

Brief context analysis and needs identification during Corona pandemic in Kenya and Nepal

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Julie Fleischer, Roel Kamerling, Jenny Dankelman, J.C. Diehl
contact: j.c.diehl@tudelft.nl

Introduction

While China, Europe and the United States are currently hit hard by the Corona crisis, there has been limited attention so far for the situation in low- and middle-income countries (LMICs). However, in the last week daily life for many people has changed rapidly as more and more countries go into lockdown and the harsh reality of these measures for a large population in LMICs is highlighted in news outlets. Africa, Asia and the rest of the world are watching with bated breath on how the situation in these often fragile healthcare systems will evolve in the upcoming weeks and months.

In the meantime, many initiatives are popping up: the entire internet is full with projects on 3D printing, ventilators and mouth masks. Many of these initiatives target the crisis situation in high-income settings. Therefore, the Global Initiative of Delft University of Technology created this document with the aim of highlighting the current situation in Kenya and Nepal and providing insights on what is needed to improve local healthcare. It gives a brief and subjective impression of the ongoing situation and healthcare challenges, without pretending to be a comprehensive and scientifically created analysis. It is based on information available until April 1st, 2020, from various journalist outlets and informal conversations with 5 Kenyans and 2 people in Nepal who are all working in the front lines of the crisis.

Corona in Kenya

Outbreak expectations

The average age of people in Kenya is around 19 and with only a very small percentage of the population over 60 it might be possible that relatively few people require care in the ICU and relatively more patients need low-level medical care. However, there is a chance that the Corona virus will spread easier as temperatures drop in the coming months and that the measures that are currently in place, would be more effective in the future.

In Kenya you can either live in large urban cities such as Nairobi, Mombasa, Kisumu, Nakuru, Eldoret, somewhere along the long coastline between the borders with Somalia and Tanzania, high up in the mountains, in the desert or everything in between. During holidays, elections and celebrations there is a large movement of people that are returning back to their familyland in the rural areas of the country, which is a trend that has also been observed during this Corona crisis. People leave the cities due to lack of work or send their children to family in rural areas. These migrations increase the number of people using public transport, but at the same time decrease the number of people in the main cities, which could be helpful in preventing contamination. However, this also introduces the scenario of contamination of people living in the local villages by the people travelling from the cities. The people living in the rural areas are already a vulnerable population, because when they require treatment in a hospital these facilities are now also at a physical distance of up to hundreds of kilometres.

Context during lockdown

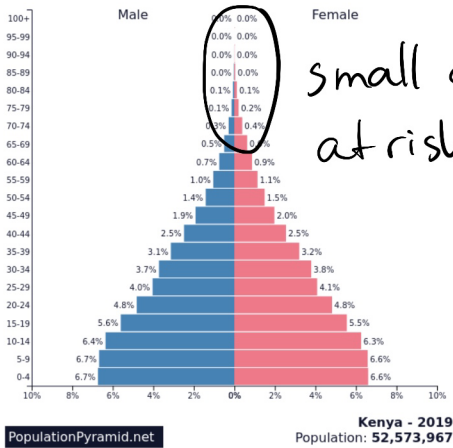
Kenyans are asked to stay at home and there is a dusk to dawn curfew in place (from 7pm to 5 am), social distancing is asked from everyone but people are complaining that 'Kenyans' are not listening. With many people aware of infectious diseases such as Ebola, one could argue whether people do not want to listen or that they simply cannot listen because they have to choose between a very basic living standard or much worse when staying at home.

Limited people in Kenya have access to bank accounts, MPESA is therefore widely used for money transactions and a big necessity in life for many Kenyans, among all different income groups. MPESA is used to pay at the local market, buy mobile credit, whatsapp credit and many more. It is a

Kenya

- ✗ no water
- ✗ no insurance
- ✗ no income
- ? quarantine

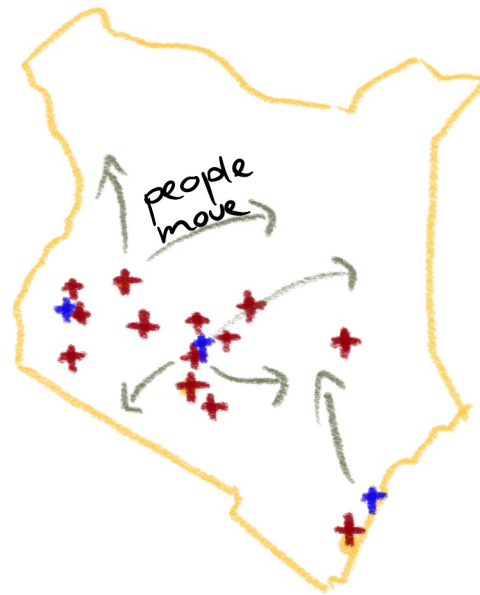
small group
at risk



Cash = transmission



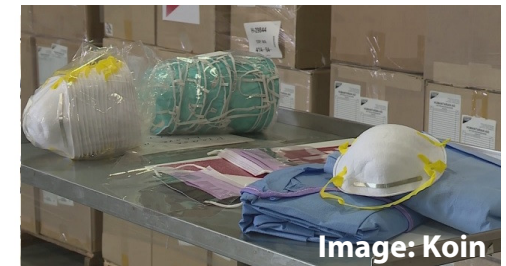
→ education, mostly
stopped



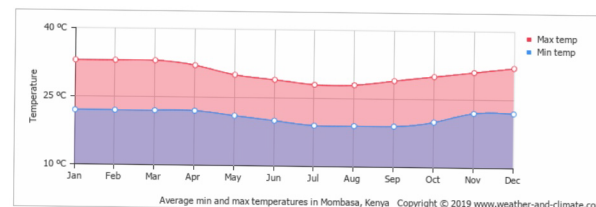
+ ICU ~ 100
+ test lab →



✗ PPE limited



Strike?



great tool to prevent contamination by the use of cash money, however, cash is required to 'top-up your MPESA' and can be done at many fruit stalls, supermarkets etc. on every corner of the street. This means that everyone with a mobile phone has easy access to these services, but it is also a potential risk of corona.

All schools and universities are currently closed in Kenya, some primary and high schools have started to provide some teaching via whatsapp or Instagram. However, universities have come to a complete stand-still again (there has been a history of strikes in the last couple of years, resulting in many delays in educational programs already). There is little infrastructure available to provide education using digital tools. There is a huge group of Kenyan students that do not have access to a laptop or computer at home. If they have a smartphone, it is often expensive to buy data and it will be challenging if they have to spend extra money on data to be able to follow their education from home.

Healthcare system

In general, there is a very small number of medical specialists, hospitals and ICUs for a population of more than 50 million Kenyans. It is expected that there are around 500 ICUs available, distributed over both (expensive) private and public hospitals, with the majority in the private hospitals in Nairobi and Mombasa. Due to large distances and limited access to ambulances it won't be possible to distribute patients easily over various hospitals. A constant supply of oxygen, which is required to treat hospitalized corona patients, is difficult to sustain in many hospitals in Kenya. Oxygen plants are expensive, vulnerable, and are often out of service because they require extensive maintenance to keep them running. Cylinders with oxygen could be a great alternative but require a reliable supply chain.

The limited access to personal protective equipment (PPE) for healthcare workers is putting them at risk when treating corona patients. This situation has led to a strike in Zimbabwe. Since Kenya has a history of strikes of medical personnel in the last few years, it is not unthinkable that this will happen again if the protection measures for healthcare workers are not improved in the near future. Additionally, healthcare personnel will require extra training to be able to treat a large number of IC patients. Some hospitals in Kenya have already implemented special Corona wards to isolate corona patients from others, but when a large inflow of patients is expected

at different levels of care more triage systems are required. There are often large groups waiting in or outside of hospitals in Kenya to get treated, or caretakers of patients are waiting to get in. This also leads to a potential contamination danger. Kenya does not have a referral system in place, for example by a general practitioner, who can make the first considerations on which patient will require additional hospital care. This is expected to lead to a large number of patients presenting themselves at the hospitals. In some countries the amount of acute care reduces because of the lock down, meaning that there is less pressure on the healthcare system by regular cases. When the amount of traffic within Kenya won't reduce drastically, it is not expected that the number of accidents - which accounts for a large part of medical cases - will go down.

Cleaning and sterilisation is a huge challenge in Hospitals in Kenya, and will be even more important while combating Corona. Many hospitals have access to an autoclave, but the capacity is often not enough for all the equipment so a large part is cleaned by chemicals (CIDEX). TU Delft has shown that autoclaving certain mouth masks up to 5 times can be safely done, but these experiments were done using laminated autoclave bags. These bags are not always available in LMICs, so testing this procedure without or with different bags is advisable. To successfully prevent contamination it is important that hospitals make use of clean and dirty rooms to handle equipment, this is currently not properly installed in all hospitals in Kenya.

To track and collect data on the number of corona infections is a challenge in Kenya, where there is a limited number of full functioning labs, let alone test equipment. The small amount of testing facilities that are available are all in Nairobi, Kisumu or Mombasa. If testing will be done eventually in the rural areas, the specimen will have to be transported to these cities to be analysed. Results are expected to take up to days or weeks.

Nairobi

Nairobi is your typical buzzing African city, people with a very-low, low, middle, middle-high and high-income live sometimes a few meters apart from each other. Yet, their worlds could not be more different in terms of access to water, soap, sanitation, information, healthcare and transportation. However, the one thing we know for sure is that their lives are affected by COVID19 and challenging times are approaching very quickly.

Nairobi

Matatu Sanitizing

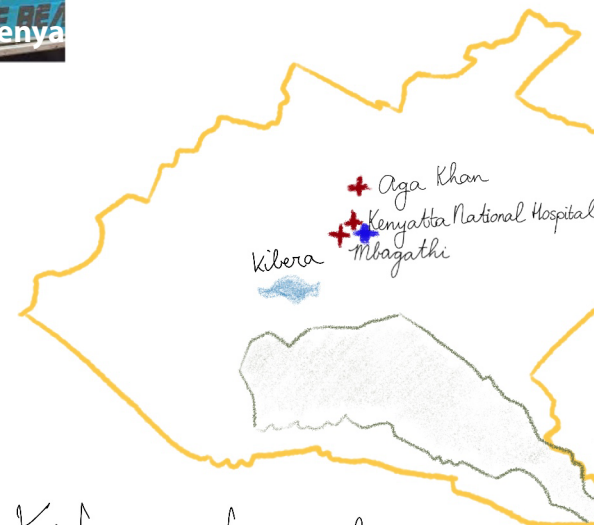


\$↑

Market Fumigation



Fever check



Kibera hand wash



+ test lab
+ ICU/quarantine

Mpesa top-up

Kijabe Hospital
kijabe_hospital

LIPA NA MPESA



Liked by amorito001 and others

kijabe_hospital To our esteemed clients, please note that the hospital shall only accept cashless payment at all our payment points including our satellite centres. This is in adherence to the government directive on cashless payments to reduce the spread of the Covid-19 (Coronavirus).

#Covid19KE
#KijabeHospital

21 hours ago

In for example Kibera, the most 'famous' informal settlement of Kenya, the home of a large group of Nairobians who live from wages of below a dollar a day up to 2-3 dollar a day. Many people depend on a daily income that they obtain from small jobs, selling some fruit or a newspaper. Houses are crowded, access to water is limited and healthcare facilities are often NGO based and overly crowded. People walk to their jobs in large groups along the main road to work in factories in the Industrial area or work in the households of the high-income groups in other areas of town.

The people that make a bit more money, can afford to use a Matatu. Which are crowded busses and therefore a typical place one should avoid during the corona crisis. It is nearly impossible to ask these people to work from home, because this will mean that they will either lose their much-needed job or will run out of money to buy food by tomorrow. To reduce the contamination rate, matatus are only allowed to drive around half empty, increasing the price and forcing more people to walk. And for some this will mean that they will lose their job. People are asking the government to reduce fuel prices to keep matatu rates affordable.

Kenyans are asked to stay at home, social distancing is asked from everyone but people are complaining that 'Kenyans' are not listening. With many people aware of infectious diseases such as Ebola, one could argue whether people do not want to listen or that they simply cannot listen because they have to choose between a very basic living standard or much worse when staying at home.

When someone gets sick when living in Kibera, or other low-income settings in Nairobi, the physical distance to a hospital might be just a few kilometres, the access to treatment is always a challenge. Health insurance is a luxury, hospitals are crowded and lack both equipment and healthcare professionals. When one gets infected with corona, large communities will have to rely on a few health care clinics with very basic facilities and the chance that they will get treated on one of the few ICUs is very small. Let alone get tested on Corona, which is done at a few places only in Nairobi (a few public institutions but also by one of the most expensive hospitals around). It will be a very hard challenge to keep track of the infectious rates in Kibera and other areas of town.

Corona in Nepal

Nepal is currently in lockdown after the 3rd Corona case was identified last week. It is a very rugged country of 30 million people. During previous lockdowns for political reasons, shops were only open in the early morning and evening. This pattern is repeated now, despite messages from the government that shops can be open all day and that this is better in order to reduce the number of people in shopping locations at the same time. Access to correct information and fake news are both problematic.

The health system was already at maximum capacity, so most non-vital care has been canceled and county hospitals have been appointed as Corona centers. They are also preparing for setting up emergency healthcare centres/ tent villages as Nepal is prone to natural disasters. There are 700 IC beds in Nepal, it is not clear how many of those are fully equipped for Corona patients (i.e. with ventilators and oxygen). The government hopes for support from China and India, but it is unclear if that will happen. Hospitals are preparing to send their staff to other locations to provide Corona care. Nepali doctors are sceptic of the value of bubble CPAP.

PPE is problematic, there are barely any FFP2/N95 masks available. Due to the lockdown, sourcing components is extremely difficult. There is hardly any access to 3D printers, so any short-term solution must be manufacturable with standard components and tools. Face masks made from a transparent plastic sheet & headband are desired.

A database with reliable tools is highly desirable. Also, basic manufacturing is definitely possible, but there are no facilities for testing solutions.

Selected equipment recommended by WHO for Corona

Device	Availability	Affordable	Suitability	Short & long term relevance of innovation
Infrared Thermometer	?	\	+	Smartphone based thermometers exist, cheaper solutions might be desirable
Mouth masks	--	\	-	Reusable mouth masks would be a great solution for LMIC healthcare independent of Corona
Face shield	-	?	?	Alternative solution for lack of PPE, DIY solutions already exist, not entirely context specific
Ventilators	--	?	0	The need for ventilators is widely publicized already
Endotracheal tubes	+	0	0	We don't see easy innovation possibilities
Cleaning chemicals (Cidex, chlorine)	?	?	0	Shortage of cleaning chemicals might occur, designs suitable for autoclaves are preferred
Oral and nasal airways	?	0	-	It could be possible to 3D print disposable airways during Corona, long-term cost effectiveness compared to injection moulding is debatable
Infusion giving set	?	?	+	No direct opportunity for innovation
Operator powered resuscitator	-	?	+	Local manufacturing and manual operation might be life-saving during Corona
Portable ultrasound scanner	-	-	?	Portable US would be a great solution for LMIC healthcare, independent of Corona
Oxygen concentrator	-	-	-	Context-specific oxygen concentrators seem useful for the large number of expected patients who can breathe on their own but are still hypoxic
Miller blades (type of laryngoscope)	?	+	0	These could be 3D printed, but have to be fitted with a reusable lightsource. This presents challenges for cleaning
Direct laryngoscope	+	+	0	
Pulse oximeters	-	0	-	Pulse oximeters would be a great solution for LMIC healthcare, independent of Corona
Corona testkit	--	?	?	Scaling up Corona testing, preferably at point-of-care is very valuable
Sharps box for needles	?	0	-	Accidents with used sharps are common in LMICs. Needle cutters are desirable independent of Corona
Suction devices	-	?	--	A shortage of context-specific suction devices was identified before Corona and suitable solutions are valuable on the long term

Recommended equipment

The World Health Organisation (WHO) has provided a list of equipment required during the Corona pandemic called the Operational Support & Logistics Disease Commodity Packages (DCP-NCOV). On Page 7 a table is presented with selected equipment mentioned in version 4 of the DCP-NCOV and a quick assessment of the availability, affordability and suitability for use in low-resource regions. Equipment designed for use in high-income countries is not always suitable for use in low-resource regions. Ideally, equipment for these regions is:

- reusable, i.e. it can be cleaned with chemicals or in an autoclave
- robust, i.e. it survives a 1-meter drop on a concrete floor
- portable
- operational during brief and/or long power outages
- protected against dust and humidity
- maintainable with local parts and tools
- equipped with English manuals
- not dependent on proprietary parts from overseas suppliers

This table also includes subjective recommendations concerning the possible impact of creating context-specific variants of these devices.

Additional suggestions for project and research directions that can positively impact the Corona response

Design and installation of oxygen plants in hospitals will benefit both Corona patients on the short term, but also significantly improves logistics for normal hospital operations.

3D printing of validated PPE will protect the workforce on the short term. A major concern about 3D printing is how effective cleaning (CIDEX, chlorine, alcohol, autoclave) procedures are on these types of surfaces. Experiments of this kind are very welcome for both the Corona response and 3D printing for general healthcare and disaster situations.

Online education systems that require limited data transfer will allow students to continue their education from home, without incurring high costs.

Smart design and building of rapid emergency hospitals is required for the large number of expected patients who don't need ICU care but should be isolated from the general population.

Improvement of cleaning and sterilization processes within the hospitals was already needed and this need has become more poignant during the Corona pandemic.

Improving hand hygiene through DIY hand sanitisers or local breweries who can make hand sanitizers of beer can help to reduce the rate of transmission.