Report on

Ethiopia COVID-19 Response Vulnerability/hotspot mapping:

Addis Ababa risk assessment

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Forward

This document is intended to provide an overall insight about COVID-19 potential risk level in Addis Ababa. It generally shows vulnerable/hotspot areas identified using geospatial analysis techniques based on secondary data collected from different sources. The document and associated results are being made available on a non-exclusive basis in response to the urgent need for measures to address the COVID-19 crisis. The results reflect general insight based on currently available information and are not exhaustive nor do they contain all of the information needed to determine a future course of action. The datasets used as bases of analysis are extracted from different sources and the result has not been independently verified and is inherently has different levels of uncertainty and subject to change. Given the uncertainty surrounding the pandemic, the results presented here are tentative, and future results could differ from any forecasts or projections. These materials do not constitute policy advice or legal, medical or other regulated advice. Particularly in light of the rapidly evolving pandemic and associated dynamics in different aspects, these materials are provided "as is" solely for information purposes without any representation or warranty, and all liability is expressly disclaimed, including as to the accuracy, completeness or usefulness of information; compliance, design, efficacy, performance, quality or safety of any products; capability or quality of any suppliers or manufacturing operations; or non-infringement of any third party rights.

Background

Since it started on 31 December 2019 in China, COVID-19 has spread globally covering almost all the countries of the world. As of the date of this reporting (10 May 2020), over 4 million people are infected out of which close to 284,000 have died. Despite the US and Europe are the ones most affected thus far, the virus is spreading fast across our continent infecting close to 65,000 and killing over 2300 people. In our country, Ethiopia, 250 people are infecting with the virus with five deaths recorded thus far. Like elsewhere in Africa, the rate of infection in Ethiopia is getting momentum with the highest number of cases (42% or 104 people) recorded during the week of 4 May 2020 only. This is very alarming as the infected people now include those with no history of foreign travel.

The government of Ethiopia under the Ministry of Health (MoH) is undertaking exemplary measures to tackle COVID-19 – both to contain its spread and minimize its associated impacts. The government has started preparing itself since the early phases of the spread and is trying its best to make sure that the virus causes minimum effect on the society and economy.

Since the virus has no vaccine and treatment, the key measures to tackle its spread are physical distancing, staying at home and washing hands frequently. However, implementing those measures strictly will not be possible and the virus has already found its way within the population. The next option is thus to speed up testing to identify potential 'spreaders' and isolate them to contain further spread. Against this background, the MoH is expanding its testing centers across the country and the number of testing per day has increased. However, the country has limited human and financial resources to test as large number of people as possible. It is also practically/operationally impossible to 'test everybody' in the country.

To minimize cost of testing and make effective use of the country's human and economic resources, a framework is developed to undertake 'bulk sampling'. This is about creating composite of samples, test those composites and conduct more detailed analysis of the composites that have shown positive.

In the case of both mass and bulk sampling, it will be more appropriate if the focus can be on those sites/communities who are more vulnerable to COVID-19 potential outbreak and spread. This can be achieved through identifying and mapping 'hotspot' areas that are likely to be susceptible to virus spread and area at higher risk compared to others. These are thus areas that require priority intervention, in this case testing.

This document is prepared in response to supporting the MoH in its fight against the spread of COVID-19. It mainly focuses on identifying and mapping potential hotspot areas and communities that require priority testing using geospatial analysis techniques. The current exercise focuses on Addis Ababa, the national COVID-19 hotspot.

Approach to map vulnerability

The approach is automated and can easily be updated as well as scaled to other parts of the country. The overall approach is based on the US Centers for Disease Control and Prevention (CDC) methodology employed for vulnerability mapping with modification depending on availability of data and to fit to the country's context.

Table 1 Key criteria adopted to map COVOID-19 hotspot areas within Addis Ababa city

Category	**Criteria**	**Rationale**	**Scoring**	**Weight**
Demographic	% pop. having age above 65	Older individuals are more at risk of COVID-19. *Due to woreda data unavailability for prevalence of HIV and TB, this analysis uses old age (>65) as a proxy for population at risk.* However it is observed that demography has not shown significant difference in Ethiopia thus far	1= Highest quantile; 5 = lowest quintile	1
	% pop. having age below 17	Global evidences thus far show that young individuals are generally at low COVID-19 risk. Again, this may not hold for Ethiopia thus far	1= Highest quantile; 5 = lowest quintile	1
	Pop. density	High population densities present less opportunity to practice safe social distancing thus more risk to COVID-19	1= Highest quantile; 5 = lowest quintile	1
Socio-economic	Poverty head count	Poverty levels determine the level of people who can stay at home and purchasing power for sanitation items	1= Highest quantile; 5 = lowest quintile	1
	% pop unemployed	Non-employed people tend to move around looking for jobs (super spreaders) and/or will likely have more contact. Their purchasing power for sanitation items is also low	1= Highest quantile; 5 = lowest quintile	1

	% pop not attended school	Awareness is important to understand and effectively practice suggestion from medical personnel	1= Highest quantile; 5 = lowest quintile	1
Housing and Infrastructure	% pop with access to piped water	Hand washing depends on access to water and the number of people who access that water.	1= Highest quantile; 5 = lowest quintile	1
	Distance to major market centers	Market centers can attract large number of people that can likely enhance susceptibility for transmission	1= Lowest quantile; 5 = highest quintile	1
	Public transport flow	High public transport flow potentially lead to high susceptibility to COVID-19	1= Lowest quantile; 5 = highest quintile	1
	Housing type and number of occupants	The size of family living in a house (crowded or not) determines possibility of disease transmission	1= High density; 5 = low density	1
Health	Distance to health facilities	The closer available health facilities the greater support from health personnel	1= Farthest ; 5 = Closest	1

Note that epidemiological data, means of livelihoods and current distribution of observed cases can improve the result. It will be advisable to assign appropriate weights to each factor by discussing with epidemiologists and health experts. It will also be essential to consider the current level of spread across the country as an input so that the map is 'adjusted' for reality on the ground.

Results

Figure 1 shows the risk level for Addis Ababa. According to this map, the majority of communities in Kolfe, Arada, Lideta are highly vulnerable to COVID-19 while Nefas Silk and Yeka sub city categorized under low risk level. The detail risk level by woreda and keleble summarized in table 2.

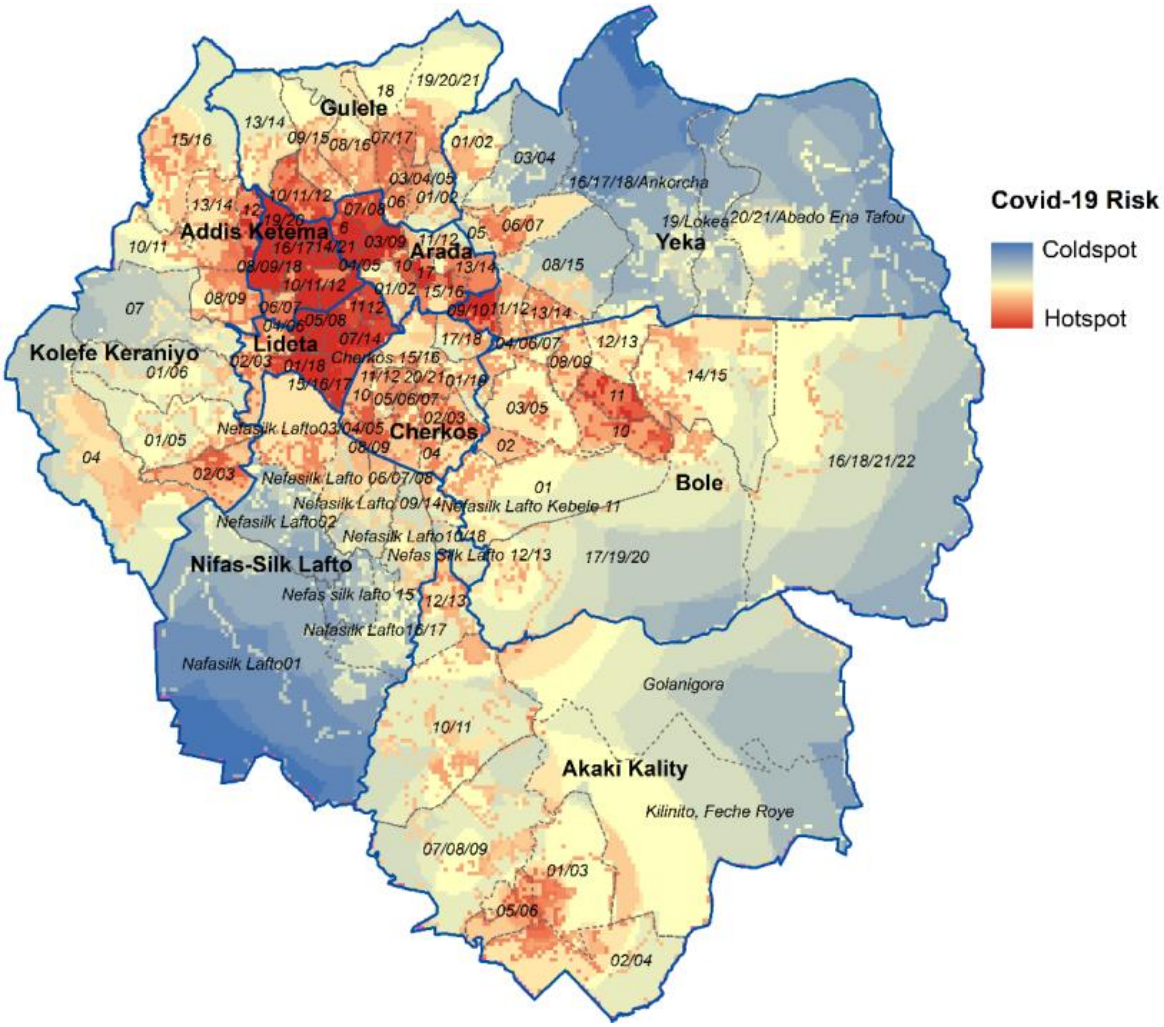

Figure 1 COVID 19 Risk level in Addis Ababa

Note: Risk levels are calculated as weighted sum of scores between 1-5 for criteria within four categories: demographic, socio-economic, infrastructure, and public health risks and housing conditions (see table for details). The map can be improved with additional datasets as well as 'adjusting weights' of the different factors by discussing with epidemiologists and health experts.

Table 2 summary of Covid 19 risk level by kebele and sub city

Risk Level	*Subcity name*	*Kebele name*
Very high	*Akaki Kaliti*	*05/06*
	Kolfe Keraniyo	*02/03, 08/09, 12*
	Gulele	*03/04/05, 07/17, 10/11/12, 06*
	Lideta	*01/18, 02/03, 04/06, 05/08, 09/10, 07/14, 15/16/17, 11, 12*
	Chirkos	*01/19, 02/03, 05/06/07, 08/09, 11/12, 13/14, 17/18, 20/21, 10*
	Arada	*03/09, 04/05, 07/08, 11/12, 6, 10, 17*
	Addis Ketema	*01/02/03, 04/05, 08/09/18, 10/11/12, 13/15, 16/17, 19/20, 14/21*
	Yeka	*11/12, 09/10*
	Bole	*04/06/07, 08/09, 02, 10, 11*
High	*Nefas Silk Lafto*	*03/04/05, 06/07/08*
	Chirkos	*15/16*
	Addis Ketema	*06/07*
	Yeka	*06/07, 05*
	Bole	*03/05*
Moderate	*Akaki Kaliti*	*01/03, 02/04, 08/08/09, 10/11, 12/13, Kilinito, Koye Feche*
	Nefas Silk Lafto	*12/13, 16/17, 11*
	Kolfe Keraniyo	*01/05, 10/11, 13/14, 15/16, 01/06*
	Gulele	*01/02, 08/16, 09/15, 13/14, 19/20/21, 18*
	Arada	*01/02, 13/14, 15/16*
	Yeka	*01/02*
	Bole	*12/13, 14/15, 01*
	Yeka	*13/15*
Low	*Akaki Kaliti*	*Golanigora*
	Nefas Silk Lafto	*09/14, 10/18, 02*
	Kolfe Keraniyo	*07, 04*
	Chirkos	*04*
	Yeka	*08/15, 19/Lokea*
	Bole	*16/18/21/22, 17/19/20*
Very low	*Nefas Silk Lafto*	*01, 15*
	Yeka	*03/04, 16/17/18/Ankorcha, 20/21/Abado-Tafou*

Developing tools accessible to users

Tool is being developed to visualize covid 19 risk level using R Shny application. The intension is making available for health officers to evaluate the risk level and redefine the weight for combining of the factor maps. In this regard, users tried to set weight for each factors considered in the risk analysis and evaluate how the risk level is changing as the weighs are changed. Further this helps to design optional measures depending on the risk level for different places. Since the very intention of this work and analysis is to use the risk map for targeting and mass testing, mobile application is also tried to develop for easy guide of health officers engaged in mass testing. In this regard mobile application is develop.

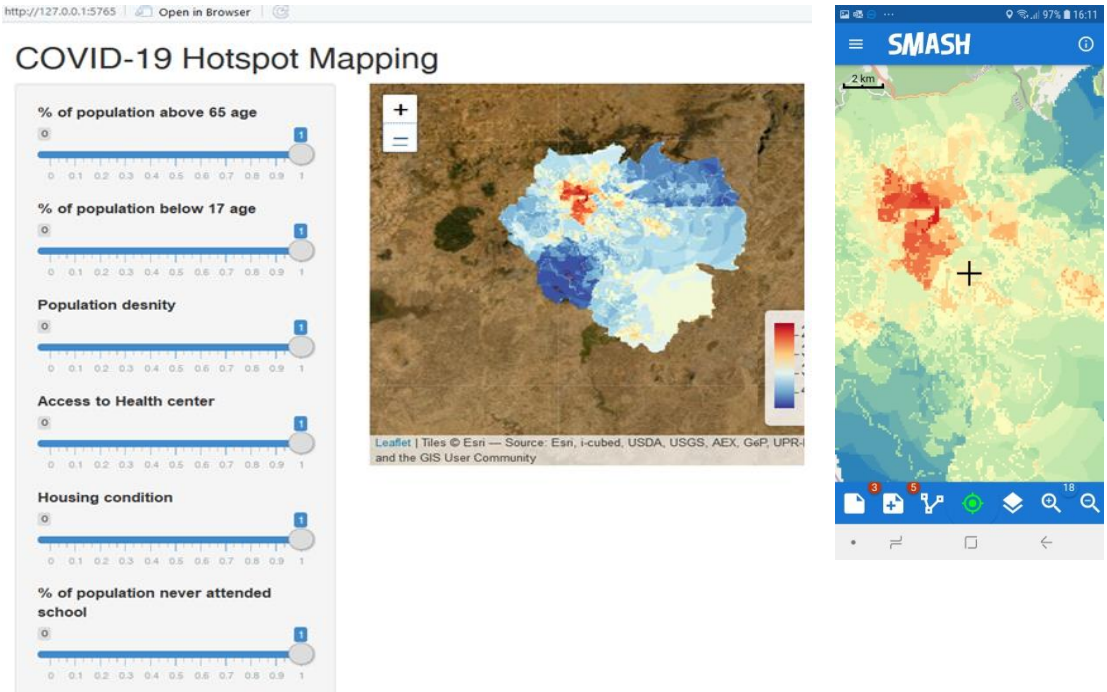

Figure 2 Shiny applications to evaluate covid risk (left), and Mobile app (right)

Way Forward

The risk analysis tried to analyses in this work is somewhat static and need to be dynamic through harvesting of data related Covid 19 confirmed cases and make the analysis in near real time. For that further development of the R Shiny application is very necessary. Further, it is planned to simulate possible optional measures and evaluate how the risk level can be changed accordingly