Crowdsourcing Covid-19 signals in sub-Saharan Africa: Leveraging digital contributor networks for participatory surveillance of Covid-19 symptoms and deaths

Ngozi A Erondu, Sagal A Ali, Mohamed Ali, Schadrac C Agbla

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Ngozi A Erondu[1, 2] BSc, PhD, MPH; Sagal A Ali[3, 4] MPH; Mohamed Ali[3] JD; Schadrac C Agbla[5] PhD

[1]Project Zambezi Castlepines Medical Foundation London GB
[2]Chatham House London GB
[3]Karibu95 Iftin Foundation Mogadishu SO
[4]Cafiya Global Medical Mogadishu SO
[5]Department of Health Data Science University of Liverpool Liverpool GB

Corresponding Author:
Ngozi A Erondu BSc, PhD, MPH
Project Zambezi
Castlepines Medical Foundation
Level 4, 97 Jermyn St, St James's
London
GB

Abstract

Background: In sub-Saharan Africa, underreporting of cases and deaths has been attributed to various factors including, weak disease surveillance, low health-seeking behaviour of flu like symptoms, and stigma of Covid-19. There is evidence that SARS-CoV-2 spread mimics transmission patterns of other countries across the world. Since the Covid-19 pandemic has changed the way research can be conducted and in light of restrictions on travel and risks to in-person data collection, innovative approaches to collecting data must be considered. Nearly 50% of Africa's population is a unique mobile subscriber and it is one of the fastest growing smart-phone marketplaces in the world; hence, mobile phone platforms should be considered to monitor Covid-19 trends in the community.

Objective: We demonstrate the use of digital contributor platforms to survey individuals about cases of flu-like symptoms and instances of unexplained deaths in Ethiopia, Kenya, Nigeria, Somalia, and Zimbabwe.

Methods: Rapid cross-sectional survey of individuals with severe flu and pneumonia symptoms and unexplained deaths in Ethiopia, Kenya, Nigeria, Somalia and Zimbabwe

Results: Using a non-health specific information platform, we found COVID-19 signals in five African countries, specifically:
•Across countries, nearly half of the respondents (n=739) knew someone who had severe flu or pneumonia symptoms in recent months.
•One in three respondents from Somalia and one in five from Zimbabwe respondents said they knew more than five people recently displaying flu and/or pneumonia symptoms.
•In Somalia there were signals that a large number of people might be dying outside of health facilities, specifically in their homes or in IDP or refugee camps.

Conclusions: Existing digital contributor platforms with local networks are a non-traditional data source that can provide information from the community to supplement traditional government surveillance systems and academic surveys. We demonstrate that using these distributor networks to for community surveys can provide periodic information on rumours but could also be used to capture local sentiment to inform public health decision-making; for example, these insights could be useful to inform strategies to increase confidence in Covid19 vaccine. As Covid-19 continues to spread somewhat silently across sub-Saharan Africa, regional and national public health entities should consider expanding event-based surveillance sources to include these systems.

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Authors:
Ngozi A Erondu[1,2], Sagal A Ali[3,4], Mohamed Ali[4] and Schadrac C Agbla[5]

[1]Chatham House, London, UK
[2] Project Zambezi, Castlepines Medical Foundation, London, UK
[3] Cafiya Global Medical, Mogadishu, Somalia
[4] Karibu95, Iftin Foundation, Mogadishu, Somalia
[5] Department of Health Data Science, University of Liverpool, Liverpool, UK

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Background: In sub-Saharan Africa, underreporting of cases and deaths has been attributed to various factors including, weak disease surveillance, low health-seeking behaviour of flu like symptoms, and stigma of Covid-19. There is evidence that SARS-CoV-2 spread mimics transmission patterns of other countries across the world. Since the Covid-19 pandemic has changed the way research can be conducted and in light of restrictions on travel and risks to in-person data collection, innovative approaches to collecting data must be considered. Nearly 50% of Africa's population is a unique mobile subscriber and it is one of the fastest growing smart-phone marketplaces in the world; hence, mobile phone platforms should be considered to monitor Covid-19 trends in the community.

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should consider expanding event-based surveillance sources to include these systems.

Keywords: smart phones; mHealth; community surveillance; event-based surveillance; digital contributor systems; Covid-19; sub-Saharan Africa; LMICs.

Introduction

The narrative versus the epidemiological reality of Covid19's impact on Africa has been mostly confused or perplexed. In the earlier phase of the pandemic, experts, including Africa CDC Director John Nkengasong warned of potential devastation of a novel virus with, at the time, no established medical countermeasures [1]. While these concerns were contextualised in the then shocking and raw imagery of the raging spread of Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in countries like China and Italy—fear about Africa's fate was heightened due to the reality of acute health system weaknesses that exist across the region and that could have likely led to an exacerbation of the Covid-19 pandemic.

In May 2020, a study led by the World Health Organization (WHO) African Regional Office estimated that Covid-19 would be responsible for 190, 000 deaths and five million additional hospitalizations across it's 47 Member States by the end of 2020 [2]. In this final month of 2020, Africa accounts for less than 5% of worldwide Covid-19 cases and, at the time of our writing, there were less than 55,000 deaths across the continent [3].

There is now agreement across public health professionals that African governments acted much quicker in enacting effective public health measures such as screening airplane passengers, stopping international travel, and enacting population movement restriction when compared with their counterparts in western and higher income countries. These actions likely resulted in fewer imported cases and caused the virus transmission to be delayed [4]. Other factors such as a honed experience controlling infectious disease by experts across the continent, as well as a younger population in comparison to other regions, are also cited as potential reasons for why countries across Africa have not been as badly impacted by Covid-19 [5].

Uncovering evidence on the extent of SARS CoV-2 spread across Africa

While prevalence and mortality are low, Covid-19 continues to spread throughout the African region. On a continent with 1.2 billion people, Africa only recorded its millionth case during the first week of August [6]. Comparatively, the United States of America, with one third Africa's population, reached that tragic milestone at the end of April [7]. India and its 1.3 billion population recorded its millionth case in mid-July [7]. There is strong consensus that the fast actions of many African countries helped to delay the SARS CoV-2 virus transmission as well as averting health system overwhelm.

And while regional efforts to improve laboratory capacity have yielded nine million tests from February to October across the African Union member states; still, it remains true that testing capacity is much lower in many African countries when compared to other countries [8].

Two conducted studies in Kenya and Malawi provide evidence that infections are more widespread than the official data reflects. One Kenyan study found that the Covid19 infection curve and peak, while delayed, resembled other countries. After testing more than 3000 blood donors, Uyoga and

colleagues estimated that one in 20 Kenyans aged 15 to 64—or 1.6 million people—has antibodies to SARS-CoV-2, an indication of past infection [9]. Another study in Blantyre, Malawi which conducted a SARS-CoV-2 serosurvey among health workers showed antibodies in 12.5% of the study participants, but the death rate in that city was 8 times lower than expected [10]. High prevalence of Covid19 antibodies has been documented in Cameroon and Mozambique as well [11].

The lack of testing and surveillance has been identified as the critical missing piece in regards to how Covid-19 has truly impacted Africa. WHO officials have repeatedly stated that it is likely that the lack of testing in most African countries has resulted in missed cases rather than the assumption that there are not many cases.

Leveraging platforms with existing local penetration could supplement disease surveillance and guide outbreak response

Historically, in many low and middle-income countries (LMIC), much disease data has also come from national disease surveillance data, academic, non-governmental organisation (NGO) and humanitarian agency surveys. While surveillance systems are essential to early detection of outbreaks, globally these systems are under-invested in, especially in LMIC [12]. Surveys are often occurring periodically, e.g. annual, biannual, every five or ten years, and are not routine enough to provide timely intelligence to guide outbreak response. Large routine surveys occurring during outbreaks are expensive and thus, rare. Further, routine health information systems often end at the health centre allowing for limited monitoring of broad community health events [13].

However, in response to the Covid-19 pandemic, the Imperial College London weekly survey is an important behavioural tracker that pairs Covid-19 data with respondent sentiments from 21,000 people in 29 countries—and makes it publicly available [14]. This feat was made possible by partnering with YouGov®, one of the largest opinion polling and market research organisations in the world; their contributor base includes more than eight million individuals across 40 markets [15]. The reach of companies like YouGov® is much further and more consistently present in some regions than traditional academic or public health organisations that must use public funding and undergo lengthy and expensive recruitment processes each time they conduct new studies. Further, these are commercial entities that often provide some type of monetary incentive to participants, which provides them with a reliable stream of opinions and insights for their chosen topic area.

Though like academic research, even behemoth data analytic companies like YouGov® have not yet penetrated lower income countries, specifically in Africa and South America. For example, none of the 29 countries in the Imperial study are in Africa. Fortunately, the rapidly increasing mobile phone usage paired with a decrease in smartphone costs should facilitate increased opportunities to accumulate survey contributors throughout Africa. The number of unique mobile subscribers in Africa was estimated at 477 million or 45% of the population in 2019; it is projected to increase to 623 million subscribers in 2025 [16]. Based on estimates by the Global System for Mobile Communications Association report [16], *The Mobile Economy: Sub-Saharan Africa 2020*, smartphones account for 50% of mobile connections in sub-Saharan Africa in 2020, and will rise to 65% in 2025, making it one of the worlds fastest growing smartphone markets in the global south where several companies have emerged that prioritize low and middle income countries and regions. We partnered with one such company for this survey.

While these surveys might not provide the depth and certainty of traditional research they can

provide “signals” to guide further investigation, and a home already exists for them in the health information architecture. Several frameworks have elevated event-based surveillance (EBS) data, or unstructured public health related data gathered from various sources, as an important component for epidemic intelligence but do not include modern crowd sourcing data and other market research outputs as a potential data sources [17]. Like other EBS and community surveillance monitoring systems, these sources could provide a signal that official structures like the Ministry of Health or a disease outbreak rapid response team would need to validate [18].

Methods

Using the existing contributor base for Premise™, we conducted a rapid cross-sectional survey of individuals with severe flu and pneumonia symptoms and unexplained deaths in Ethiopia, Kenya, Nigeria, Somalia and Zimbabwe. The objective of the survey was to identify the extent of potential SARS-CoV-2 spread across these five countries.

Premise™ is a commercial data and analytics platform that has more than 2.1 million contributors across 110 countries. The majority of contributors exist in LMIC in South America, Africa, and Asia. Their business model provides monetary incentives to contributors in exchange for providing local insights through surveys, especially for the health and humanitarian fields.

The survey was deployed from 6 July to 14 August 2020. Like other surveys on the Premise™ platform, the survey entitled *‘Flu or Pneumonia-like symptoms in your community’* was added to the Premise™ marketplace as a “task” that contributors in 14 cities and peri-urban areas in Somalia [5 cities], Ethiopia [3], Kenya [2], Nigeria [2], and Zimbabwe [2] could access and submit. Each contributor was allocated one completed task for filling out the survey (no matter how much data was included, e.g. knowing multiple potential cases or people who had potentially died), which was then counted along with other tasks to reach a threshold for a monetary incentive. An online consent statement regarding the use of their responses for research purposes was included for contributors to give consent before starting the survey. A minimum number of participants was determined by an a priori power analysis indicating that a sample of more than 200 participants per country for adequate statistical power (i.e., power * .80).

The survey was translated into five local languages (English, Somali, Arabic, Swahili and Amharic) and included questions related to flu and questions related to unexplained deaths that occurred in recent months (e.g. since November 2019). All questions were structured to include potential rumoured cases of flu/pneumonia and unexplained deaths, e.g. *Have you heard of any individual who has had severe flu or pneumonia?* An image showing different symptoms for Covid-19 was incorporated in the survey (Figure 1).

As respondents provided responses for multiple cases or people, complex survey analysis approach was used to account for clustering. The survey was considered to be a one-stage stratified cluster survey, with countries as the stratification variable. Percentages of survey responses were estimated and association was assessed using the adjusted Wald test. Multinomial logistic regression was conducted to evaluate associations between categorical outcome variables and covariates such as employment status, gender and education level. All analyses were performed using Stata 14.

Results

A total of 1615 respondents completed our survey. Respondents were mostly male (73%) and more

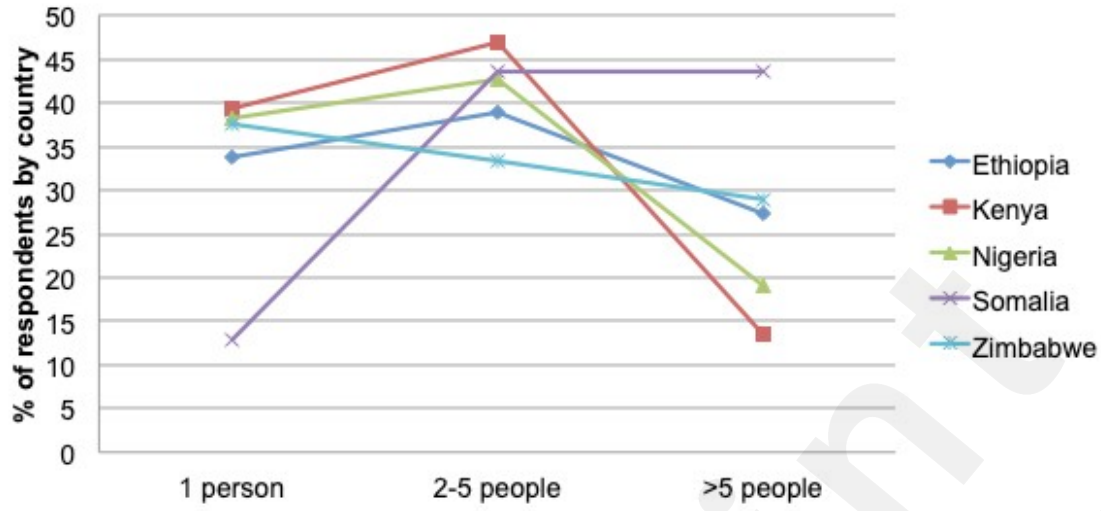
educated than the general populations in most of these countries, with 60% having secondary education or higher (Table 1). The survey respondents were also young, with a large proportion of students—this is reflective of the general young African median age of 19. These factors also reflect the intrinsic bias of bias of leveraging digital contributor networks that can only access surveys through a smart-phone only application. More than 10% of survey respondents identified as either unemployed or self-employed.

Figure 1 Image provided to show flu symptoms- adapted from Nigeria CDC Covid19 ***(need to get the version used from Jason)***

Table 1 Demographics of survey contributors

	Ethiopia (n=401)	Kenya (n=395)	Nigeria (n=398)	Zimbabwe (n=222)	Somalia (n=199)	Total (1615)
Gender, (%)						
Female	19.7	39.2	17.8	20.5	40.2	26.6
Male	80.3	61.8	82.2	79.5	59.8	73.4
Age of respondent, (%)						
<16	3.3	0.5	5.0	0.0	6.7	3.0
16-25	63.8	56.8	42.5	61.7	71.8	57.5
26-45	32.2	40.9	51.8	36.0	21.0	38.3
>45	0.7	1.8	0.7	2.3	0.5	1.2
Education, (%)						
None or Primary	2.3	0.8	4.1	0.5	14.7	3.6
Secondary	24.9	33.8	37.2	47.5	50.3	36.4
College or University	72.8	65.4	58.7	52.0	35.0	60.0
Employment status, (%)						
Un-employed	9.5	14.7	7.0	12.1	22.6	12.1
Student	55.1	39.8	36.4	39.2	49.8	43.9
Employed	26.7	31.1	33.7	32.0	21.6	29.6
Self-Employed	8.7	14.4	22.9	16.7	6.0	14.4
Refugee, (%)	7.7	3.1	12.5	4.7	9.9	7.6
IDP, (%)	12.9	7.1	25.0	5.7	22.4	14.6

Figure 2 Number of people each respondent knows with flu symptoms by country



P<.001; Adjusted Wald test showing strong evidence of variation in the number for people known with flu symptoms per respondents across countries.

Rumours of flu-like symptoms

Across countries, nearly half of the respondents (n=739) knew someone who had severe flu or pneumonia symptoms in recent month. There was strong evidence of variations across countries in the proportion of respondents who knew someone with flu-like symptoms (*P<.001*).

More than half of the respondents in Nigeria (52%) and Somalia (68%) said they had heard of or knew someone with severe flu symptoms in recent months. Ethiopia had the less than a third (28%) of its respondents that knew someone displaying severe flu or pneumonia symptoms. Across four countries, more respondents said they knew between two to five people that had displayed flu symptoms than those who said they knew at least one person; in Zimbabwe slightly more people knew more respondents said they knew just one person. In Somalia and Zimbabwe, more than a 20% of respondents said they knew more than five people recently displaying flu and/or pneumonia symptoms.

Note that in all five countries nearly a third of respondents said that they were not sure how many people they knew. Those percentages were similar across countries (*P=.81*). We therefore re-adjusted the percentages after excluding people unsure about the number of people they knew and assuming that the distribution of unrecalled number of people were similar to that of the recorded number of people.

Rumours of recent unexplained deaths

Between 36% (Ethiopia) to 63% (Somalia) of respondents indicated that they knew someone who had recently died in an unexplained manner (Figure 3). In all countries, except Ethiopia, more than half of the respondents said that they knew someone. Of these, one in five respondents in Nigeria, Zimbabwe and Somalia said they knew more than six people who had recently died. Ethiopia had the highest number of respondents who knew at least one person (32%) as well as the highest proportion of individuals who were not sure how many people they knew who had died in an unexplained manner (38%).

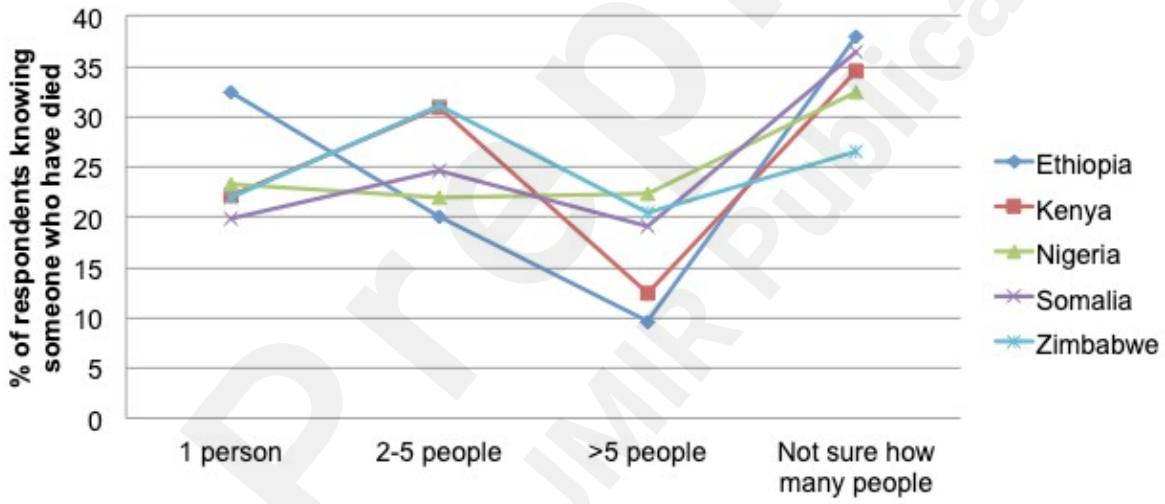
In total, respondents identified 2,387 individuals that potentially recently died in an unexplained manner in recent months (i.e. from December 2019). The reported characteristics of people who the respondents knew that had died varied by country (Figures 4 & 5).

In Nigeria 56% of the reported deceased were 25 years and younger and one third were over 45 years old—the highest proportion in the study. Fifty per cent of reported deaths were people who resided rural areas and the majority of reported deaths occurred in either the hospital or the home.

In Kenya, 35% of individuals reported to be deceased by respondents were between 26 and 45 years of age and 30% were over 45 years of age. Sixty per cent of recently deceased individuals described by respondents resided in urban areas and most deaths reportedly occurred in either the hospital or the home.

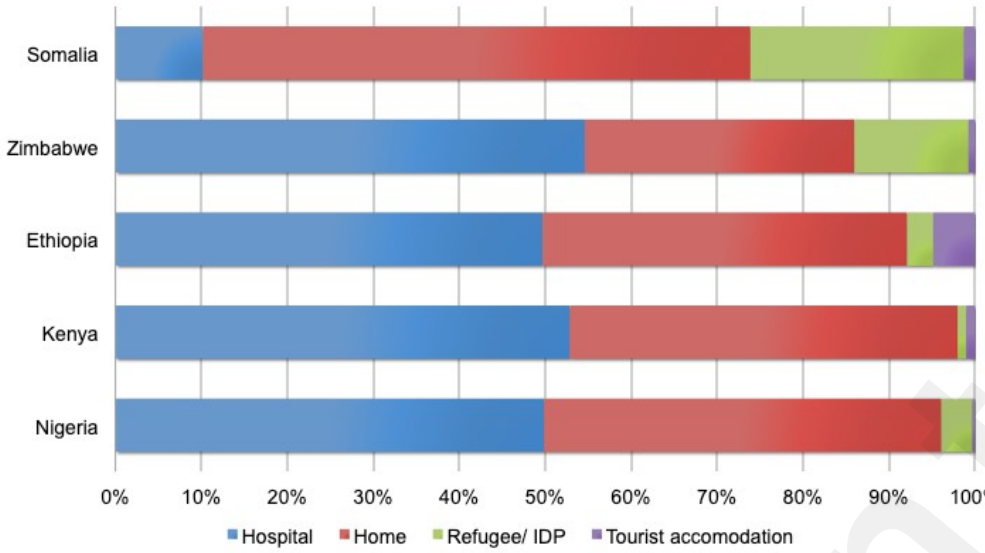
Respondents in Ethiopia reported just 15% of those rumored to be deceased were over 45 years of age, with most of the people respondents identified (50%) being 25 and younger. More than half (58%) of rumored deaths were people who resided in rural areas. While most deaths occurred in the hospital, nearly 30% occurred in home and approximately12% of reported unexplained deaths occurred at a refugee camp.

Figure 3 Number of individuals who recently died in an unexplained manner, reported by respondent by country



* P value = .004

Figure 4 Location of individuals reported to have died in an unexplained manner by country



Zimbabwean respondents identified the highest proportion of reported deaths in higher age groups with more than 70% being 26 years of age or older; one in four of the reported recently deceased were over 45 years of age. Fifty-nine per cent of reported deaths were people who resided in urban areas and most deaths occurred in either the hospital or the home.

Somalia had the highest proportion of reported deaths (40%) in people aged 46 and older. Forty-nine per cent of known deaths were people who resided in urban areas and Somalia had the lowest proportion of (10%) of reported deaths that occurred at the hospital. Conversely 63%, the highest in the sample, reportedly occurred at home and 25% in a refugee camp.

Figure 5 Proportion of individuals reported to have died in an unexplained manner by age

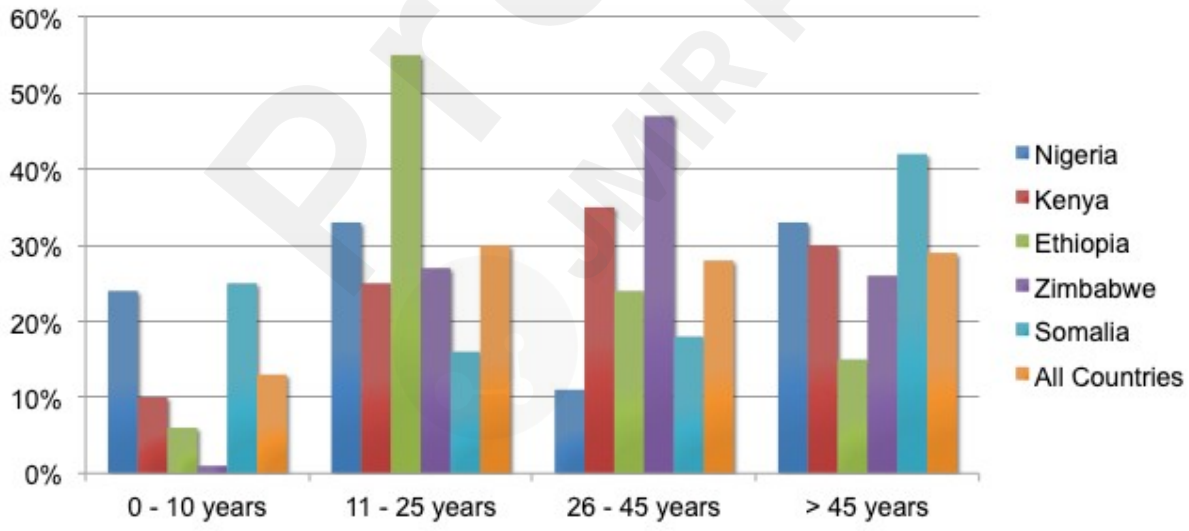


Table 2 Respondent recall of which month reported unexplained death occurred

Country *(Reported # of deaths)*	# of deaths with reported month*	Nov-Dec 2019 n (%)	Jan-March 2020 n (%)	**April – June 2020 n (%)**

Ethiopia (n=279)	167	10 (6.0)	116 (69.5)	41 (24.5)
Kenya (n = 725)	398	117 (29.4)	141 (35.4)	140 (35.2)
Nigeria (n = 720)	374	122 (32.6)	159 (42.5)	93 (24.9)
Somalia (n=285)	154	18 (11.7)	58 (37.7)	78 (50.6)
Zimbabwe (n=378)	167	14 (5.1)	94 (34.2)	167 (60.7)
Total (n = 2387)	**1368**	**281 (20.5)**	**568 (41.5)**	**519 (38.0)**

* The remaining respondents were unable to recall the month of death and therefore were excluded.

After excluding ‘not sure’ responses, respondents were able to recall a specific time period for 1368 individual deaths of unexplained manner (57% of total reported deaths). They reported a two-fold increase of these reported deaths between January and March and April and June 2020 when compared to November to December 2019. Nigeria, Kenya, and Zimbabwe reported the most absolute numbers.

We performed a logistic regression analysis on several respondent variables for potential associations with knowledge of individuals with flu/pneumonia symptoms and knowledge of individuals who had recently died in an unexplained manner. These variables were occupation, rural/urban location, refugee status, and IDP status. Among these, only IDP and refugee status showed a significant association with knowing people who died ($p < 0.001$) and number of people who died ($P=0.003$) (Table 3).

Table 3 Association between Refugee and IDP status and knowledge of and number of reported persons with recent flu or pneumonia symptoms and of reported persons dying from unexplained deaths.

	Total number	# with known IDP/ Refugee status	IDP/Refugee Status, (%)			P[#]
			No	Refugee	IDP	
Know someone with flu/pneumonia symptom	**1615**	**1567***				*<.001*
Yes	739	719	35.8	76.5	83.8	
No	876	848	64.2	23.5	16.2	
# of persons known with flu pneumonia symptom	**495***	**484[§]**				*.003*
1	163	162	28.8	42.9	40.7	
2-5	208	202	48.0	34.3	28.7	
>5	124	120	23.2	22.8	30.6	
Know someone who died	**1615**	**1567***				*.008*
Yes	848	828	50.8	58.8	60.7	
No	767	739	49.2	41.2	39.3	
# of persons known to have died	**563***	**546[$]**				*.03*
1	202	200	32.8	46.8	48.7	
2-5	218	209	40.7	35.5	27.6	
>5	143	137	26.5	17.7	23.7	

[#]Adjusted Wald test. * Excludes 'not sure' responses. [§] Restricted to respondents who know someone with flu/pneumonia symptoms and 'not sure' responses excluded. [$] Restricted to respondents who know someone who have died and 'not sure' responses excluded.

Discussion

What insights to the Covid-19 outbreak do these signals tell us?

Currently, there is a lack of information about the Covid-19 pandemic in Africa beyond the official case and death data, which is incomplete due to the aforementioned shortcomings of the health system, as well as the uncontrolled spread of SARS-CoV-2 in many countries in Africa and around the world. While asymptomatic spread of SARS-CoV-2 has been estimated from 15% to 45% [19,20], that leaves a significant proportion of susceptible individuals that will display mild, moderate, and severe Covid-19 symptoms once infected. Our survey found several insights that may be important to investigate regarding potential Covid-19 symptoms in the countries we included in the study, but potentially across Africa and other regions.

First, more survey respondents said they knew or heard of more than one person with symptoms across all five countries. This aligns with the clustered transmission reality of SARSCoV-2 and other respiratory viruses that cause acute respiratory illness. While Influenza-like illness (ILI) surveillance is limited across Africa there are some published data about ILI seasonality from the African

Network of Influenza Surveillance and Epidemiology [21]. While defined seasonality is not available for West African countries, the data shows a higher percentage of influenza cases between June and August in South Africa—which is winter for the southern hemisphere. This likely means that in Zimbabwe, which shares climate patterns as well as a border with South Africa, a proportion of individuals that the Respondents identified could have been displaying flu symptoms or a combination of both flu and Covid-19 symptoms. Contrastingly, East African seasonality shows a higher prevalence of influenza between July and October. From our study, Kenya, Ethiopia and Somalia are part of this region and showed differing results; more than half of respondents from Kenya and Somalia reported knowing people recently displaying symptoms with two-thirds of Somalia respondents knowing at least one person. Ethiopia had the lowest proportion of respondents, one in three, reporting knowledge of individuals with symptoms. In Kenya and Somalia, there is a potential signal for Covid-19 since the survey did not coincide with the flu season, as currently defined.

When it comes to deaths, our data is less clear regarding insights to Covid-19. Though respondents recalled the month of death for only one-third of reported deaths, the dramatic increase of numbers follow the importation and transmission of Covid-19 to various African countries [22]. The proportion of the African population in the highest risk categories of Covid-19 (e.g. 60 years of age and older) is very low at 6% and reflects lowered life expectancy in this region [23]. However, many African countries have targeted as young as 45 year olds for Covid-19 vulnerability messaging given that they are more likely to have diagnosed and undiagnosed chronic illnesses. In our survey, respondents from Somalia, Nigeria and Kenya had the highest absolute numbers of reported deaths in Covid-19 in the older age group of interest. While these were also the most populous countries in the survey, they also have the youngest median age and thus this finding could be an important signal for further investigation. Zimbabwe, reported has the highest proportion of deaths among adults (>70% were over 26) in the study. As a country experiencing prolonged economic hardship, which has resulted in famine and hunger, unprecedented unemployment and an increase in many diseases and conditions but a reduction in accessible and affordable healthcare services, these parallel crises likely accounts for a large proportion of these unexplained deaths.

Two other interesting findings could contribute to future research and inform control strategies. The first is the association of IDP and refugee status and knowing someone with flu/pneumonia symptoms or someone who had died. These populations and settings are more vulnerable than other settings for several reasons and could be experiencing more negative outcomes from uncontrolled spread of SARS-CoV-2 [24,25]. Also, across all countries was that there was no real difference in the reported deaths by rural or urban areas, contrary to current hypotheses of African regional spread [26].

Beyond these insights, the experience of using this platform is also notable. Unlike traditional research, the Premise platform afforded us agility and flexibility to collect data. During our survey, Ethiopian Internet services were cut for one week due to political unrest. Even with the missed time, once services were restored, we were able to reach our sample quota in the included regions in just two days. Further, the contributors represented numerous communities across the five countries—areas that we did not have to travel to or put individual data collectors at risk in the midst of this pandemic.

Limitations

There were several limitations with the way the survey was designed, which is why we are conservatively presenting our findings. First, questions were posed in a manner that would allow

respondents to answer as easily as possible, but the lack of concrete timings means that respondent recall of 'recent' could be well before the introduction of Covid-19 to their country. Recall bias was also apparent in the large percentage of respondents across countries select 'I am not sure' for many questions. This study did not follow any standard established surveillance definitions of ILI or severe acute respiratory infection in order to allow respondents to answer questions with more ease.

There are also limitations to our method of selecting contributors from the Premise platform. Specifically, our pilot study used the general contributor base (as opposed to a targeted recruitment strategy), which has a selection bias towards the 16-35 year male old age demographic—this reflects the realities of the low-income countries in their database such as males having digital bank accounts and higher smartphone ownership, younger people being more internet savvy and having more free time during the day, and two-thirds of Africa's population being under 25 years old. Additionally, the cost of employing these platforms is likely much higher than traditional methods, thus, distributor platforms should be considered as a complementary data source and not a replacement of traditional surveillance measures.

Conclusion

In the Covid-19 era, face-to-face recruitment of study participants is not only challenging but also risky, but data on the potential spread of disease and its impact on communities are needed now more than ever. Partnering with digital contributor platforms and market research vehicles is one way to identify trends and target limited resources. Contributor platforms provided by companies like Premise™ and YouGov® could supply important country, regional, and global insights especially for policy makers and public health entities needing data to guide resource allocation and inform dynamic control strategies. With the introduction of vaccines and the rise of vaccine hesitancy and scepticism across Africa and worldwide, these platforms could be vital in gathering rumours and developing crafted messages to quell the fears of specific groups. While these vehicles must not usurp traditional research nor do they need to be part of a permanent information system structure they can be an important signal generator that can feed into EBS. Like other EBS sources, these signals and rumours should then be investigated and verified by the appropriate officials.

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Conflicts of interests

None declared

Abbreviations

COVID-19: Coronavirus disease 2019

EBS: Event-based surveillance
ILI: Influenza-like illness
SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2
WHO: World Health Organization

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