UN-Habitat's support to **Preparedness and Response strategies** in Kakuma-Kalobeyei, Kenya

UN-HABITAT
FOR A BETTER URBAN FUTURE

TURKANA COUNTY GOVERNMENT

IMPLEMENTING THE NEW URBAN AGENDA

ACKNOWLEDGMENTS

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Preparedness and Response Strategies
in Kakuma-Kalobeyei, Kenya

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UN-Habitat's support to **Preparedness and Response strategies** in Kakuma-Kalobeyei, Kenya

Supporting COVID-19 Pandemic Efforts

UN-HABITAT
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IMPLEMENTING THE NEW URBAN AGENDA

ACRONYMS

KISEDP	Kalobeyei Integrated Socio-Economic Development Plan
WHO	World Health Organisation
Kenya's MOH	Kenya's Ministry of Health
UNDRR	United Nations Office for Disaster Risk Reduction
NGOs	Non-Governmental Organisations
CDC	US Center for Disease Control and Prevention

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Introduction

1.1 Background

Since late 2019, when the first case of COVID-19 was identified[1], cities around the world have been facing varying impacts of the COVID-19 pandemic and have employed different measures to respond to the growing risks. While strategies might differ between countries and cities, the key objectives remain the same: to prevent, suppress, and slow transmission of the virus.

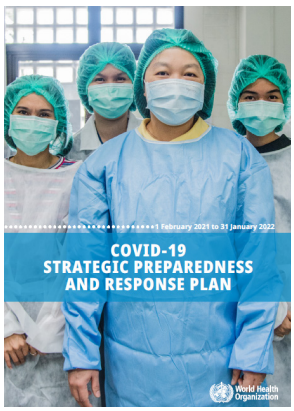
In 2020, UN-Habitat began supporting efforts in preparing for, responding to, and recovering from the COVID-19 pandemic in Kakuma-Kalobeyei, Turkana County, Kenya – through UN-Habitat's role as technical lead for the Spatial Planning & Infrastructure Development component under the Kalobeyei Integrated Socio-Economic Development Programme (KISEDP). The support stems from UN-Habitat's recognition of the role of urban management systems in either (1) contributing to the exacerbation of COVID-19's transmission or (2) "prevent[ion], suppress[ion], and slow[ing]"[2] transmission of the virus.

Photo Above: UN-Habitat participated in site visits to schools identified as potential (temporary) healthcare facilities in Kakuma-Kalobeyei.

1 WHO, 2020a.
2 IASC, 2020, pg. 12.

The first case of COVID-19 in Kenya was confirmed in March 2020[3], while the first case of COVID-19 in Kakuma-Kalobeyei was confirmed in May 2020[4]. During the earlier months of the pandemic, the Government of Kenya (GOK) released a series of measures in response to the growing number of COVID-19 cases in the country[5]. UNHCR also responded with developing preparedness and response strategies for Kakuma-Kalobeyei[6]. The report will cover UN-Habitat's two key spatial strategies across different scales developed to provide spatial insight into preparedness and response strategies in the earlier months of the pandemic in 2020: (1) Repurposing study of existing facilities through accessibility studies, and (2) Spatial outbreak investigation. The objective is to cover the processes in the development of these strategies and its implementation, and share insights and lessons learnt in the context of Kakuma-Kalobeyei.

1.2 COVID-19 Preparedness and Response in Kakuma-Kalobeyei



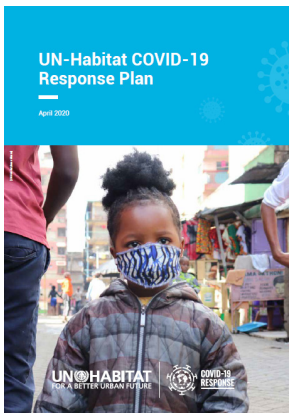
Report Above: WHO's COVID-19 Strategic Preparedness and Response Plan document.

The World Health Organisation's (WHO) 2021's ***COVID-19 Strategic Preparedness and Response Plan (2021)***[7] noted that COVID-19's transmission "is highly clustered", and spread can come from a small group of infected persons.[8] In addition, WHO explained that one key reason for the increased transmission rates observed in last quarter of 2020 was a lack of "robust public health infrastructure" capable of (1) detection of infected cases, and (2) quarantine and support of their contacts to "break chains of transmission".[9] Furthermore, WHO shared that humanitarian settings may face additional difficulties due to low resources and capacity – which can, for example, lead to reporting limitations on transmission rates.[10] Recognising these limitations, WHO called for "strategic shifts, investments, and partner support to foundational health system capacities including financing; data management, collection, and analysis".[11]

Furthermore, UN-Habitat and the United Nations Office for Disaster Risk Reduction (UNDRR) recognised that close to 95% of global COVID-19 cases have come from urban areas and that "[p]andemic preparedness in cities and towns is more urgent than ever for reducing disaster risk".[12] Moreover, UN-Habitat noted that the impact of COVID-19 will be particularly devastating in the informal settlements worldwide where refugees, internally displaced people, and migrants, typically dwell and where they often face overcrowded conditions and a lack of basic resources like water and soap.[13]

Hence, it is critical to explore the role of spatial lenses in supporting preparedness and response strategies in the COVID-19 pandemic. *UN-Habitat's COVID-19 Response Plan*[14] shared that it is critical to develop and provide evidence-based urban data, mapping, and knowledge for informed decision making[15], which can in turn support health infrastructure.

3 Kenya's Ministry of Health (MOH), 2020.
4 UNHCR, Kenya MOH, 2020, pg. 3.
5 President of the Republic of Kenya, 2020.
6 UNHCR, 2020.
7 https://www.who.int/publications/i/item/WHO-WHE-2021.02
8 WHO, 2021, pg. 3.
9 WHO, 2021, pg. 4.
10 WHO, 2021, pg. 5.
11 WHO, 2021, pg. 7.
12 UN-Habitat Executive Director and UN Special Representative for Disaster Risk Reduction, 2020.
13 UN-Habitat, 2020, pg. 2.
14 https://unhabitat.org/un-habitat-covid-19-response-plan
15 UN-Habitat, 2020, pg. 5.



Report Above: UN-Habitat's COVID-19 Response Plan document.

Integrated spatial lenses in preparedness and response can be achieved by[16]:

- Generating and integrating community data to shape local responses, mapping emerging hotspots, reorganising informal markets and transport hubs as well as public spaces and buildings for health and emergency services;
- Mobilizing an extensive network of global and local partners to support data collection, mapping and analysis using smart technologies enabling a more targeted response to emerging priority needs including water and sanitation, food, housing, health services and livelihoods;
- Fast tracking learning, training and capacity building on how cities and communities are dealing with the COVID-19 crisis, in terms of preparedness, response and recovery.

In Kakuma-Kalobeyei, the settlements possess various spatial factors which compound the risk of clustered transmissions for communities living in the area. Refugee settlements, including Kakuma Refugee Camps and Kalobeyei Settlement, are located alongside host communities – with a total population of 245,223 host and refugees in the area.[17] Settlements in the area face diverse challenges such as overcrowded conditions[18] and/or lack of equitable access to water[19], and a universal lack of integrated utilities in households[20]. Additionally, these factors make it necessary for host and refugee communities to travel in overcrowded conditions to access their basic needs and necessities such as water and food aid, which can contribute to increased contact and risk of transmission. Hence, UN-Habitat proposed two key spatial strategies across different scales to provide spatial insight: (1) ***Accessibility studies of Existing Facilities for Repurposing***, and (2) ***Spatial outbreak investigation***.

Photos: Majority of refugees do not have integrated utilities to their shelters, and sometimes rely on solar panels to provide electricity (above); majority of host community members also do not have integrated utilities in their shelters (bottom).

16 UN-Habitat, 2020, pg. 5.
17 Kakuma & Kalobeyei Spatial Profile, pg. 74.
18 UNHCR, 2019, pg. 2.
19 A. A. Cronin et al., 2008, pg. 9 – 10.
20 See Figure 4.

Photo: Host community members, usually women and children, travel extensive distances to refugee settlements such as Kalobeyei Settlement and Kakuma Refugee Camps for informal livelihoods like selling charcoal.

02

Accessibility studies of existing facilities for repurposing

Photo Above: Demarcations being used as one of the strategies employed in healthcare facilities to encourage physical distancing.

According to WHO, COVID-19 spreads "mainly when an infected person is in close contact with another person".[21] As mentioned above, this means that communities are therefore exposed to increased risks as they need to travel outside of their houses, to access basic needs and necessities. Their increased exposure, therefore in turn can increase transmission rates. Moreover, UN-Habitat studies have shown that "private and (public) transport…is extremely limited"[22] and that "92.9% accessed lower-order services (dispensaries) on foot" and "80.2% of respondents travelled on foot" to access hospitals[23]. In addition, in *The Kalobeyei Model*, Betts et al. found that among the respondents "2% have a bicycle, 0.7% have a motorcycle, and 0.5% have a car."[24] This may indicate increased risk where persons have to walk on foot through the intensely overcrowded settlements, particularly in areas where services and access to daily necessities are located resulting in increased contact within the community. An accessibility study of facilities in Kakuma-Kalobeyei is therefore useful in identifying appropriate locations for potential COVID-19 facilities that will provide improved

21 WHO, 2020b.
22 UN-Habitat, 2018, pg. 99.
23 UN-Habitat, 2016, pg. 25.
24 Betts et al., 2019, pg. 19.

access to communities across the settlements. On a settlement-wide scale, improved accessibility through increased provision will reduce the need for communities to travel extensive distances to access the COVID-19 facilities, and in turn potentially reduce contact rates within the community. An accessibility study of facilities in Kakuma-Kalobeyei is also key to understanding the potential population catchment each facility will serve (i.e. the area covered and number of households each facility is responsible for). This will help inform which area is under serviced by facilities and require additional support to handle the loads.

2.1 Strategic selection of schools in Kakuma Refugee Camps and Kalobeyei Settlement

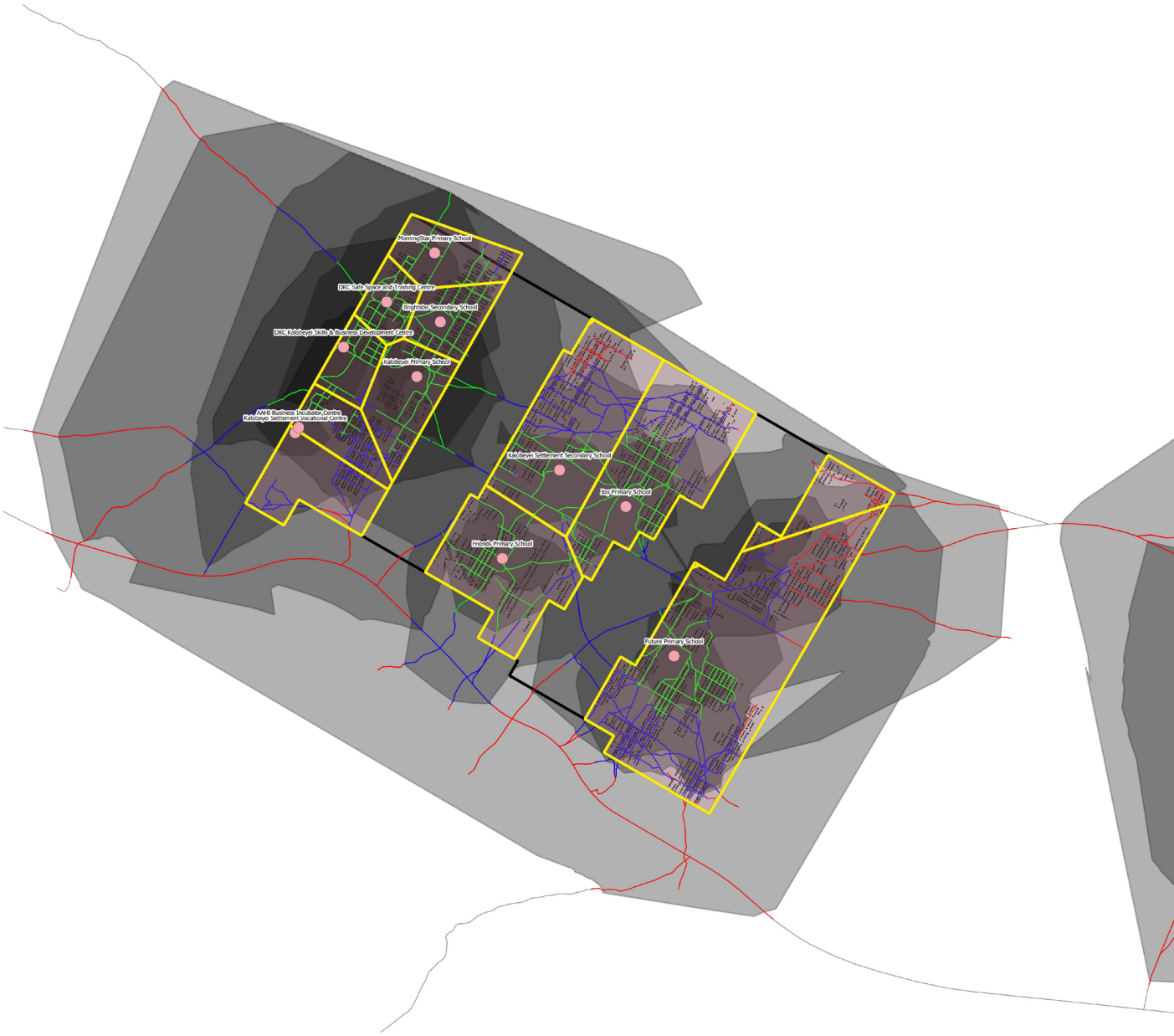
In order to boost bed capacity to respond to potential outbreak events, the strategy in Kakuma-Kalobeyei recommended selecting schools to be repurposed as temporary COVID-19 healthcare facilities. These temporary healthcare facilities were further differentiated into isolation and quarantine facilities, the former being occupied by confirmed COVID-19 cases and the latter by contacts of confirmed COVID-19 cases – preventing potential cross-transmissions.

Reflections

The schools were an appropriate choice for key reasons: (1) the Government of Kenya has closed schools during the earlier months of the pandemic[25], (2) schools in Kakuma-Kalobeyei are well distributed compared to other facilities, and (3) schools are better equipped compared to other facilities in terms of utilities like electricity and sanitation. However, there were also concerns about potential stigmatisations of the schools that were repurposed into temporary medical facilities, with students and families potentially avoiding these places when school resumes.

UN-Habitat conducted an accessibility study of the schools in two parts: (1) a Voronoi analysis, and (2) a Service area analysis. A Voronoi analysis of Kakuma-Kalobeyei (see following Figure 1) demonstrated that Kalobeyei Settlement has (1) not only lesser schools compared to Kakuma Refugee Camps, but also (2) schools that are not as well distributed which results in certain schools potentially taking on more patients than possible. In addition, the service area analysis demonstrated that certain schools across the settlement are better placed to provide improved accessibility to the community. With this analysis, UN-Habitat worked with UNHCR in selecting appropriate schools that can be repurposed, based on factors including the accessibility analysis, conditions of schools, density of population, and maximum bed capacity of each school.

25 President of the Republic of Kenya, 2020.



20200928_Kakuma Public Facilities Combined (Educational)_Voronoi
20200928_Kalobeyei Public Facilities Combined (Educational)_Voronoi
20200928_Kakuma Public Facilities Combined (Educational)_Service Area (750)
20200928_Kakuma Public Facilities Combined (Educational)_Service Area (1500)
20200928_Kakuma Public Facilities Combined (Educational)_Service Area (3000)
20200928_Kakuma Public Facilities Combined (Educational)_Service Area (Polygon)
20200928_Kalobeyei Public Facilities Combined (Educational)_Service Area (750)
20200928_Kalobeyei Public Facilities Combined (Educational)_Service Area (1500)
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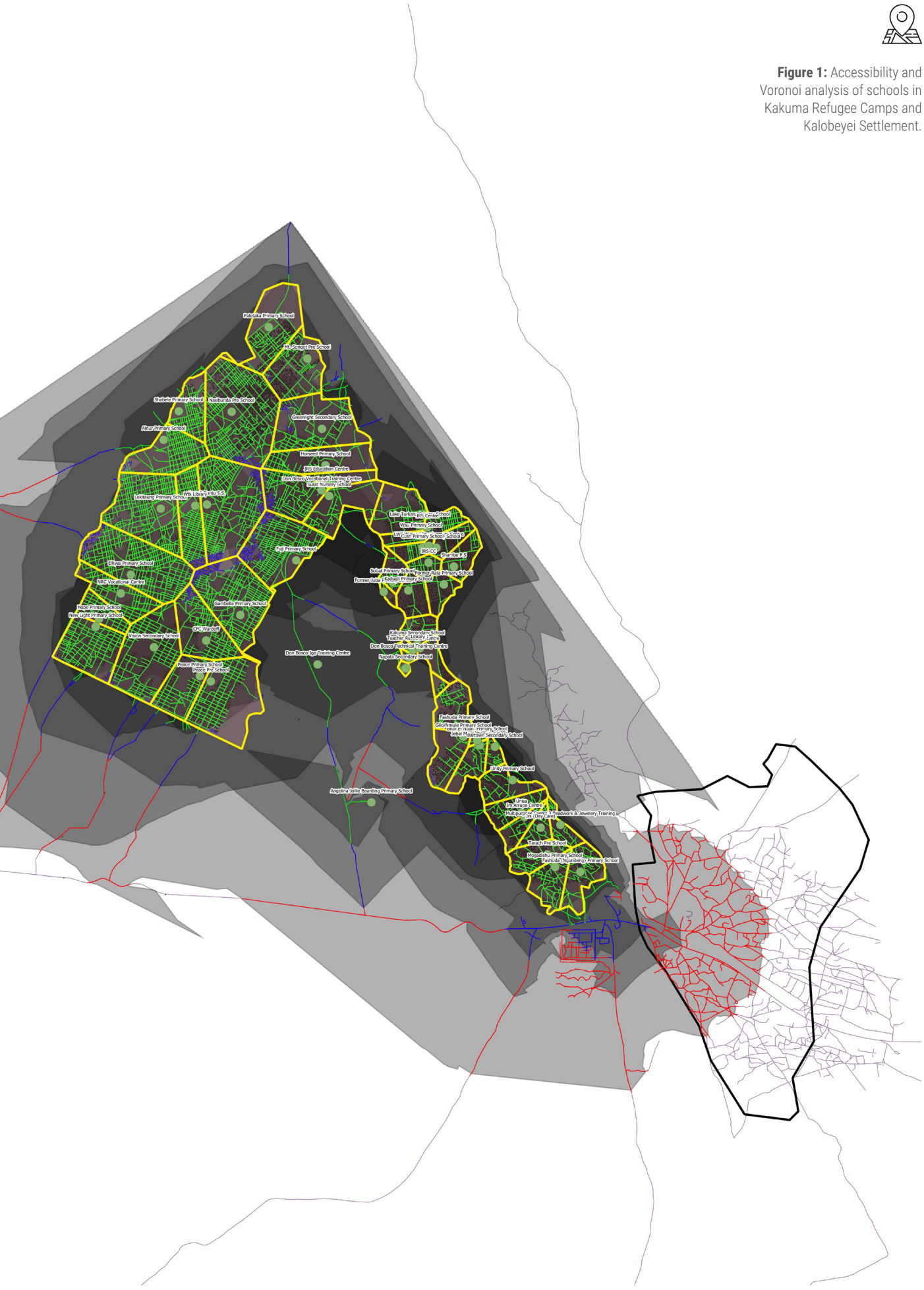


Figure 1: Accessibility and Voronoi analysis of schools in Kakuma Refugee Camps and Kalobeyei Settlement.

Reflections

An ideal situation based on the accessibility analysis would be to develop temporary healthcare facilities (such as tent structures) in appropriate locations to improve accessibility across the settlements. However, in a humanitarian context such as Kakuma-Kalobeyei, authorities and non-governmental organisations (NGOs) usually face a lack of resources and adequate manpower to be able to execute such scale of implementation. There are two key benefits to the decision to repurposing existing facilities: (1) reduces the resources needed for the emergency preparedness and response, and (2) enables the adaptations to benefit existing facilities and communities in the long-term.

Firstly, repurposing existing facilities help to reduce pressure on resources, but also additional time needed to construct temporary structures. In the case of tent structures, a lack of extensive electric infrastructure in Kakuma-Kalobeyei and difficulty in procuring additional generators means that it is more effective to rely on repurposing existing facilities. In addition, a lack of specialised manpower (such as frontline healthcare workers) can also mean that there remains a gap in operating many healthcare facilities across the settlements. In addition, there is also concern about the potential stigmatisation of repurposed facilities – this was extrapolated from incidents where persons of concerns avoided healthcare facilities because of the virus. On top of practical concerns such as condition of different facilities and their capacities, there is a myriad of factors that will ultimately decide the most appropriate facility to be repurposed.

Secondly, with proper planning, resources dedicated to humanitarian efforts can also be employed to support the trajectory for development in the long-term. In the repurposing exercise, utilities of existing facilities are either improved or introduced to support healthcare activities. In turn, when these repurposed facilities are returned to their previous functions, in this case as schools, there will be better access to water, sanitation, and electricity for their activities, improving the quality for students and educators.

Photo Below: Site visit to local schools to determine feasibility to

2.2 Repurposing process of schools in Kakuma Refugee Camps and Kalobeyei Settlement

Following the accessibility study, UN-Habitat also supported preparedness and response strategies by developing repurposing strategies for selected schools across the settlements. The strategies follow WHO's *Practical Manual on Severe Acute Respiratory Infections Treatment Centre* to develop appropriate layout of services and facilities, with further additions and alterations to be made considering that this is a repurposing exercise of originally non-medical facilities (schools). To develop the schedule of accommodation, UN-Habitat conducted an assessment to better understand (1) the users accessing the facility, (2) their routines, and (3) the structures and equipment necessary to facilitate their jobs.

2.2.1 Reducing contact between patients and healthcare personnel

According to the WHO, COVID-19 spreads between people through infected "small liquid particles when they cough, sneeze, speak, sing or breathe" that enters the mouth, nose, or eyes of the susceptible person.[26] Hence, it was of critical focus that the spatial layout of the repurposed facility reduces contact between patients and healthcare personnel where possible.

In the practical manual, WHO recommended zoning the treatment centre into two key zones: (1) an area for healthcare workers, and (2) an area for patients, which is further divided into three areas for patients of different medical conditions.[27] In the context of Kakuma-Kalobeyei, UN-Habitat identified three groups of users with different access to three key zones:

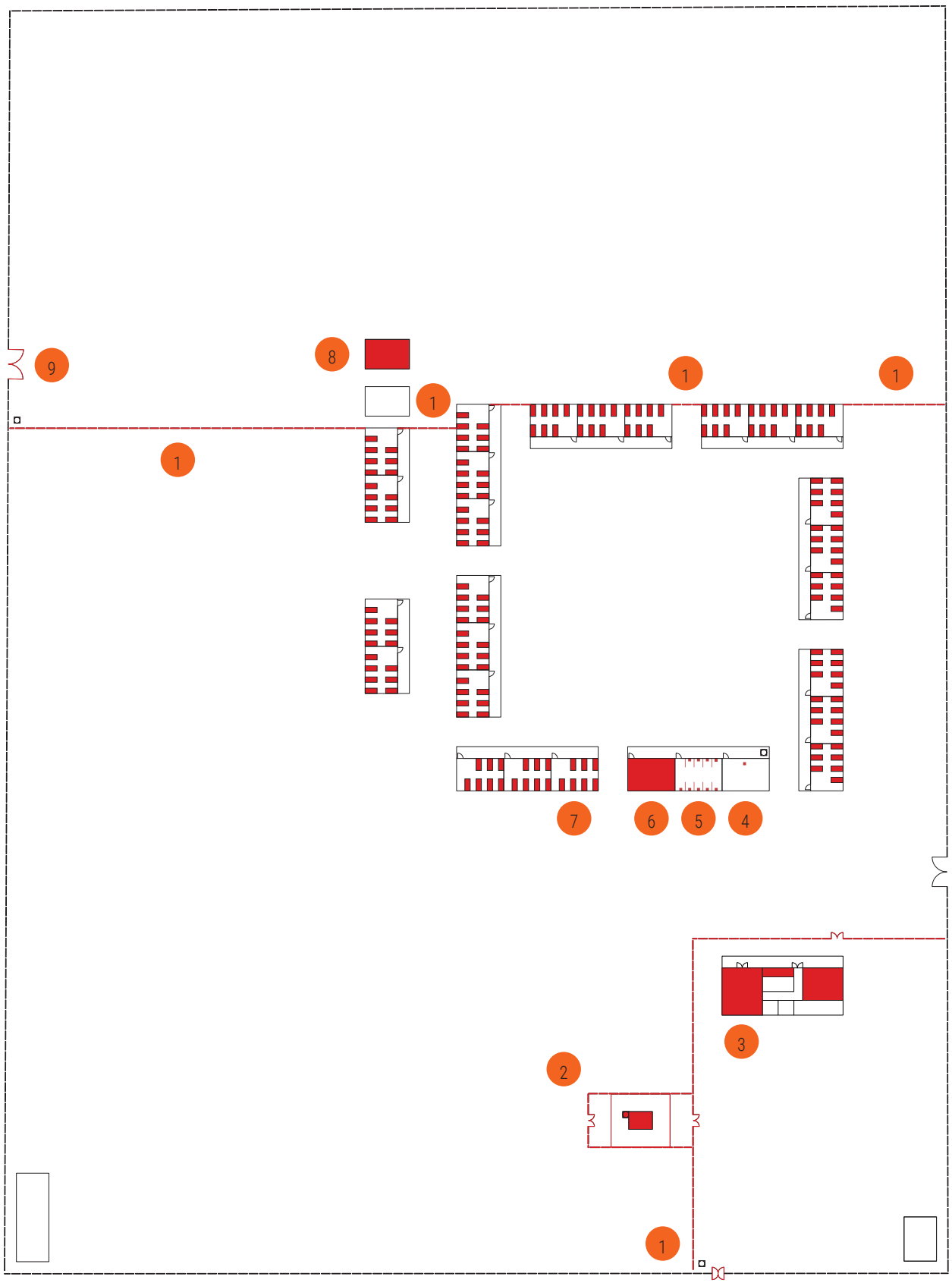
- Contaminated/Red zone for patients: Infected and suspected;
- Clean/Green zone only for medical personnel: Doctors, nurses, ambulance drivers, and waste disposal;
- Clean/Green zone only for non-medical personnel servicing the facility: Cooks.

In order to achieve the three key zones, UN-Habitat proposed addition and alterations to the facility which are highlighted in red compared to the existing structures in black (see Figure 2). For example, fencings (highlighted in red) is proposed to be set up to achieve clear zonal distinction to prevent accidental crossing of persons into the wrong zones. In addition, UN-Habitat proposed capitalising on existing layouts to reduce contact between patients and healthcare personnel: classrooms which are typically consolidated in an area should be repurposed to support patients, and offices which are usually a separate block from classrooms should be repurposed to support medical personnel and storage.

2.2.2 Sequencing for both patients and healthcare personnel

Based on WHO's recommendations on the layout of the treatment centre and how patients and personnel can flow through[28], UN-Habitat developed three sequencing for the three groups of users identified above.

26 WHO, 2020b.
27 WHO, 2020c, pg. 33.
28 WHO, 2020c, pg. 37 – 53.



Legends

1. **Temporary Fencing**
2. **Doffing/Disinfection Chamber**
3. **Donning Station**
4. **Nursing Station**
5. **Waiting area + Barriers**
6. **Store for waste and biomedical waste**
7. **Patient beds**
8. **Additional Kitchen**
9. **Entry for non-medical personnel**

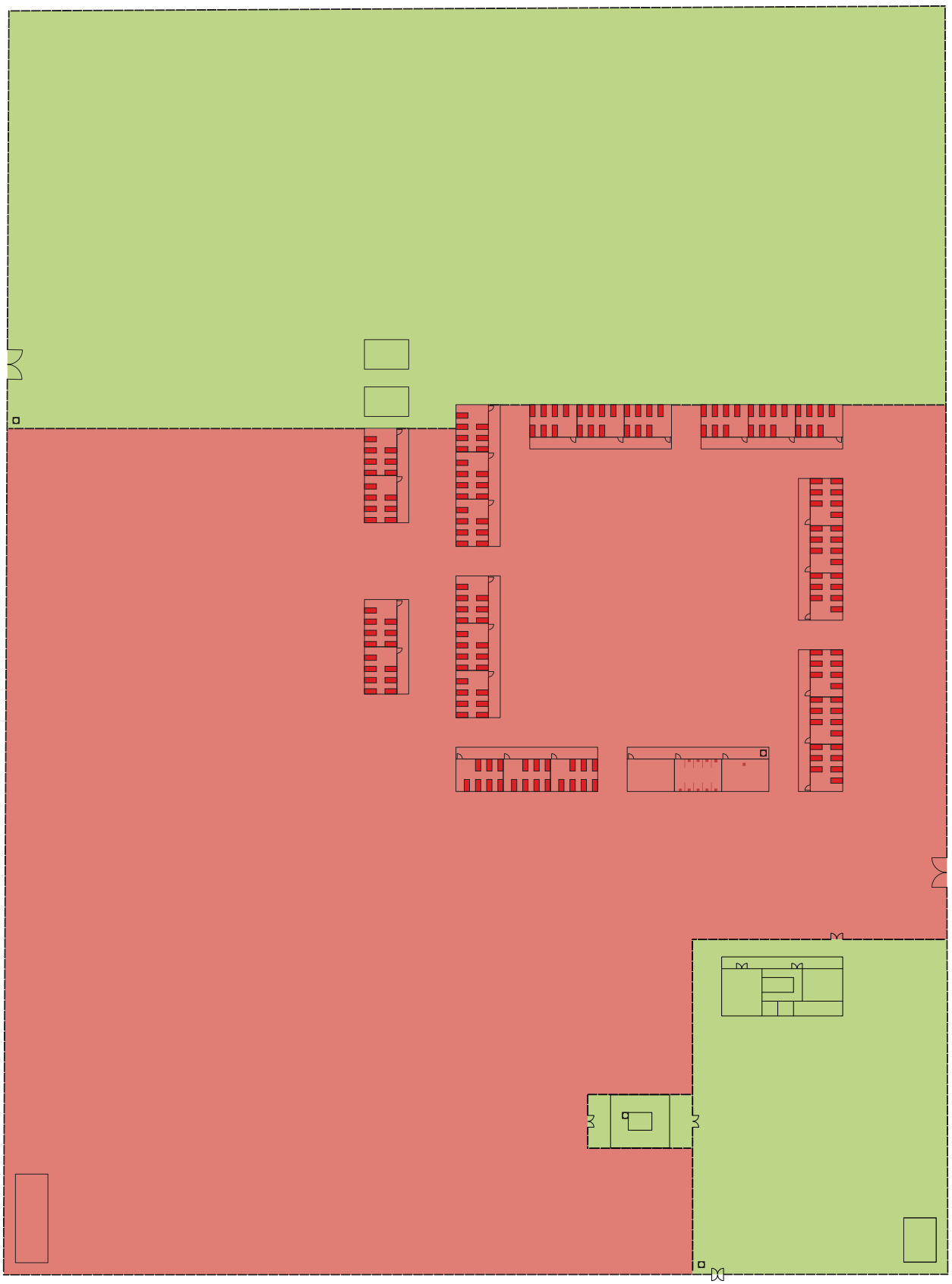
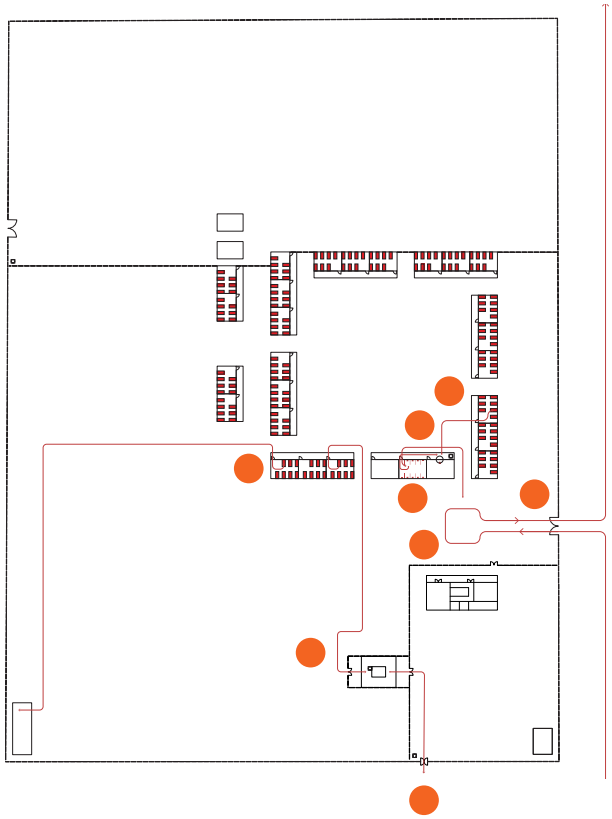


Figure 2: Draft repurposing strategies with Morning Star Primary as an example.

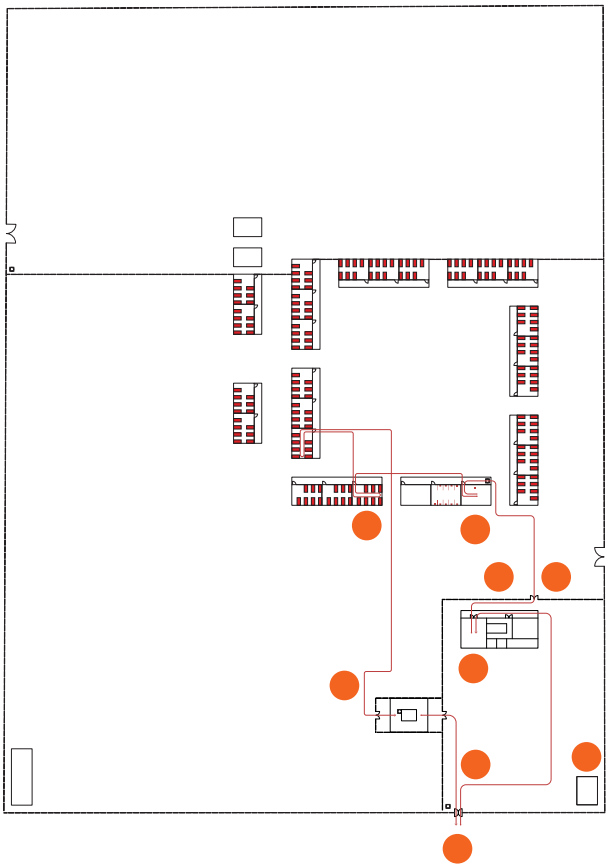


1. Patients will enter through the existing gate either by walk-in or by ambulance;
2. For those transported by the ambulance, they will be dropped off at a specified drop-off point;
3. At this point, the patient will be provided a mask and requested to wash his/her hands. Patients will be directed towards the waiting area if there are other patients before him/her;
4. The patient will then be directed towards the triage counter - which is an adapted classroom window - to be triaged. If necessary, a sampling counter can be set up with another available window;
5. The patients will then be directed to one of the beds in the classrooms;
6. Patients will be able to access toilets in the compound;
7. Discharged patients will be brought to the new disinfection chamber to be disinfected;
8. Once disinfected, discharged patients can safely exit the facility.

Figure 3: Circulation strategy for patients in the draft repurposing strategies with Morning Star Primary as an example.

Figure 4: Circulation strategy for medical personnel in the draft repurposing strategies with Morning Star Primary as an example.

1. Medical personnel reporting to work will access a different gate from the one used by the patients;
2. The medical personnel will first be triaged at the window;
3. Following triage, they will head to the re-purposed library or offices to don their PPEs. There should be different changing rooms for men and women;
4. Once donned, they will enter the red zone through a one-way gate;
5. The medical personnel will then report to the nursing station where they will conduct hand-over and take-over with the previous shift;
6. The medical personnel will perform the duties for a maximum of 4 hours within the red zone;
7. Once they hand-over their shift, they will head to the disinfection chamber to begin doffing of their PPEs which will be disposed within the chamber;
8. The medical personnel will then proceed to exit the green zone using the same gate;
9. Medical personnel can doff their PPEs to access the toilet in the green zone.



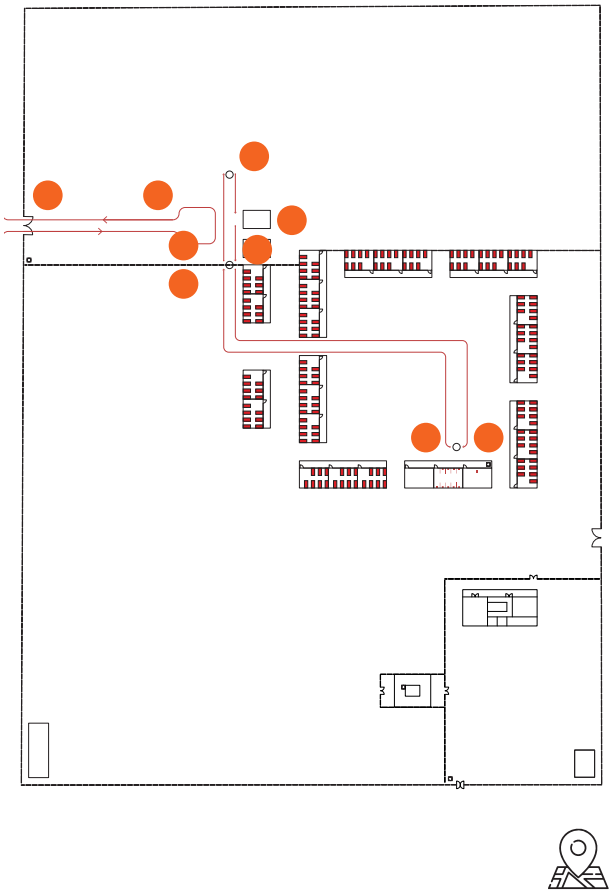


Figure 5: Circulation strategy for non-medical personnel in the draft repurposing strategies with Morning Star Primary as an example.

1. Non-medical personnel and goods will access the compound through a new gate, preferably away from the gate used by patients - to prevent any confusion that may lead to cross-transmission;
2. Goods will be dropped off at the kitchen without interacting with the cooks.
3. The cooks will enter and wash their hands at the gate;
4. Once done, they will be triaged by medical personnel over the table at the fencing;
5. Once triaged, the cooks will prepare food at the expanded kitchen;
6. Prepared food will be passed over the table, while ensuring that they do not interact with the medical personnel;
7. The medical personnel can deliver the food to the nursing office to distribute to the patients - ensuring social distancing;
8. Once done, the plates and cutlery will be collected at a common point;
9. The plates and cutlery will then be returned back to the same table - ensuring that they do not interact with the cooks;
10. The cooks will take precaution when collecting and washing the plates and cutlery for use later.

Photo: Fencing were critical in creating visible zonings to help

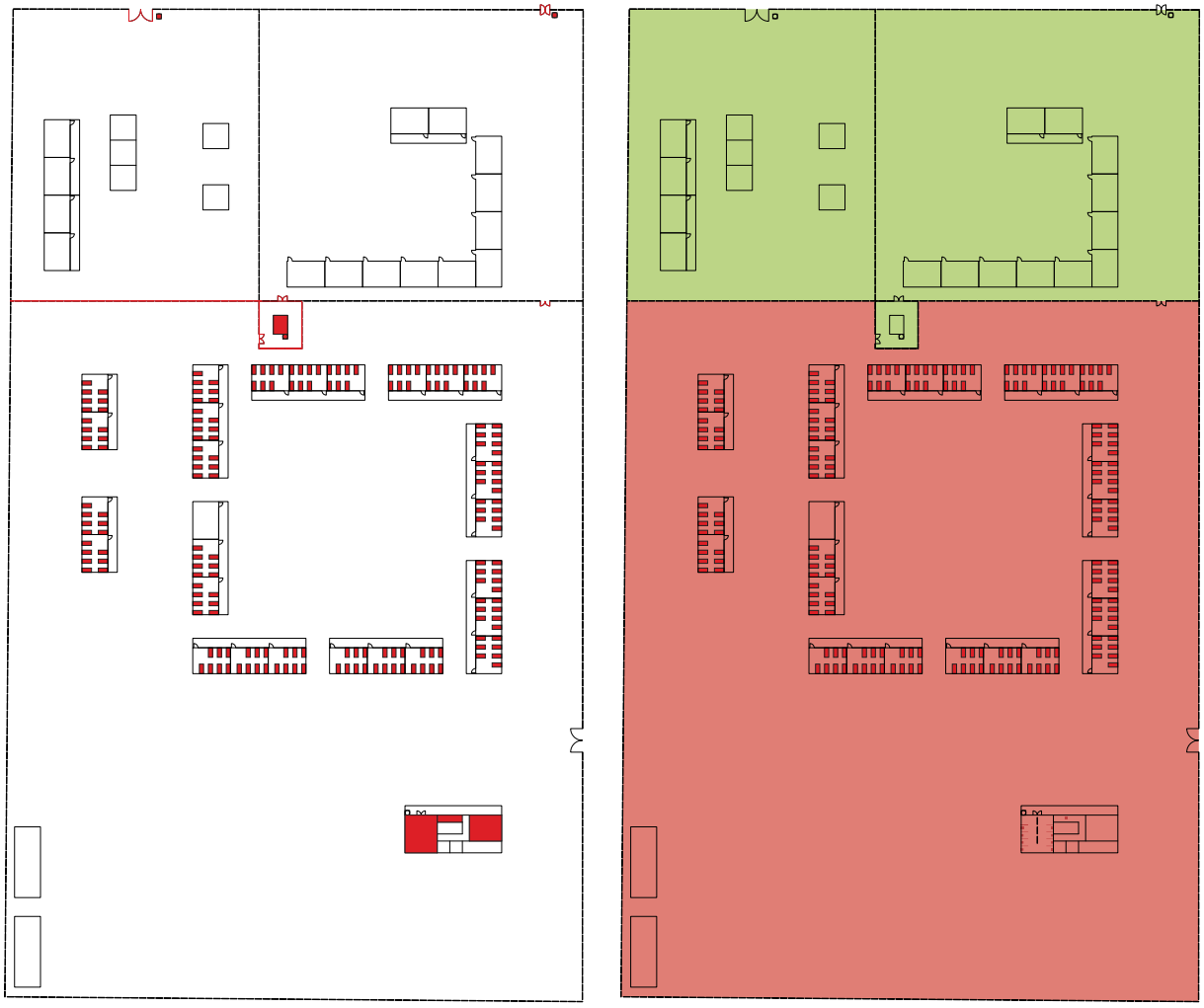


Figure 6: Draft repurposing strategies with Kalobeyei Settlement Primary as an example.

To further emphasise on the importance of zoning and reducing of contact between patients and personnel, UN-Habitat developed additional draft plans with different schools to demonstrate the repurposing strategies. For example, in Kalobeyei Settlement Primary, similarly like in the Morning Star Primary previously shared, the draft recommends running drills to familiarise staff with the zoning measures to prevent accidental cross-transmission and the additional ECD is appropriated for the entry of medical personnel. This allows for a clean separation of medical and non-medical personnel which is recommended for all re-purposing, where possible. Temporary fencing extends the ECD's fence to create the zones as it is extremely critical to ensure that the zonings are clear and easy to understand.

Photo: Students walking back home from school.

Photo Above: A waiting area in one of the healthcare facilities.

03

Spatial Outbreak investigations

3.1 Spatial Planning in Kakuma-Kalobeyei pre- and post-COVID-19

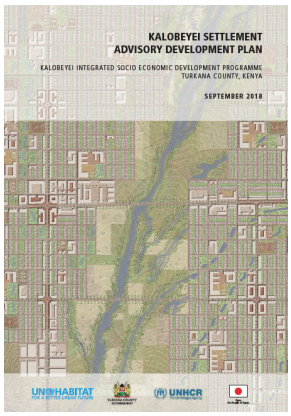
Since 2016, UN-Habitat has employed various spatial planning tools in Kakuma-Kalobeyei to ensure that settlements developed are sustainable, resilient, and respond to the needs and wants of both the host and refugee communities. The planning process for Kalobeyei Settlement was developed in three key phases: (1) inception, (2) baseline assessment and concept development, and (3) plan formulation. In particular, one spatial planning tool, the comprehensive participatory baseline survey and mapping conducted was instrumental in providing a situational analysis for evidence-based planning. Spatial data was collected across (1) various themes, including economic, physical, social, and environmental, and (2) sectors, including infrastructure and housing, energy, WASH, waste management, environment.[29]

29 UN-Habitat, 2018, pg. 30 – 96.

In addition, the spatial planning process was designed to be iterative – recognising the need to continue adapting to the "analytical outcomes of an incremental accruement of new data".[30] In the case of Kalobeyei Settlement, UN-Habitat recognized that spatial planning processes must rely on a collaborative and participatory approach to ensure that outputs respond to the needs and wants of both the host and refugee communities in Kakuma-Kalobeyei.[31] This meant continued engagement of stakeholders throughout the planning process to ensure that the plan remains relevant. Activities conducted to participate stakeholders included: (1) bi-monthly and quarterly meetings of the partner organisation in the Spatial Planning and Infrastructure Development Component of KISEDP, (2) workshops with host and refugee communities, (3) consultation with Turkana County Government officials, and (4) consultation with local community leaders in Kalobeyei.[32] In addition, UN-Habitat established Settlement Development Groups to support community engagement processes in Kakuma-Kalobeyei – these are composed of host and refugee community members that are nominated and selected by elders and community leaders, trained by UN-Habitat in town planning and livelihoods, and engaged on issues and planning for integrated communities.

Reflections

In early 2020, with the onset of the COVID-19 pandemic, these participatory strategies which rely on in-person engagements were heavily impacted, as measures were put in place to ensure limited field implementation activities and banning of gatherings. Furthermore, UN-Habitat also observed that challenges in engagement of the communities may be further compounded by the settlements and communities lack of access to adequate ICT infrastructure and poor internet connectivity that is easily affected by external conditions.



Report Above: UN-Habitat's Kalobeyei Settlement Advisory Development Plan document.

Photo Right: UN-Habitat conducting a participatory mapping workshop with host community members. Source: UN-Habitat

30 UN-Habitat, 2018, pg. 30.
31 UN-Habitat, 2018, pg. 30.
32 UN-Habitat, 2018, pg. 30.

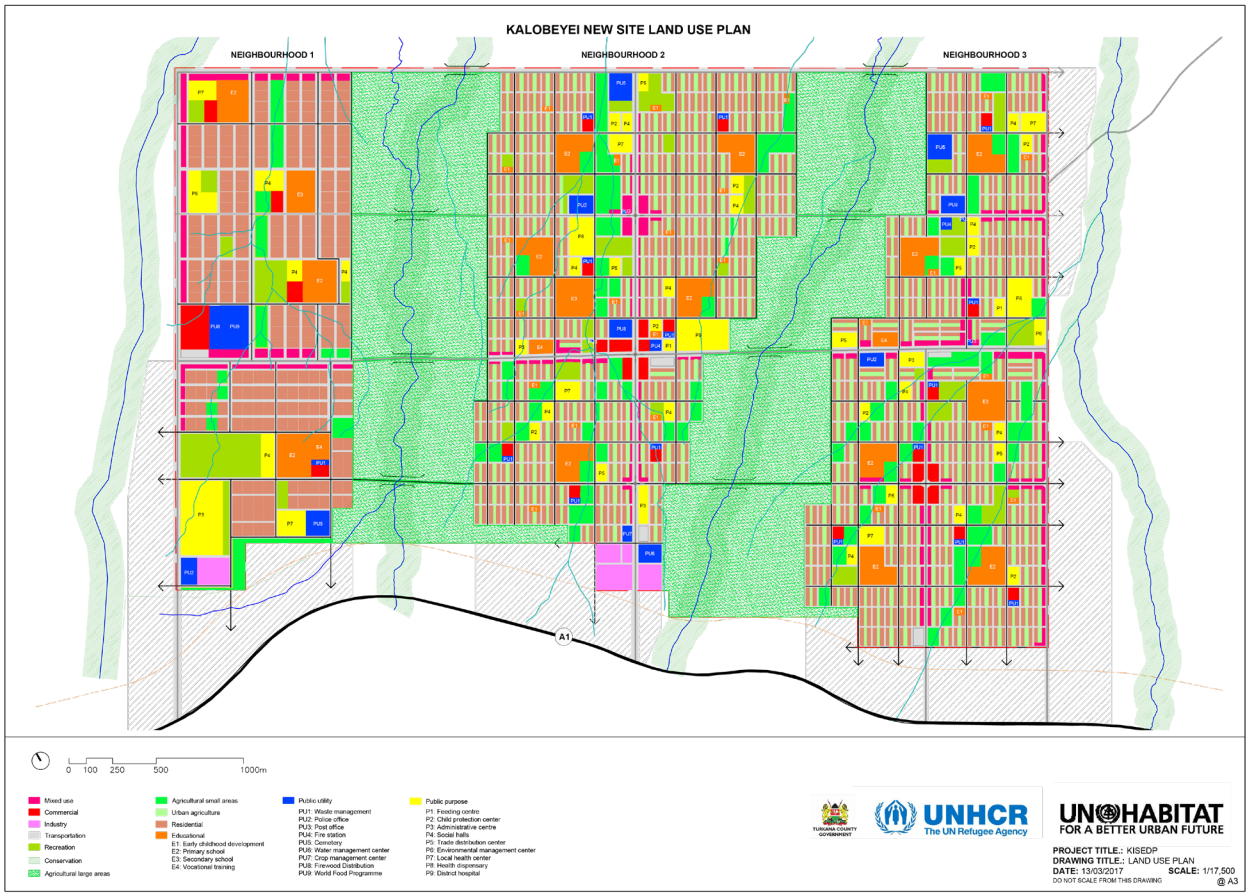


Figure 7: UN-Habitat's Kalobeyei Settlement Land Use Plan.

Photo Below: UN-Habitat participating as technical lead in KISEDP's Spatial Planning and Infrastructure Development Component meeting. Source: UN-Habitat

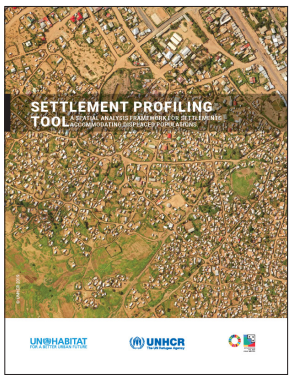
Photo Above: UN-Habitat organising a social hall with host community members from Kalobeyei.

Photo Right: UN-Habitat conducting stakeholder workshops with Turkana County Government, UNHCR, partner organisations, host, and refugee.

3.2 Spatial Outbreak investigations in Kakuma-Kalobeyei

As mentioned above, UN-Habitat recognised that there is opportunity to boost existing preparedness and response strategies with a spatial lens. The US Center for Disease Control and Prevention (CDC) refers to an outbreak as "an increase, often sudden, in the number of cases of a disease above what is normally expected in that population in…a more limited geographic area"[33]. In the context of Kakuma-Kalobeyei, where almost 200,000 refugees reside with local host community members visiting the Kakuma Refugee Camps and Kalobeyei Settlement on a daily basis, a "sudden" and "unexpected" increase in COVID-19 numbers would demonstrate a level of ineffectiveness in mitigating spread through preparedness strategies. In addition, given Kakuma-Kalobeyei's overcrowded conditions[34], a "sudden" and "unexpected" increase could potentially translate into uncontrolled outbreak events, therefore it is critical to shift the focus towards containment of these outbreaks. Hence, partners should shift priority towards response strategies to curb outbreaks and prevent further spread.

33 CDC, 2021.
34 UNHCR, 2019, pg. 2.



Report Above: UN-Habitat's Settlement Profiling Tool document.

3.2.1 Spatial tools for Outbreak Investigation

In *Spatial Methods for Infectious Disease Outbreak Investigations*, Smith et al. explained that while investigations into disease outbreaks are "conventionally framed in terms of person, time and place", spatial analyses are "relatively infrequently" used as an investigation strategy.[35] In line with recommendations on the critical need to develop and provide urban data evidence-based, mapping and knowledge for informed decision making[36], UN-Habitat capitalised on its past experiences and pool of spatial planning tools in Kakuma-Kalobeyei, including *Kalobeyei Settlement Advisory Development Plan*[37], and *The Settlement Profiling Tool*[38], to develop an approach to provide a spatial lens which can guide humanitarian partners and inform potential interventions.

Building upon the understanding that planning processes should be designed to be iterative to enable preparedness and response strategies to continue adapting to the dynamic situation of potential outbreak events in Kakuma-Kalobeyei, UN-Habitat recognised the value of Settlement Profiling Tool as an important spatial planning tool in the context of COVID-19. As part of early preparedness and response strategies in Kakuma-Kalobeyei, Spatial Profiling is able to utilise a "rapidly developed but reliable baseline of information" to guide humanitarian partners in informed interventions, such as outbreak control and identification of vulnerable populations in the settlement.[39] In addition, this approach also builds upon UN-Habitat's work on bridging the humanitarian-development nexus – by providing the potential for future "incorporation of wider development considerations to guide incremental improvements"[40] and imbuing urban resilience into the settlements in the long-term.

UN-Habitat's Spatial Outbreak Investigation in Kakuma-Kalobeyei, covered in the following sections, builds upon Smith et al's findings in *Spatial methods for infectious disease outbreak*. First, UN-Habitat developed a 5-stage spatial outbreak investigation by contextualising Smith et al. defined eight stages[41] into Kakuma-Kalobeyei.

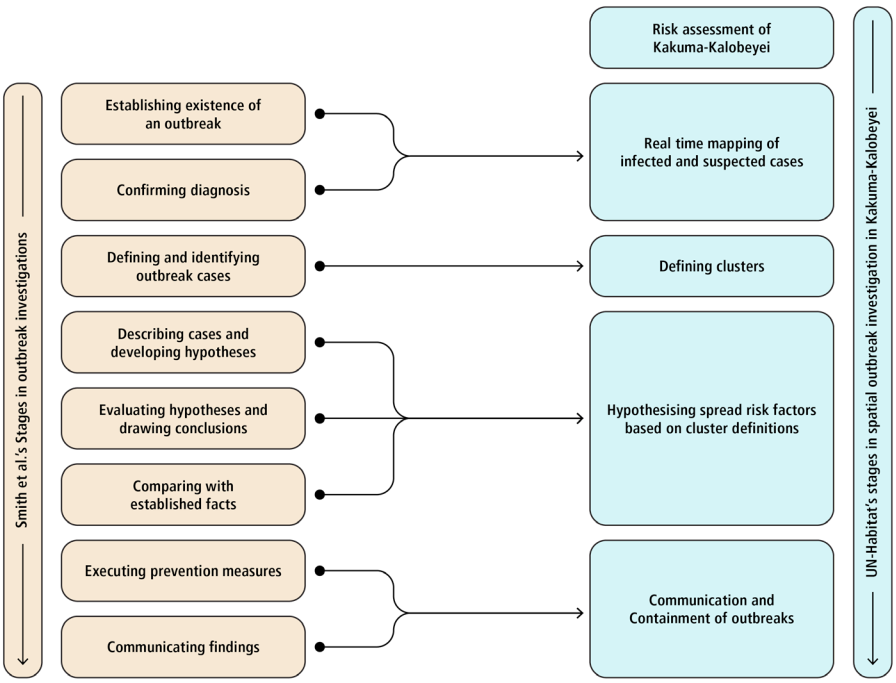


Figure 8: UN-Habitat's proposed stages of spatial outbreak investigation in Kakuma-Kalobeyei.

35 Smith et al., 2015, pg. 2.
36 UN-Habitat, 2020, pg. 5.
37 https://unhabitat.org/kalobeyei-settlement-advisory-development-plan-turkana-county-kenya-final-draft
38 https://unhabitat.org/settlement-profiling-tool
39 UN-Habitat, 2020(b).
40 UN-Habitat, 2020(b).
41 Smith et al., 2015, pg. 16.

In addition, UN-Habitat integrated its planning experience and pool of spatial tools with a list of spatial methods used by different infectious disease investigations identified in Smith et al.'s literature review[42].

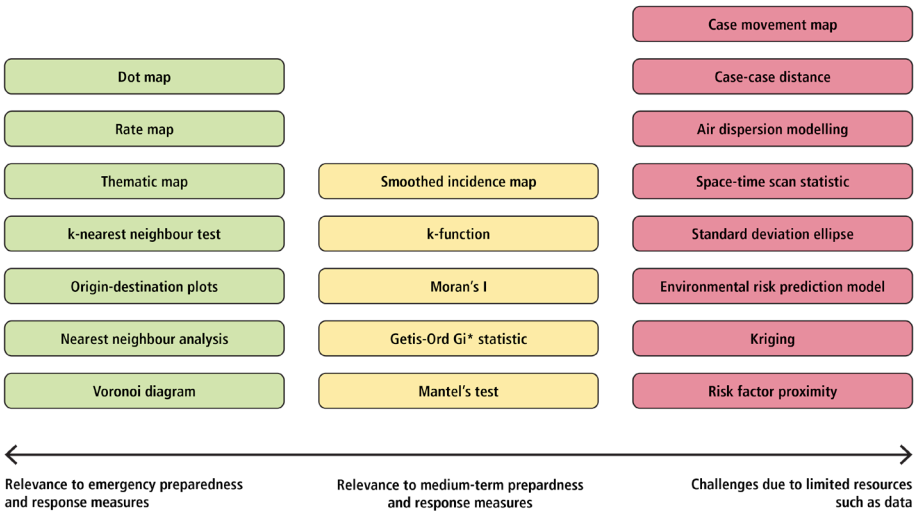


Figure 9: GIS tools employed in UN-Habitat's proposed spatial outbreak investigation in Kakuma-Kalobeyei.

3.2.2 Stage 0: Risk assessment of Kakuma-Kalobeyei

In order to investigate potential outbreak events in Kakuma-Kalobeyei, UN-Habitat first developed a risk assessment of Kakuma Refugee Camps and Kalobeyei Settlement. This was achieved by identifying risk hotspots through an overlay of several factors: (1) access routes, (2) areas with high population density, and (3) clusters of facilities that draw crowds (e.g. distribution centres, water points, marketplaces).[43]

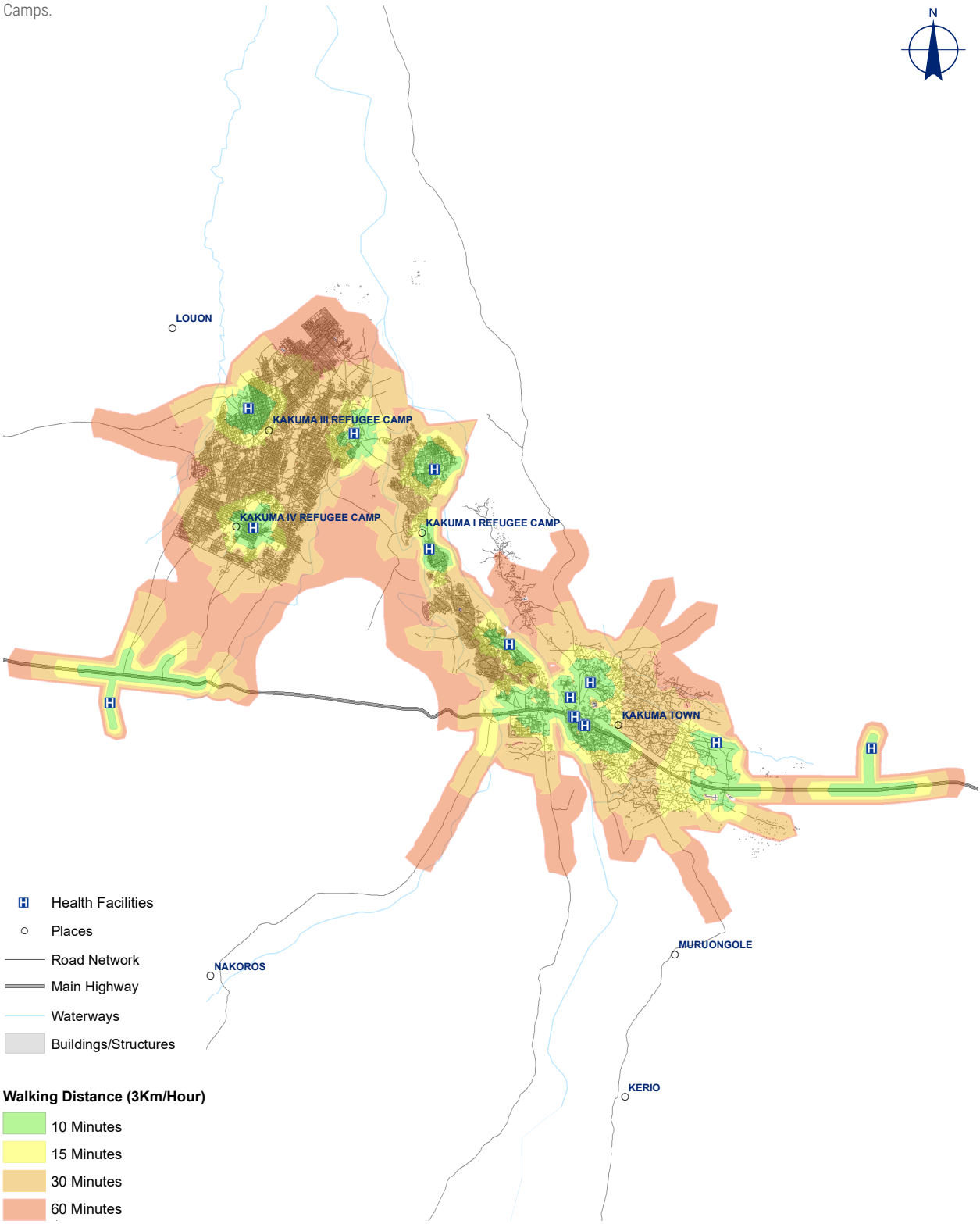
The findings are also helpful in providing insight into "immediate support needs and revealing infrastructure weak spots and systemic gaps"[44] that needs addressing to protect potential vulnerable populations.

Reflections

UN-Habitat presented the findings to humanitarian partners who shared that this was helpful in identifying potential areas of vulnerability and communities that may face higher risk to outbreaks. One avenue identified for application of these analyses was the identification of priority areas for sensitisation activities such as road shows and broadcasting of messages on COVID-19.

42 Smith et al., 2015, pg. 15.
43 UN-Habitat, 2020(b).
44 UN-Habitat, 2020(b).

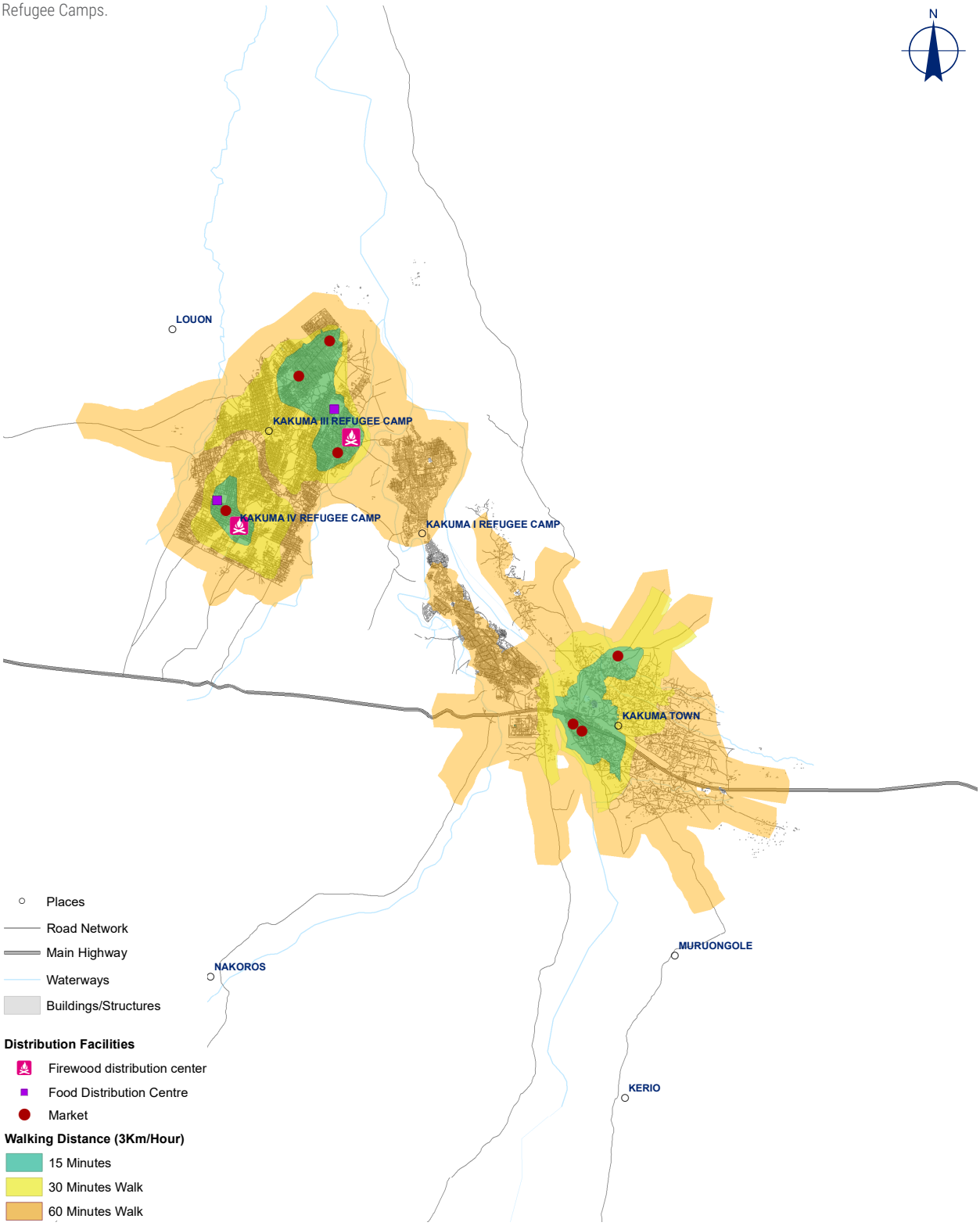
Figure 10: Accessibility analysis of Health Facilities in Kakuma Refugee Camps.



Access to Health Facilities

Walking at an average speed of 3 km per hour, people living within the area covered by red can access a health facility within 10 minutes while those living within the area covered by green can access a health facility within 1 hour.

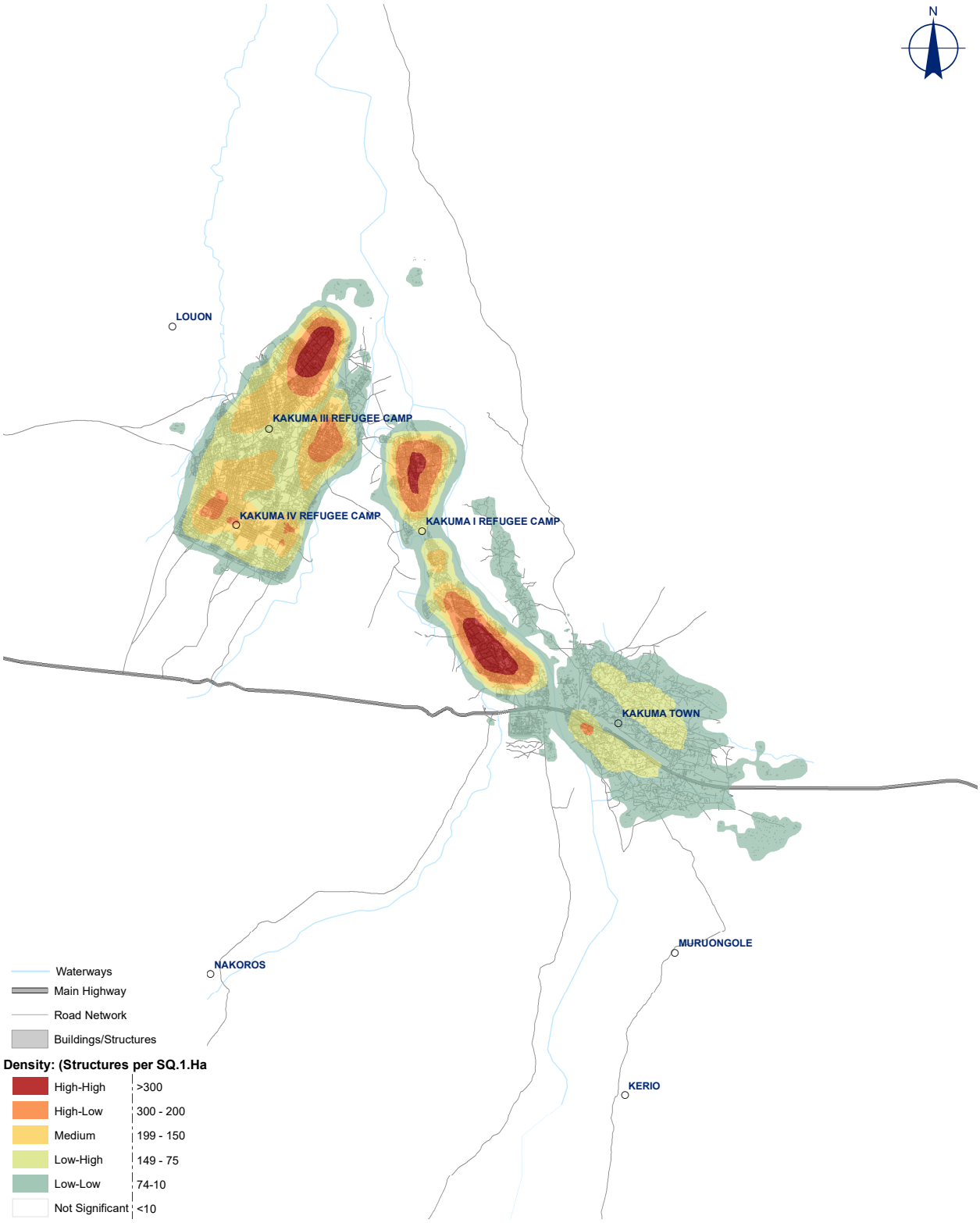
Figure 11: Accessibility analysis of Distribution Facilities in Kakuma Refugee Camps.



Access to Distribution Facilities

Walking at an average speed of 3 km per hour, people living within the area covered by green can access a health facility within 15 minutes while those living within the area covered by orange can access a health facility within 1 hour.

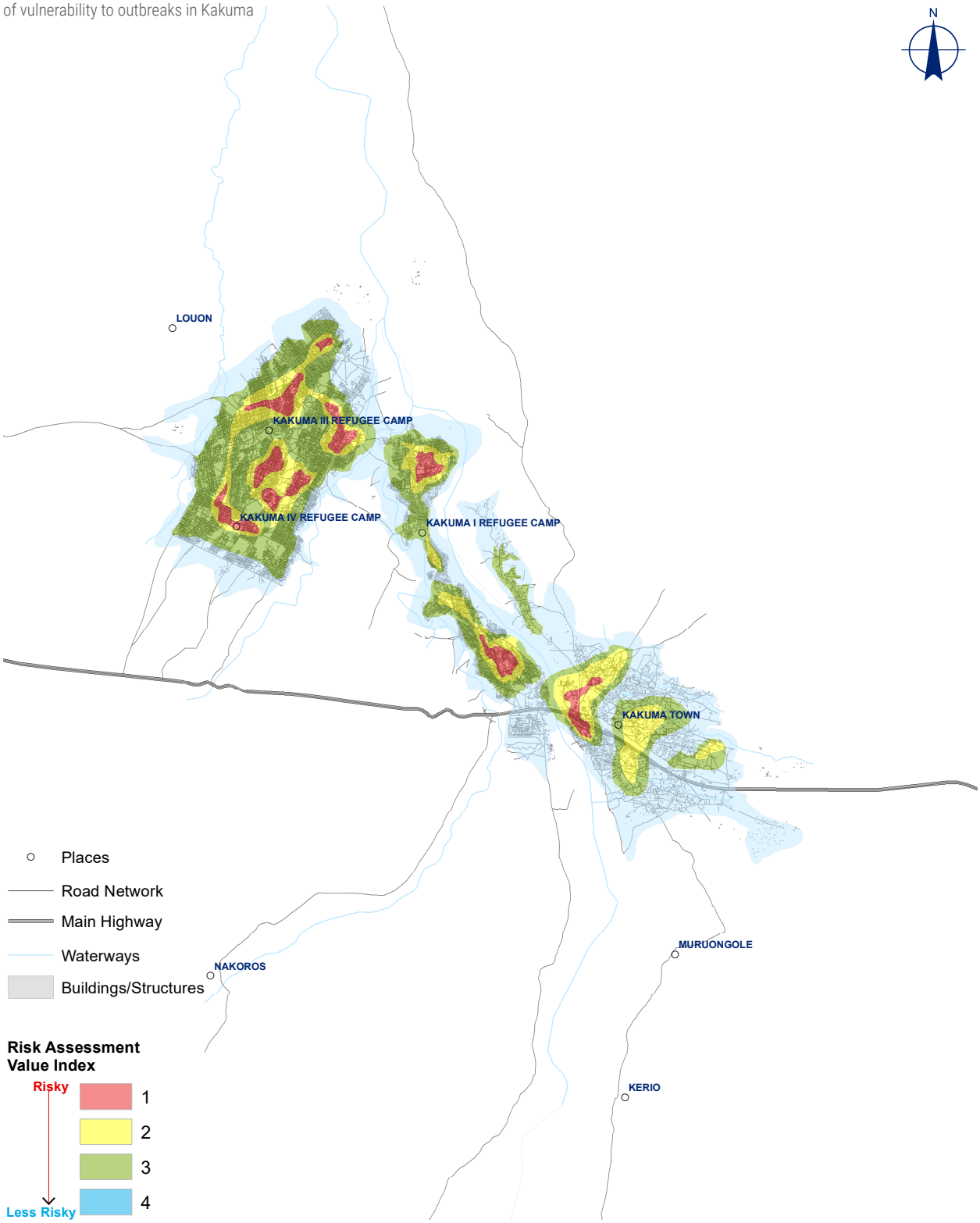
Figure 12: Density Analysis of Kakuma Refugee Camps.



Area Density

Density was calculated by establishing the number of structures within an area of 100 m by 100 m (1 square hectare). It was assumed that every structure represents a household. Values were then assigned to each structure to calculate density within the aforementioned unit area. The dense area (in red) has more than 300 structures, while the less dense

Figure 13: A risk assessment using various indicators to determine areas of vulnerability to outbreaks in Kakuma



Risk Assessment

In the risk assessment, value 1 (in red) represents areas of high risk while value 4 (in blue) represents areas of least risk. The risk index values were calculated by assigning weight values to density of structures, location of health

3.2.3 Stage 1: Real time mapping of infected and suspected cases

Following preliminary assessments, UN-Habitat recognised that there was an opportunity to capitalise on the existing camp address systems in Kakuma-Kalobeyei as a common platform to work with the healthcare sector in the contact tracing processes. The investigation will be able to identify the (1) place of residence, and (2) locations where confirmed and suspected COVID-19 patients have been to. In the Smith et al. example, a study of Affolabi and colleagues' work in Benin showed that their "... mapping of patients' residences, workplaces and movements" were able to reveal a "corresponding spatial cluster".[45] UN-Habitat proposed to use a common excel structure between the healthcare sector and spatial outbreak investigations.

Reflections

In UN-Habitat's experience, humanitarian contexts such as Kakuma-Kalobeyei usually lack adequate resources including specialised manpower for adequate response. In times of emergency, challenges in coordination can be expected and where possible partners should seek to support lead sectors to support the response. In the case of the COVID-19 pandemic, UN-Habitat sought to work with the approaches employed by the healthcare sector and adapting where necessary and possible to optimise results.

In turn, UN-Habitat proposed employing GIS to develop a real time composite mapping comprising of a dot mapping of residences (of infected cases) and movement mapping of infected cases to and from the residence to different locations, which would reveal a potential spatial cluster, which would aid in preventive response and management processes. The residence of the patients (infected) will be mapped as a dot (in red), with residences of suspected patients (in blue) (see Figure 14). In turn, these dots will be connected by lines to different locations visited by the patients (see Figure 14). The use of GIS will enable any updates to the common excel sheet to reflect changes in real time, such as the residence and locations visited by the infected patient, and provide an overview of the situation in Kakuma-Kalobeyei. The ability to develop rapid overviews is especially critical given the highly infectious nature of COVID-19 and the high risk of outbreaks in Kakuma-Kalobeyei.

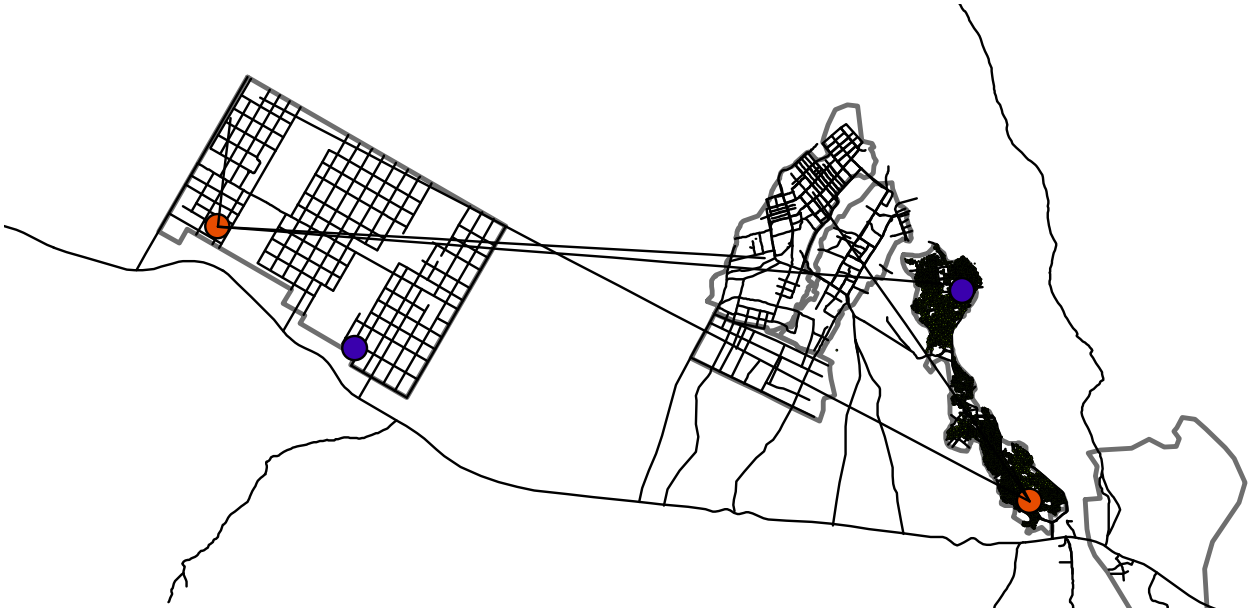


Figure 14: An example map of Kakuma 1 with shelters in green, residences of infected patients in red, suspected patients in blue, and locations visited by infected patients in the past 14 days connected by lines to residences of infected patients.

45 Smith et al., 2015, pg. 4.

By mapping infected patients, spatial outbreak investigations will be able to identify clusters in the outbreak and in addition, overlaying both analyses would give an overview of the spread of the outbreak and allow UNHCR and partners to pre-emptively lockdown areas to prevent further spread.

Reflections

In a review of the proposed strategies with humanitarian partners, it was highlighted that not all refugees residing in Kakuma Refugee Camps are aware of their addresses as compared to refugees residing in Kalobeyei Settlement. While the analyses are planned as rapid overviews to be used alongside other information, a lack of accurate data may create an incomplete picture of the situation which can lead to erroneous distribution of resources to address the situation.

3.2.4 Stage 2: Defining clusters

The US Center for Disease Control and Prevention (CDC) explained that clusters are "an aggregation of cases grouped in place and time that are suspected to be greater than the number expected, even though the expected number may not be known".[46] Likewise, Smith et al. defines clusters as "areas with higher than expected levels of disease risk", and notes that "identification and analysis" of these clusters would help outbreak investigations.[47] In the context of Kakuma-Kalobeyei, UN-Habitat recognised that outbreak events will inevitably lead to the development of clusters (spatially), and recommended identification and analysis of these clusters in order to prevent further spread.

However, UN-Habitat recognised that in the context of Kakuma-Kalobeyei, these spatial methods are employed to develop a rapid overview of the situation on the ground and is not meant to determine finalised diagnostics. Rather, it can provide humanitarian actors such as UNHCR and partners additional avenues to consider in their response to COVID-19. Likewise, Smith et al. noted that spatial methods alone are insufficient in determining the diagnostic of outbreaks, it is "useful in developing plausible preliminary diagnostic hypotheses".[48]

3.2.4.1 Spread of infected cases

As mentioned above, the geolocation of infected and suspected patients is meant to provide an overview of the situation in Kakuma-Kalobeyei. Smith et al. example of John Snow's cholera outbreak investigation[49] offers insight into how clusters can be identified. Geolocation of infected patients (or dot mapping) can be translated into density mappings to identify areas of high density in infected cases, which in turn can be defined as a cluster. While this method is not conclusive, it provides insight into the situation on the outbreak.

3.2.4.2 Potential spread of infected cases

The same as above can be done for the suspected patients to identify a potential spread of COVID-19 and potential clusters. This will allow UNHCR and partners insight into potential areas to conduct further testing or areas to lockdown to prevent further spread.

46 CDC, 2011.
47 Smith et al., 2015, pg. 3.
48 Smith et al., 2015, pg. 12.
49 Smith et al., 2015, pg. 2.

3.2.5 Stage 3: Hypothesising spread risk factors based on cluster definitions

As explained, in the case of outbreak events, it is critical for UNHCR and partners to immediately focus on containment and mitigation of further spread. Therefore, definition and eventual isolation of clusters should also be accompanied by analyses of these outbreaks. Two hypotheses should be derived from the outbreak analyses, (1) risk factors that can lead to the potential spread of the disease beyond the cluster and/or (2) existing risk factors that the disease spread through to create the identified cluster.

3.2.5.1 Identifying sources of COVID-19 transmission

Smith et al. identified different methods in their paper on outbreak investigations. A Voronoi map[50] can be developed for each public facility/infrastructure frequent by the refugees, such as water points, aid distribution centres, healthcare facilities, and marketplaces. Overlapping a Voronoi map with hypothesised clusters would help demonstrate potential spread risk factors[51], both inwards into the cluster and outwards from the cluster. This method is effective when UNHCR and partners are not aware of the spread risk factors that led to the clusters being formed.

For example, in Kakuma-Kalobeyei, in Figure 15, a Voronoi mapping of healthcare facilities can show (1) its coverage across Kakuma Refugee camp, and (2) which zones have the highest number of (sample) cases. However, this is not conclusive and has to be studied with other Voronoi mappings and analyses. In Figure 16, a Voronoi mapping of latrines in Kakuma Refugee Camp can also show the coverage by each latrine, and in this case demonstrates that most of the (sample) cases are concentrated in 1-2 latrine zones.

Reflections

It is important to note that when using Voronoi mappings an assumption is made that people will visit the facility closest to them, although this may not be true for everyone. Some people may choose to visit a slightly further facility just because they are more familiar with the community there, or for any other reason.

Another method involves working with hypothesised sources of infection that UNHCR and partners are aware of. A composite mapping of "concentric circles of varying radii around potential sources" is overlaid with geolocated infected cases to determine correlation between proposed risk factors and density of infected cases in its proximity[52]. However, this is only effective when UNHCR and partners are aware of potential spread risk factors, for example through interviews.

50 "Voronoi maps identify zones around each sample point such that every location within the zone is closest to the sample point compared to other sample points." ESRI, 2007.

51 Smith et al., 2015, pg. 13.

52 Smith et al., 2015, pg. 13.

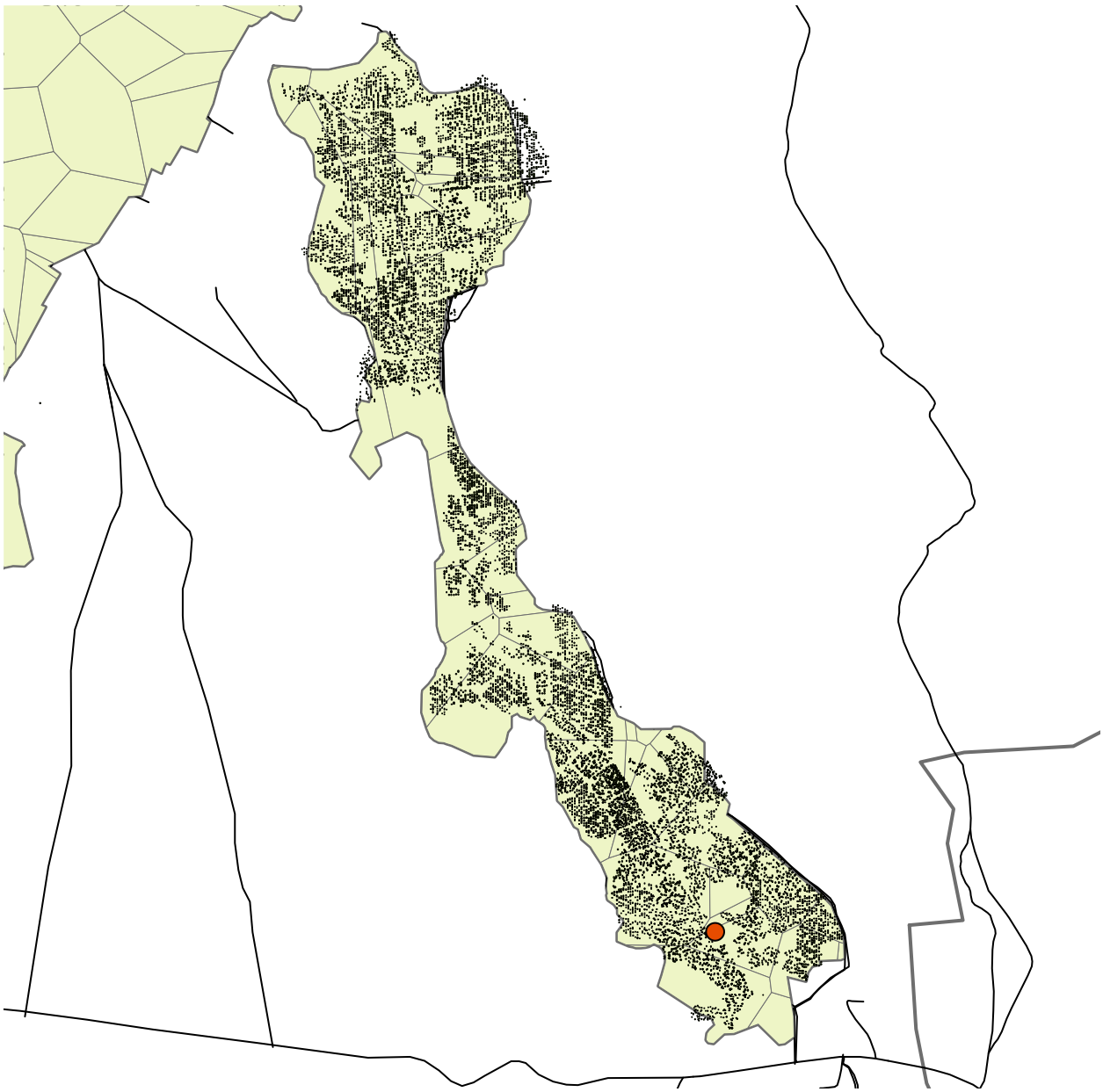


Figure 15: A Voronoi mapping of Public Purposes in Kakuma Refugee Camp overlaid with sample infected and suspected patients.

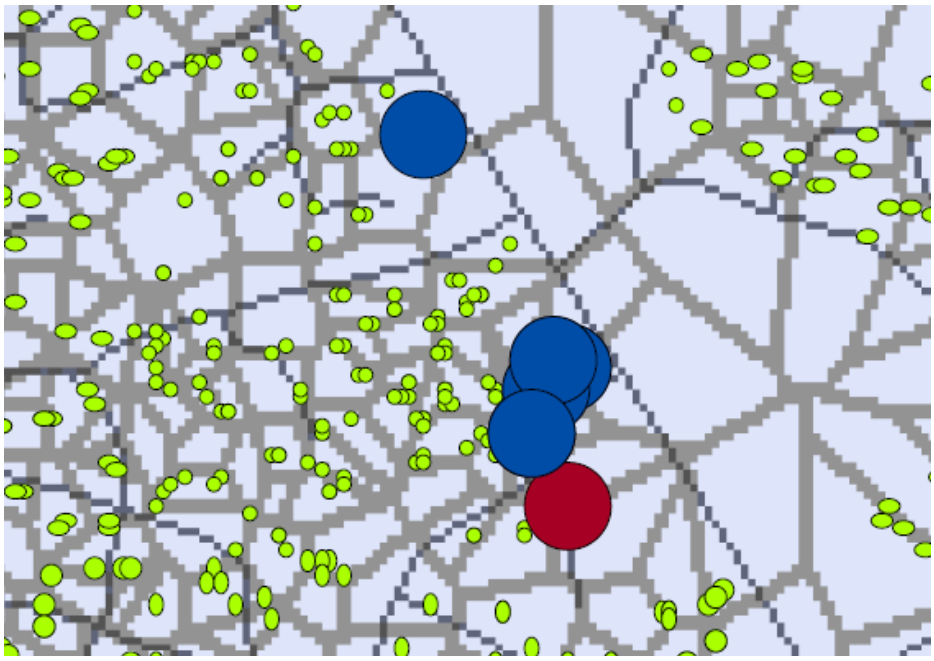


Figure 16: A Voronoi mapping of latrines in Kakuma Refugee Camp with sample infected and suspected patients.

3.2.5.2 Spread pathways

A mapping of infected/suspected patients and the locations they have travelled to (see Figure 14) allows GIS to produce an overview of the different locations thereby allow insight into the extent of the potential spread of COVID-19 in Kakuma-Kalobeyei. The map can be read two ways:

1. **Origin:** the denser the lines from the origin, the more the spread of COVID-19 beyond the cluster;
2. **Destination:** the denser the lines at the destination, the higher the risk of a cluster forming in the area.

3.2.5.3 Overlaying analysis with Risk Assessment mapping

Analyses can also be overlaid with the Risk Assessment mapping (see Figure 13) to determine potential spread pathways. For example, this can allow UNHCR and partners to pre-emptively intervene in areas that are determined to be highly vulnerable to outbreaks and have been visited by infected patients.

Reflections

A final review of Spatial Outbreak Investigations application in Kakuma-Kalobeyei found that there were three key factors that render the application ineffective.

First, testings conducted by humanitarian partners are targeted and are driven by external factors such as pre-flight testing and pre-activities testing (such as aid distribution). As humanitarian partners lack resources to conduct mass testing, this means that cases identified are not random and cannot present a comprehensive overview of Kakuma-Kalobeyei. Hence, analyses derived through this proposal will be skewed and potentially contribute to incomplete overviews of the settlements. Second, it was noted that most of the cases identified are asymptomatic, which suggests a larger pool of invisible cases had yet to be detected in the settlements – this will further compound the potential skewed overview that will be derived from this proposal. Third, without the means to identify clusters it is difficult to hypothesise on the potential sources of infection.

UN-Habitat recognised that while Spatial Outbreak Investigations is unable to produce conclusive results with current limited datasets and studies made, there is value in its role towards preparedness and response strategies. It is clear with the current studies made that with better means to develop datasets, and finetuning of the approach accordingly, Spatial Outbreak Investigations can yield results to become more concretely useful to the preparedness and response to pandemics.

3.2.6 Stage 4: Communication and Containment of outbreaks

Communication of these mappings is critical to ensure that all parties, including laymen, involved understands the findings, and are able to respond with containment & mitigation measures. The above mentioned mappings provide an overview of the existing situation.

1. Composite mapping of risk assessments	2. Dot map and Cluster analysis;	3. Contact tracing (locations);	4. Area Density study; and,	5. Voronoi analysis.
Recommended	Mandatory	Mandatory	Recommended	Recommended
2 weeks - 2 months	1 week	3 days	1 week	1 week

3.2.6.1 Chronology study

In addition, a time study of the cases in the settlements can provide UNHCR and partners a tool to prioritise interventions. A good example comes from the Government of Hong Kong's mapping of COVID-19 cases in the country[53], spilt between those that are less than 14 days old and those that are more than 14 days old. Cases that are beyond 14 days poses less of a risk as "[t]he incubation period for COVID-19 is thought to extend to 14 days, with a median time of 4-5 days from exposure to symptoms onset"[54], therefore by then the patient should be aware of his/her symptoms and would avoid interaction with others. However, this does not apply to patients who are asymptomatic, therefore it is critical to note that this chronology study, as is with the other hypotheses' studies, are guides to derive and support hypotheses but are not conclusive evidence.

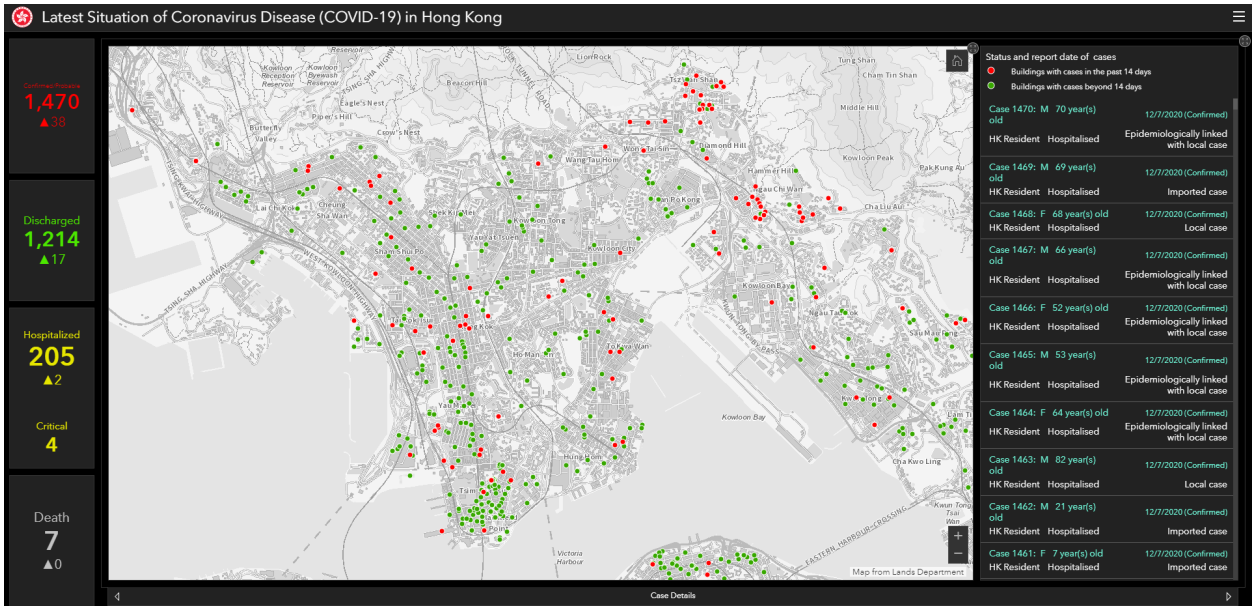


Figure 17: COVID-19 Mapping in Hong Kong. Source: Government of Hong Kong.

53 Government of Hong Kong.
54 CDC, 2021.

Photo: A Turkana dance performed by local community members

04 Lessons learned and Recommendations

In the support towards preparedness and response strategies in Kakuma-Kalobeyei, UN-Habitat has found that ***spatial lenses can contribute to a more informed decision-making process for humanitarian partners in the formulation and implementation of preparedness and response strategies***, such as in the COVID-19 pandemic. However, at the same time, UN-Habitat recognised that in humanitarian contexts such as Kakuma-Kalobeyei, where there is a lack of adequate resources and capacities, spatial findings are best utilised with other resources and factors to determine a combined best way forward. This was observed in the case of conducting accessibility studies whereby schools in Kakuma Refugee Camps and Kalobeyei Settlement were chosen as part of a repurposing strategy on account of their spatial accessibility, on top of practical concerns such as condition and size of schools. Likewise, without adequate resources to conduct mass testing and develop an accurate picture of the COVID-19 transmission patterns in Kakuma-Kalobeyei, spatial planning analyses could instead create an incomplete picture of the situation that lead to erroneous interventions – which is of critical concern given already limited resources.

In addition, building upon UN-Habitat's experience in spatial planning in Kakuma-Kalobeyei, it is noted that iterative spatial planning processes which are able to continue presenting "analytical outcomes of an incremental accruement of new data"[55] are pivotal in humanitarian contexts like Kakuma-Kalobeyei. In an emergency like the COVID-19 pandemic, where potential outbreak events could be disastrous and could lead to rapid spread in overcrowded conditions, ***it is necessary to develop rapid and reliable databases or precedent baseline information that can provide humanitarian partners an additional tool for informed decision-making.***

UN-Habitat's experience in strengthening the humanitarian-development-peace nexus has also revealed ***the need to create avenues for the "incorporation of wider development considerations to guide incremental improvements"[56] and imbuing resilience into the settlements in the long-term.*** For example, analyses from the Settlement Profiling Tool and settlement profiles not only inform humanitarian partners of existing areas within settlements that are vulnerable and require immediate intervention, but can also guide incremental improvement by identifying potential opportunities to build and strengthen urban resilience for future responses. This is further underpinned by UN-Habitat's cross-sectoral work in KISEDP, allowing UN-Habitat and partners to collaborate better and find sustainable developmental solutions in humanitarian-development contexts.

55 UN-Habitat, 2018, pg. 30.
56 UN-Habitat, 2020(b).

05

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