to encourage individuals hesitant to the vaccines to take them. Pharmacists and others who already have gotten their COVID-19 vaccines and/or have mobile phone caller tunes are more likely to download such COVID-19 vaccine caller tunes. |

## 4 Pilot-test COVID-19 vaccines caller tunes prior to roll-out

In line with public health campaigns, it is critical to ensure that caller tunes on COVID-19 vaccines should be pilot-tested prior to making them available for download. During pilot-testing, there is a need to have adequate representation of the intended users to ensure that key perspectives are considered. Pilot-testing is a form of co-creation that ensures that end users of an intervention make inputs into its development.[21] This could involve the use of qualitative and quantitative methods to assess the features of the public health messaging to be delivered via caller tunes in an iterative fashion.[22] Pilot testing of the caller tunes could involve a small non-randomized sample pharmacists and members of the public to provide feedback on the caller tunes regarding their appeal, messaging and potential effectiveness in convincing vaccine hesitant people to accept the vaccines. Pilot-testing can yield useful information for successful implementation of an intervention. For example, a pilot-test of a text message vaccine reminder system for promoting influenza vaccination during a pandemic resulted in a recommendation that to include more pandemic information to improve its use among the intended population.[23] ~~During pilot-testing, there is a need to have adequate representation of the intended users to ensure that key perspectives are considered.~~

## 5 Make caller tunes free to ~~download~~activate

Mobile phone telecommunication networks must be willing to make caller tunes on COVID-19 vaccines free for ~~download~~activation by customers. The good news is that in low- and middle-income countries mobile telecommunication companies already implement social projects as part of their corporate social responsibilities. For example, in Ghana, the National Blood Service has partnerships with telecom companies to promote blood donation. Pharmacists associations must be willing to approach telecommunication companies with this idea. Already, MTN Group, a telecommunication company which operates in many African and Asian countries has pledged 7 million COVID-19 doses to 9 African countries, with the first batch arriving in the countries in March 20, 21.[24] Thus, it is reasonable for the same company and other telecommunication companies to entertain an idea put forward by pharmacists — as experts in medicines — to use caller tunes to promote uptake of COVID-19 vaccines.

## 6 Pharmacists must lead

Globally, community pharmacists continue to be inundated with questions on COVID-19 vaccines because of their easy accessibility to members of the public. Given that pharmacists in many low- and middle-income countries were among the first to be vaccinated, and are often viewed as trusted sources of information by others in their community, it would be beneficial to have pharmacists associations encourage their members to put COVID-19 vaccine caller tunes on their personal mobile phones and organization-issued mobile phones. Thus, callers to the mobile phone numbers of these pharmacists or pharmacies will hear COVID-19 vaccines messages or songs. Pharmacists can use platforms such as WhatsApp groups to mobilize their members to download the caller tunes. Community pharmacists can also encourage other members of the pharmaceutical care team to do likewise. For example, as members of the public or patients call pharmacists for advice on their medications, the callers may get exposed to the caller tunes on COVID-19 vaccines. This, in itself, could trigger conversations about COVID-19 vaccines.

## 7 Engage first COVID-19 vaccine recipients to ~~download~~activate caller tunes

As individuals in the general population receive their vaccine, vaccinators should encourage them to install caller tunes on COVID-19 vaccines on their mobile phone. The total number of people expected to be reached would depend on several factors such as available funding, proportion of people who are hesitant to get COVID-19 vaccines and availability of the COVID-19 vaccines. Consistent with the Theory of Planned Behaviour[13,25] which highlights the importance of social norms (i.e., doing as others do or expect you to do) as a key contributor to intention and behaviour (Table 3), as more and more people add caller tunes to their mobile phone it will amplify the message that vaccination is growing within the population. In Asia, for example, social norms have been found to predict the uptake of HPV vaccine.[26–28]

In sum, the availability of COVID-19 vaccines in several low- and middle-income countries is already a challenge, and the last thing we want is for vaccine conspiracy theories to spread via social media and stall vaccination progress. The use of mobile phone caller tunes could be a welcome addition for use by pharmacists to help combat disinformation and hesitancy, and promote widespread vaccination as availability increases.

## 8 Consider branding the caller tunes on COVID-19 vaccines

Already, many non-health caller tunes exist in low- and middle-income countries. Asking members of the public to give up those caller tunes in favour of those focusing on COVID-19 vaccines would require creativity and branding. For example, what would distinguish caller tunes on COVD-19 vaccines from the others? Unfortunately, many public health campaigns lack identity or brand.[29] Branding can also help to raise the positive image of those implementing an intervention. Consider a caller tune that concludes with, for example, “This is a message from the Pharmaceutical Society of Ghana,” or “This is a message from the Ministry of Health”. If songs on caller tunes will be produced, it would be helpful to include a sound effect that can help listeners associate all the caller tunes songs on COVID-19 vaccines.

## 9 Practical considerations for planning, implementing and evaluating caller tunes-based messaging

As in the case of COVID-19, based on the variety of public health strategies undertaken by countries around the world, we are living through a natural experiment in witnessing both the effective and non-effective use of public health messaging by policy makers. Thus, knowing strategies that appear effective as well as those that appear non-effective, in public health messaging is essential. Messaging becomes essential particularly in cases where unique cultural values within communities are, or are not, adequately considered.

In line with public health campaigns, it is critical to ensure that prior to making caller tunes on COVID-19 vaccines available for download, they should be designed with perspectives of key stakeholders. For example, in an attempt to explore the feasibility of using mobile caller tunes to promote blood donation in Ghana, the perspectives of both blood donors and non-blood donors were sought.[30] Similarly, perspectives of pharmacists and members of the public regarding the use of caller tunes for promoting COVID-19 vaccination need to be obtained. Such studies would need to have representation of those perceived to be vaccine-hesitant and those who may favour the vaccines or who may have already received their vaccines. With such information, pharmacists and creative content creators would be able to design culturally appropriate caller tunes on COVID-19 vaccines.

In designing the caller tunes, care should be taken to enhance their effectiveness. For example, public health messaging based on fear could backfire particularly if not accompanied by strong self-efficacy messages.[31] To increase perceptions of self-efficacy, factors that could impede people's ability to download the caller tunes and to get the COVID-19 vaccinations should be addressed. For example, if COVID-19 vaccines are not widely available in a population, caller tunes-based strategy highlighting dangers of not vaccinating on time may provoke anger because it may not be the fault of people waiting for their vaccines. Moreover, a careful balance between humor or entertainment and health messaging would need to be established for caller tunes to be effective. Humor has been found to reduce hesitancy regarding MMR vaccine, but for parents who were already favourable to vaccination humorous messages reduced effectiveness relative to non-humorous messages.[32] Caller tunes, by design, are typically short, making a careful balance of entertainment and messaging even more critical.

The caller tunes must also appeal to local culture. In crafting the messages, social norms must be considered. To be successful, interventions based on social norms in low- and middle-income countries would need to consider factors such as laws, government structures, individual factors, availability of people who can serve as role models, and positive deviants.[33] Such interventions need to avoid common pitfalls such as positioning social norms as though it is the main driver of people not engaging in the useful behaviour.[34] For example, in most low- and middle-income countries, the ‘common good’ or ‘family’ might outweigh ‘individual autonomy’. However, in some regions within the same country, appealing to personal autonomy might be better. In other words, should the messages or songs focus on asking recipients to take the vaccines to protect themselves from the disease, the community or both? Also, businesses in LMICs often have corporate social responsibilities including promoting health and education. Pharmacists and health agencies can leverage this social norm to seek partnerships to aid the creation and sustainability of the caller tunes on COVID-19 vaccines.

When implementing the caller tune-based strategy, efforts must be put in place to assess their exposure. Without such efforts, determining the success or failure of the strategy would be difficult, if not impossible. Indeed, insufficient exposure of communication campaigns to the priority populations could lead to their failure.[35]

Pharmacists associations and other health-focused entities involved in the implementation would need to consider partnering with public health and social science researchers including communication scholars to assess the campaign. Departments of social pharmacy, administrative pharmacy, or clinical pharmacy in pharmacy colleges of universities in low- and middle-income countries should also be actively involved in such evaluations. The involvement of these key academic departments or scholars in planning the intervention may make such partnerships welcoming and successful. While assessment of the success or otherwise of the caller tunes-based strategy nationally would be ideal, the evaluation cost could be a challenge. Involving academic partners in evaluation efforts could help address the cost issue, particularly if students are recruited to include evaluation as part of their research projects. In evaluating the effectiveness of the caller tunes, a mix of different strategies will be required. For example, discussions on the caller tunes on social media could be assessed through content analysis. Also, periodic surveys could be conducted to assess attitudes, beliefs, intentions and behaviours related to COVID-19 vaccines before and after exposure to the caller tunes.

## 10 Potential limitations of using caller tunes to aid COVID-19 vaccination

Despite the potential of using caller tunes to promote COVID-19 vaccination, potential limitations exist. Addressing these limitations may be key to success.

## 11 Me[Instruction: TO DC: renumber as 10.1 and tag as sectionb]ssage fatigue

There is no doubt that hearing the same message continuously could backfire. Two case studies involving COVID-19, perhaps, stand out. In the early phase of the COVID-19 pandemic in India, the health ministry required telecommunication operators in the country to add a COVID-19 prevention caller tune for dissemination to callers to mobile phones.[5,36] Months later, callers to mobile phones became annoyed about listening to the same voice and message, thus forcing the government to change the voice.[37,38] Important steps were also instituted so that mobile phone customers could also opt out of caller tunes.[39] The focus was also changed from general prevention to vaccination.

MTN Uganda also implemented a caller tune on COVID-19 prevention in Uganda in early 2020. In April 2020, customers voiced their anger on Facebook.[40] "MTN UG.please stop that caller Tune Advert of Corona virus on our calls.its real irritating ... so stop ruling n controlling our phone calls ... (sic)", a customer said. Another added: "For sure am also tired of that advert, we already know what to do, MTN please also remove it from my number because we're already aware of corona virus and our president has sensitized us better. Please stop that advert" (sic). Other customers expressed similar sentiments, resulting in MTN Uganda reducing "the number of times it broadcasts [the caller tune] in a day to at most three, first calls of the day."

These brief case studies in India and Uganda indicate what could go wrong with implementing caller tunes on COVID-19 vaccination, and what could be done to address them. In addition to changing the voice, song, or message to prevent people from tuning them out, the number of times people may hear about it could be reduced. For example, as implemented by MTN Uganda, perhaps a decision could be taken to determine how many callers in a day should be exposed to caller tune from a mobile phone. The exact number could be determined during pilot-testing. And as it happened in India, steps could be given to mobile phone customers to follow to avoid listening to the repetitive message. However, if care is not taken, most callers may follow steps to remove the caller tunes on vaccination, and thus defeating the overall intent of the initiative. The tendency to remove the caller tunes could be assessed as part of the pilot-testing and monitoring.

## [Instruction: TO DC: renumber as 10.2 and tag as sectionb]12 Potential harms of mis-matched messaging

Given the potential of telecommunication companies to service wide geographic areas over many different regions and communities within countries, and different culture even within countries, there is the possibility of some caller tunes not being well-received by others. In other words, a message designed for one region may not be applicable or appropriate for another region even within the same country. The good news is that caller tunes can be made in local languages. Thus, content developers would need to tap local people and consider their culture and social norms when designing caller tunes. Carefully matching of the messages to specific populations or communities will be key for this strategy to be effective.

## [Instruction: TO DC: renumber as 10.3 and tag as sectionb]13 Lack of favourable conditions for vaccination

No matter how well a health communication campaign is crafted to positively influence behaviour, if conditions are not favourable for the priority population to engage in that behaviour, it is likely to fail and cause people to even resent it.[35]The availability or unavailability of the COVID-19 vaccines must be considered when designing caller tunes. For example, when people are still waiting for COVID-19 vaccines, caller tunes could include messaging about what people need to do when the vaccines become available. When the vaccines eventually become widely available, caller tunes must indicate where people need to go for the vaccines or advice. Caller tunes could recommend that those who

would like to know more about the vaccines should speak to their pharmacists. In rural communities where pharmacists may not be available, other health care providers including community health workers could be trained to provide the necessary advice. Ultimately, easy availability of the COVID-19 vaccines would provide the necessary conditions for making the caller tune-based messaging successful.

[Instruction: TO DC: add heading "11 Conclusion" and tag as sectiona]In sum, the availability of COVID-19 vaccines in several low- and middle-income countries is already a challenge, and the last thing we want is for vaccine conspiracy theories to spread via social media and stall vaccination progress. The use of mobile phone caller tunes could be a welcome addition for use by pharmacists to help combat disinformation and hesitancy, and promote widespread vaccination as availability increases.

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## Declaration of competing interest

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The corrections made in this section will be reviewed and approved by a journal production editor. The newly added/removed references and its citations will be reordered and rearranged by the production team.


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## Queries and Answers

Q1

**Query:** Please confirm that the provided email "beappiah@syr.edu" is the correct address for official communication, else provide an alternate e-mail address to replace the existing one, because private e-mail addresses should not be used in articles as the address for communication.

**Answer:** This is to confirm that "beappiah@syr.edu" is the correct address for official communication

Q2

**Query:** Kindly check section hierarchy and correct if necessary

**Answer:** Thanks. The numbering under section 10 ideally should be sub-sections, and thus they should not be numbered as 11, 12 and 13.

Q3

**Query:** Have we correctly interpreted the following funding source(s) and country names you cited in your article: Bill and Melinda Gates Foundation, United States?

**Answer:** It is not a funding source for this article but rather a competing interest. Bill and Melinda Gates Foundation has funded me to implement a project to improve childhood vaccination, thus making this paper a competing interest. Thus, leaving it the way it is now is correct.

Q4

**Query:** Please confirm that given names and surnames have been identified correctly and are presented in the desired order and please carefully verify the spelling of all authors' names.

**Answer:** Yes