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DIVISION OF DISEASE SURVEILLANCE AND EPIDEMIC RESPONSE

REPORT

Identification of the Priority Areas for Multisectoral Interventions for Cholera Control in Kenya

March 2024

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ABBREVIATIONS AND ACRONYMS

CSP	Country Support Platform
DDSR	Division of Disease Surveillance and Response
DNLS	Division of National Laboratory Services
GTFCC	Global Task Force for Cholera Control
ICG	International Coordination Group
IDSR	Integrated Disease Surveillance and Response
IFRC	International Federation of Red Cross and Red Crescent Societies
KHIS	Kenya Health Information System
Moh	Ministry of Health
NCP	National Cholera Plan
NMRL	National Microbiology Reference Laboratory
OCHA	Office for the Coordination of Humanitarian Affairs
OCV	Oral Cholera Vaccine
PAMIs	Priority Areas for Multisectoral Interventions
PCR	Polymerase Chain Reaction
RDT	Rapid Diagnostic Test
UNICEF	United Nations International Children's Emergency Fund
UNHCR	United Nations High Commissioner for Refugees
WASH	Water, Sanitation, And Hygiene.
WHO	World Health Organization

EXECUTIVE SUMMARY

Cholera priority areas for multisectoral interventions (PAMIs) are geographically limited areas where cultural, environmental, and socioeconomic conditions facilitate the transmission of disease and where cholera persists or reappears regularly. Targeting cholera PAMIs will help to focus interventions proposed in the National Cholera Plan on the most at-risk populations and effectively control and eliminate cholera.

An analysis was conducted between February and March 2024. The PAMIs were selected based on the previous six years' epidemiological data (Jan 2018 - Dec 2023), at the sub-county level[1]. For each unit, the Kenyan Health Information System provided the sub-county population data, estimated from the 2019 census and the UNHCR data for the refugees and asylum-seekers.

The identification of PAMIs was carried out following the 2023 GTFCC Methodology to identify PAMIs for cholera control. The priority index was calculated using the cholera outbreak line list, i.e. confirmed, probable or suspected cholera cases[2], all ages combined, admitted or reported to the health facilities. The indicators were defined as follows:

- Incidence: total number of cholera cases per 100,000 person-years over the analysis period.
- Mortality: total number of deaths attributed to cholera reported per 100,000 person-years over the analysis period.
- Persistence: percentage of weeks with at least one cholera case among the total number of weeks over the period.
- Weekly testing coverage: percentage of weeks with at least one suspected case tested for cholera (regardless of the testing method), among weeks with at least one suspected case, over the analysis period.
- Number of years with case(s) tested positive: number of years with at least one case tested positive for cholera (regardless of the testing method), over the analysis period. This testing indicator was selected considering the sub-optimal representativeness of testing (71.9% of the geographic units with a weekly testing coverage ≥ 50%).

Among the units with at least one case, the median and the 80th percentile of the incidence were 4.04 and 16.20 per 100,000 pers-year, respectively. The mortality rate had a median of 0.24 per 100,000 pers-year and an 80th percentile of 0.47 per 100,000 pers-year. The median and the 80th percentile for the persistence (percentage of weeks with at least one case) were 2.2% and 8.5%, respectively.

[1] Sub-county corresponds to the level 2 administrative units. Some newly created sub-counties were merged.
[2] Confirmed, probable and suspected cholera cases will be mentioned as cholera cases, later in the document.

Concerning the testing, 89.5% (n: 137) of the units reported a testing coverage > 0%; 75 and 78 of the units tested at least one positive case for 1 year and for 2 years or more.

Using these four indicators, we determined a numerical priority index for each administrative unit, per the GTFCC method.

In addition, geographical and contextual factors were considered to identify additional PAMIs. The group of national experts in charge of the PAMI identification selected several vulnerability factors, including access to water and sanitation services, population density, presence of at-risk populations (refugees, fishing community, and mining populations), areas subject to extreme climate events, and areas bordering identified cholera hotspots in a neighbouring country.

County representatives, governmental institution representatives, and partners discussed the initial list of PAMIs in a workshop and validated a final list of PAMIs. The workshop participants discussed scenarios with different priority index thresholds. Following the reports of the groups, the workshop assembly chose a PAMI threshold of 6 to consider a sub-county as a PAMI.

Out of the 304 sub-counties, 107 geographical units were identified as PAMIs with 78 PAMIs based on priority index ≥ 6 and 29 additional PAMIs.

Of the 29 additional PAMIs, five sub-counties had a priority index of 5, six of 4, six of 3, and twelve of 0. The main reason to upgrade these sub-counties as PAMIs were:

- The recent change in the administrative boundaries, impacting the cholera case reporting in the sub-counties.
- Under-reporting of cholera cases in units where insecurity prevails (surveillance difficulties, access to health facilities).
- Sub-counties neighbouring PAMIs
- Movement of population leading population to seek care in other sub-counties.
- Cyclical nature of the epidemic in the country: past outbreaks or very recent sub-county cholera cases not captured by the study period.
- Increase of climate-related events in the past years (heavy rains, floods, droughts).
- Transport corridors.

The identified PAMIs included a total population of 21,574,063 (40% of the estimated national population in 2023) and covered 97% and 96% of the registered cholera cases and cholera-related deaths respectively, during the studied period (Table 1).

Table 1 Summary table of key parameters for the PAMIs defined by the priority Index and upgraded following the PAMI workshop, Kenya, 2024

PAMI Decision	Nber of Units	Rel. % of units	Cumulative % of units	Population*	Rel. % of population	Cumulative % of population
PAMI_PI	78	25.7	25.7	15,688,178	31.3	31.3
Additional PAMI	29	9.5	35.2	4,294,545	8.6	39.8
No PAMI	197	64.8	100.0	30,175,858	60.2	100.0
Grand Total	**304**	**100.0**		**50,158,580**	**100.0**	

*Unit: sub-county, some sub-counties are not represented as merged to account for some recent administrative changes

All the sub-counties of nine counties were identified as PAMIs (Figures 1-2). Five counties had half or more of their sub-counties considered as PAMIs and 20 had less but included at least 1 PAMI. Thirteen counties did not have any PAMI.

Figure 1 Distribution of the sub-counties by PAMI decision, stratified by county, Kenya 2024

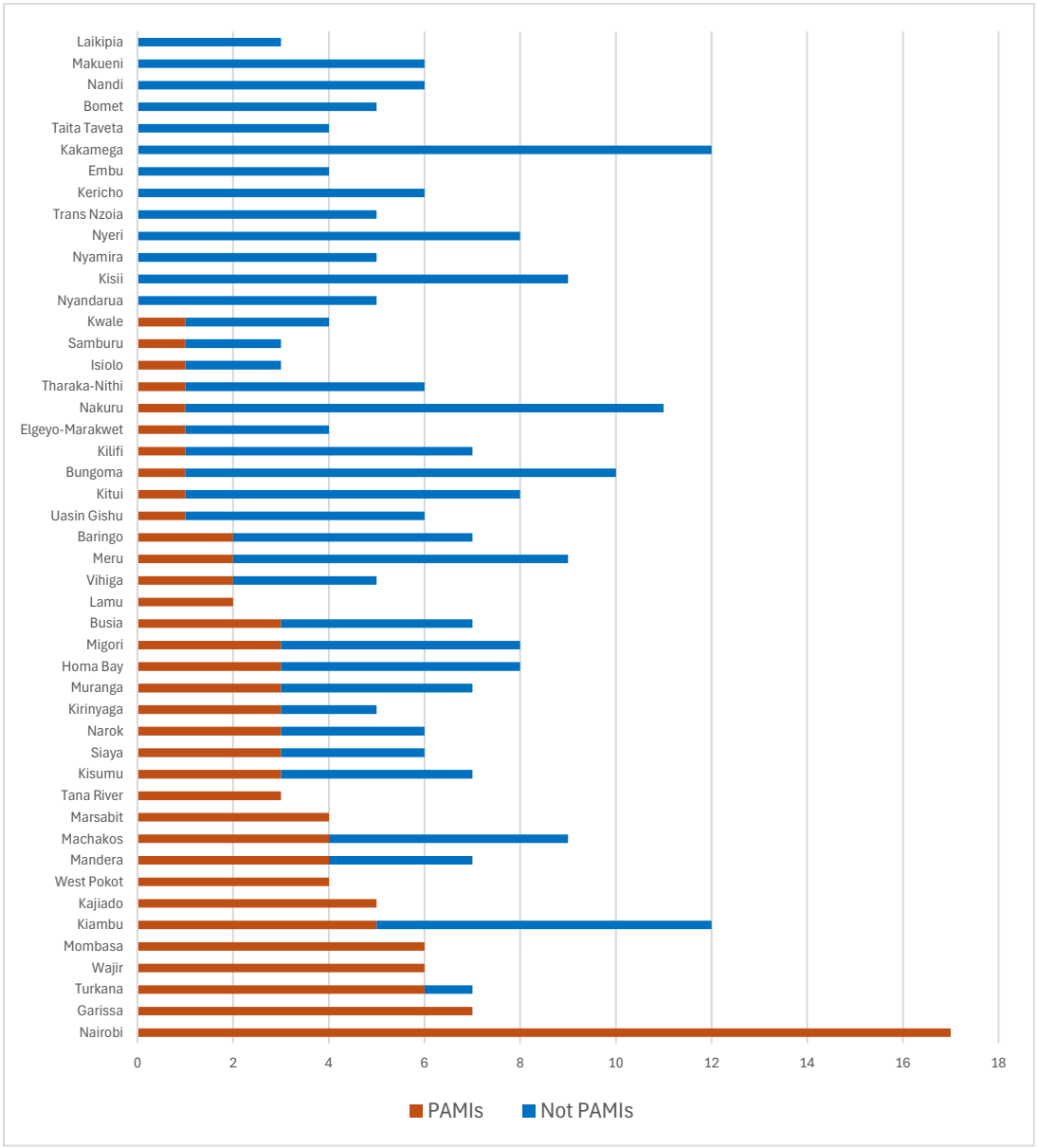
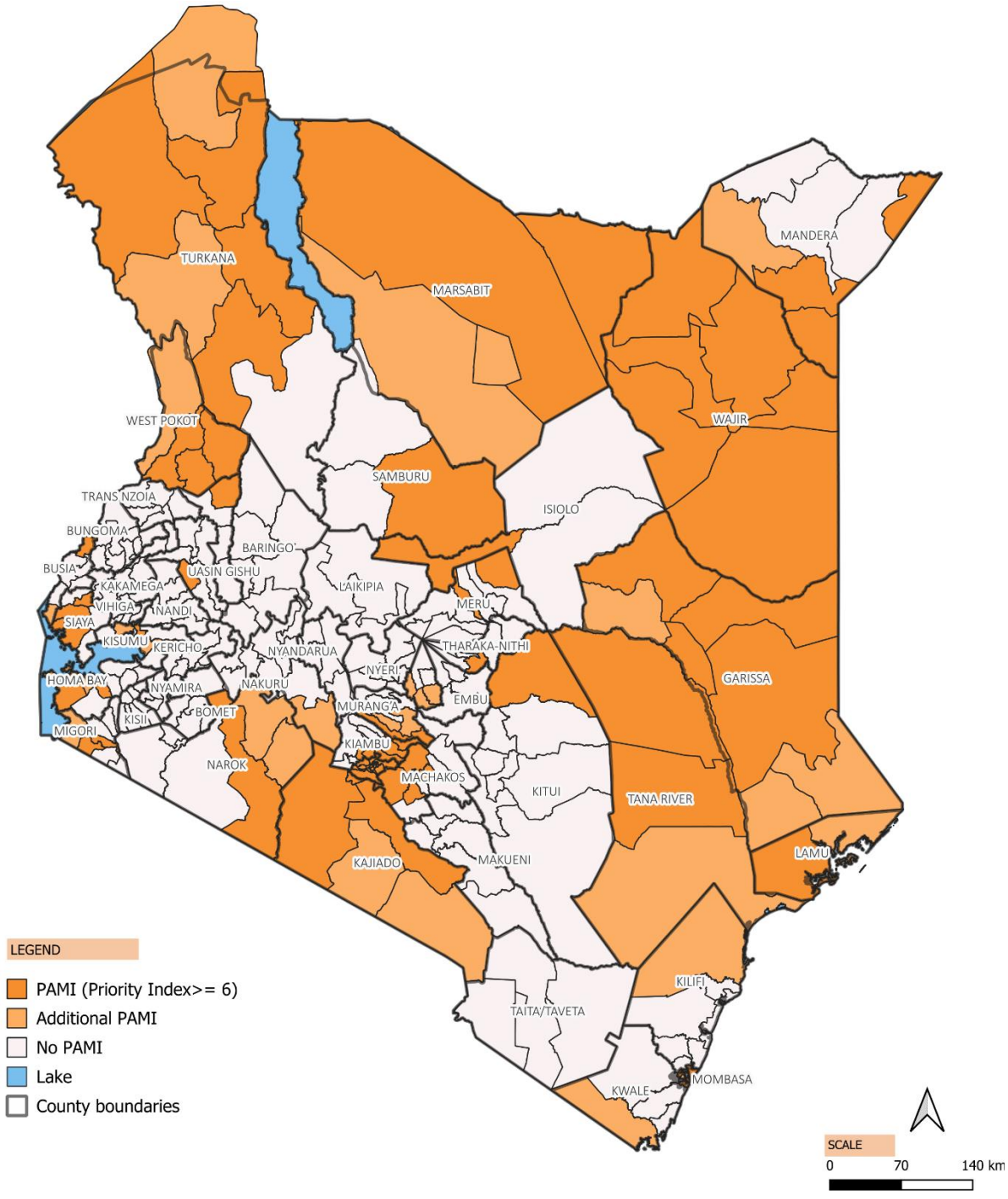


Figure 2 Final Map of the PAMIs, Kenya, 2024



Prioritizing and targeting these areas with cholera prevention and response interventions is expected to reduce the burden of cholera and cholera epidemic spread. The National Cholera Plan will be updated, considering the new list of PAMIs. The Multi-Year Plan of Action will be developed based on these results, to initiate preventive vaccination campaigns against cholera. A review of PAMIs will be conducted regularly by analysing surveillance data and country-specific contextual situations to further guide decisions, in line with the National Cholera Plan.

I. BACKGROUND

1. Identification of PAMIs

The identification of cholera hotspots or priority areas for multisectoral interventions (PAMIs) is proposed as part of a National Cholera Plan, for countries engaged in the initiative entitled "Ending Cholera: A Global Roadmap to 2030". This initiative consists of reducing cholera deaths by 90% worldwide and eliminating cholera in at least 20 countries by 2030.[1]

PAMIs are geographically limited areas where cultural, environmental, and socioeconomic conditions facilitate the transmission of disease and where cholera persists or reappears regularly.[2]

The identification of PAMIs serves several objectives, including:

- **Targeted interventions:** Implementation of preventive measures in high-risk areas would help to prevent cholera outbreaks. This can include promoting hygiene practices, improving water and sanitation infrastructure, providing access to clean water and sanitation facilities, and targeting Oral Cholera Vaccine (OCV) campaigns.
- **Early detection and response:** Health authorities and other stakeholders may detect potential cholera outbreaks early and respond quickly to contain them. This can include enhanced surveillance, early warning systems, and rapid response teams.
- **Resource allocation**: Resources may be allocated more efficiently, directing funding and personnel to areas with the highest risk of cholera outbreaks. This can improve the effectiveness and efficiency of cholera prevention and control activities.
- **Data collection and analysis**: Finally, identifying PAMIs can help to improve our understanding of the epidemiology of cholera and the factors that contribute to outbreaks. This information can be used to inform future prevention and control strategies and to guide ongoing surveillance and monitoring efforts.

In the 2023 guidance document, the GTFCC recommends using data at least from the previous five years to identify PAMIs.[2] The hotspot mapping would be reviewed regularly to adapt interventions to the cholera situation in the country.

2. Cholera Situation in Kenya

a. General context

Kenya is an East African country, located in the Horn of Africa, bordered by the Indian Ocean, Tanzania, Uganda, South Sudan, Ethiopia, and Somalia. The land rises from a low coastal plain on the Indian

Ocean in a series of mountain ridges and plateaus rising above 9,000 feet in the centre of the country. Approximately 80% of the land area of Kenya is arid and semi-arid and only 20% is arable.[3]

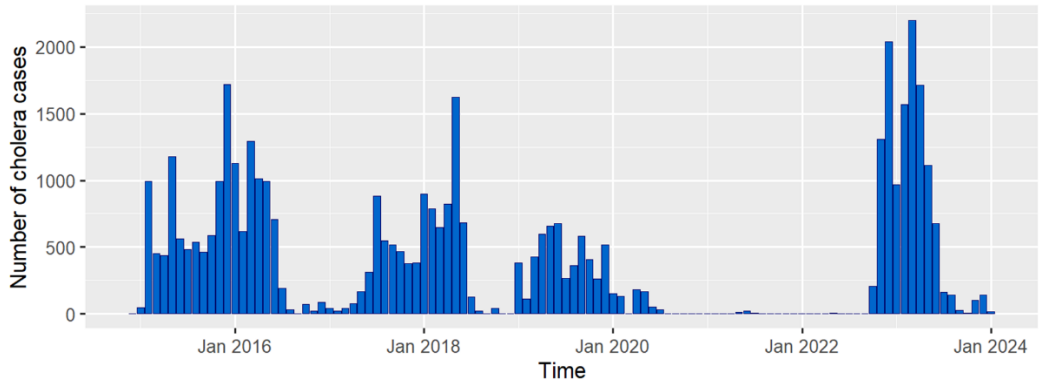
The country is divided into 47 counties in Kenya that are administratively subdivided into 304 sub-counties. Kenya's population was enumerated at 47.6 million in 2019 with an inter-censual population growth rate of 2.3 percent.[4] The population is dominated by young people with those below 15 making up for 39 percent of the population. About one-third of the population lives in urban areas with Nairobi County, hosting Nairobi, the capital. The second largest city is Mombasa, located on the South-East Coast.[4] The average population density is 82 per km2 and varies greatly across the counties, but the patterns of the spatial distribution regarding population density show that they remained unchanged between 1999 and 2019.[5]

b. Cholera situation in Kenya

Cholera remains a disease of major public health concern on the list of priority diseases under Kenya's Integrated Disease Surveillance and Response (IDSR) strategy.[6]

Kenya reported first the disease in 1971, in Turkana County. It was associated with a cholera pandemic originating in Southeast Asia in the 1960s. The country has experienced an upsurge of cholera cases affecting various counties, with large cyclical epidemics occurring every five to seven years. Widespread cholera outbreaks occurred between 1997-1999, 2007-2010, and recently between 2015-2019 and 2022-2024, as illustrated in the epi curve (Figure 1).

Figure 1 Monthly distribution of cholera reported Cases, Kenya, 2015-2023, source: Division of Disease Surveillance and Response



An outbreak commenced in October 2022 and persists to this day. As of February 25th,2024, a total of 12,521 cases with 206 deaths have been reported in 28 counties.[7] In addition to the regular occurrence of cholera outbreaks in the country, the cholera situation in the country was exacerbated by the regional situation. Between 2022 and 2024, 18 countries were affected in the WHO African Region, including neighbouring Kenya countries (United Republic of Tanzania, Uganda, Ethiopia, and Somalia).[7]

Counties in northern Kenya alongside Somalia, South Sudan, and other countries in the Horn of Africa, are experiencing the worst drought in 40 years following four failed rainy seasons, classified by WHO as a grade 3 health emergency.[8]

As part of the response to control the cholera outbreak, the country requested oral cholera vaccines (OCV) from the International Coordination Group (ICG), in 2022.[9] The ICG provided Kenya with 2,213, 943 OCV doses in January 2023, 1,331,199 OCV doses in June 2023, and 175,575 doses in July 2023. The Ministry of Health (MoH) and the county governments conducted reactive vaccination campaigns in February 2023 and August 2023, in areas reporting the highest attack rates at the time, as a single-dose strategy (see Appendix 1). The ICG, in October 2022, temporarily suspended the standard two-dose regimen in cholera outbreak response campaigns to a single-dose approach, due to the strained global supply of the OCV. Post-vaccination coverage surveys reported 93.2 % vaccine uptake among the eligible household individuals versus 99.2% as administrative coverage and 98.1% versus 105.1%, respectively for the first and second campaigns.[10,11]

The main risk factors associated with cholera outbreaks in Kenya were identified in the literature and by various studies as open defecation, high population density, cross-border movements of persons, transmission in crowded settings and amongst refugees and internally displaced persons, mass gathering events, and changes in rainfall patterns.[12, 13]

3. National Cholera Control Plan in Kenya

Kenya endorsed in 2013 its' first multisectoral cholera prevention and control plan, housed at the Ministry of Health.[14] A new plan was developed and endorsed in 2022. The National Multisectoral Cholera Elimination Plan (NCP) for Kenya is a multisectoral and multiyear plan, implemented phase by phase over 8 years (2022-2030). This plan is co-signed by the MoH and the Ministry of Water, Sanitation, and Irrigation, and implemented in collaboration with other government sectors, including county governments and partner organizations.[12] Priority activities were proposed for each prevention and control pillar (surveillance and reporting, health care system strengthening, use of OCV, Water, Sanitation and Hygiene (WASH), and community engagement). Interventions are already ongoing, but the COVID-19 pandemic and sub-optimal funding have delayed the progress of implementation.

The main proposed strategies of interventions are:

- Conduct a sustained and efficient surveillance system that can predict, detect, and respond to cholera outbreaks in a timely manner,
- Ensure appropriate cholera case management in all health facilities,
- OCV vaccination in conjunction with WASH in cholera PAMIs to complete interruption of transmission and any new outbreaks,

- Improve nationwide WASH Services as a long-term solution.

4. Previous identification of PAMIs

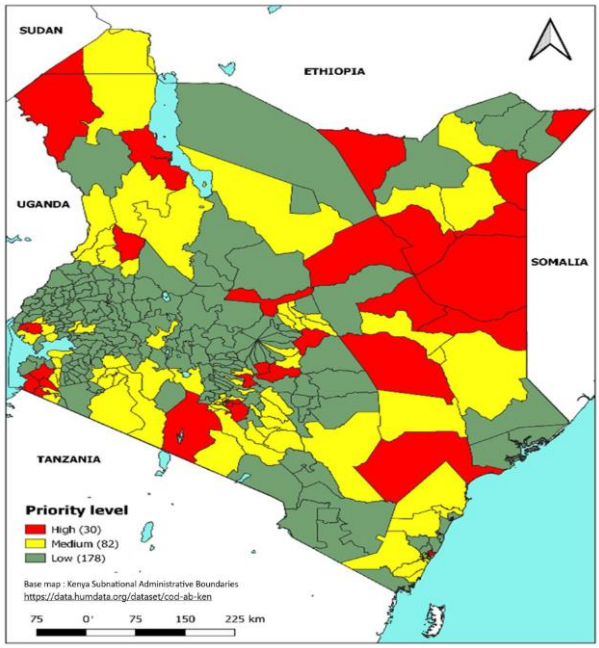
a. NCP PAMIs

In parallel with the development of the NCP, a cholera hotspot identification was conducted in 2019.[15] The results were published and included in the NCP to guide intervention decisions. The identification was based on two epidemiological indicators (mean annual incidence and weekly percentage persistence) and two WASH indicators (access to improved drinking water and access to improved sanitation), analysed between 2015 and 2019.

The 2019 analysis identified 30 sub-counties with a high priority level (score between 9-12), 82 with a medium priority level (Score 5-8), and 178 with low priority (score 1-4). The hotspots identified as high-priority levels represented 9.1 percent of the population (n: 4,892,015). (Figure 2)

The challenges faced during this previous cholera hotspot identification concerned the data with incomplete information (missing variables), the lack of comprehensive and updated WASH data at the sub-county level, and the other competing public health emergencies as the analysis was conducted during the Ebola alerts in Central Africa, and the COVID-19 pandemic.

Figure 2 Priority sub-counties, based on a combination of Epidemiological and WASH indicators, Kenya 2015-2019



b. Academic Institutions

In collaboration with Johns Hopkins University, the Kenyan Field Epidemiology and Laboratory Training Program, part of the Ministry of Health, published the results of another hotspot mapping based on

the 2019 GTFCC methodology.[16] The analysis was based on the cholera IDSR line list from 2015 to 2020. They identified 13 high-risk sub-counties from eight counties, including the three high-risk counties of Garissa, Tana River, and Wajir. The high-risk sub-counties represented 6% of the Kenyan population.

Another publication reported an epidemiological analysis of the incidence of cholera in the country, describing the geographic repartition of the different outbreaks over the studied years.[17] One study even analyses the spatial and temporal distribution of cholera cases in high-risk areas (Dadaab refugee camp, Lake Victoria region (Kisumu, Siaya, Migori, and Homabay) and Mukuru informal settlement in Nairobi), to prioritize high-risk clusters, in the response and resource allocation.[18]

Several publications reported regional analysis for Sub-Saharan Africa.[19,20] Their work highlighted the importance of cholera in the region and the potential cholera dynamics between countries. Nevertheless, they stressed that the analysis showed that the temporal distribution of cholera incidence varies substantially from country to country and often also from district to district. Q. Zheng et al. reported 999 suspected cholera outbreaks in 744 regions across 25 sub-Saharan African countries, between 2010 and 2019. The outbreak periods accounted for 1.8 billion person-months, representing 2% of the total Sub-Saharan Africa population.[19]

II. METHODS

The identification of the PAMIs is based on the 2023 GTFCC guidance for the identification of PAMIs for cholera control which entails using cholera data from recent years (at least 5 years) to compute epidemiological indicators.[2] The guidance document recommends a two-step process for the identification of PAMIs for cholera control. The cholera control methodology has been selected based on the epidemiological situation of the past years.

The first step aims to rank all geographical units of a country according to a numerical priority index. This priority index results from the sum of four scored indicators: incidence, mortality, persistence, and positivity testing. (Table 1) Two potential testing indicators may be considered depending on the representativeness of the testing in the county during the studied period.

Table 1 Case definition of the epidemiological Indicators, GTFCC PAMI identification guideline, 2023

Indicator	Definition
Incidence	Number of cholera cases (suspected & confirmed) reported per 100,000 person-years over the analysis period
Mortality	Number of deaths attributed to cholera (suspected & confirmed) reported per 100,000 person-years in the unit over the analysis period
Persistence	Percentage of weeks with at least one reported suspected cholera case in the unit over the period of interest
Weekly testing coverage	Percentage of weeks with reported cholera cases that tested at least one suspected case for cholera (regardless of the testing method) in the unit over the analysis period
Positivity rate	Cholera positivity rate in the unit over the analysis period
Number of years with case(s) tested positive	Number of years with at least one case tested positive for cholera (regardless of the testing method) reported in the NCP operational geographic unit over the analysis period

The second step is for country stakeholders to validate a final list of PAMIs. At this step, contextual local knowledge that considers vulnerability to cholera transmission might be considered.

The DDSR, MOH, held an inception meeting on February 14th, 2024, with key stakeholders from governmental institutions and partners. A working group was constituted to ensure that the methodology was adapted to the country. The list of participants is attached to this report (Appendix 2). Following the discussions, no change was made to the recommended methodology.

1. Step 1. Priority index

a. Operational geographical units and population

Kenya is divided into 47 counties, 304 sub-counties, and 1,450 wards.[21] The health care system follows the administrative tiers in the country (Appendix 3).

After discussion with the different stakeholders, we choose to perform the analysis at the sub-county level (level 2 units), considering the large population, some extended counties, and specific epidemiological risks. The surveillance system and response to a cholera outbreak are usually coordinated at the sub-county level and supported by the county government institutions. Wards (level 3 units) were not selected due to the surveillance system organization and the impact of missing data.

The number and geographical boundaries have changed in recent years. To ensure consistency with the data collected, we merged certain sub-counties (population data and cholera case data), if the administrative units were newly created and annual population data were missing for the period studied (Appendix 4).

There is another geographical division, the constituencies (n:335), used to elect members of the National Assembly. A correspondence table, with a unique geographic identifier, has been drawn up to ensure the correct attribution of cases to the unit.[4,22]

An additional analysis was requested by the PAMI working group at the county level (level 1 units) to facilitate the result discussions. The same case definition and methodology were applied for both administrative-level analyses. (Result not presented in this report)

The Kenya Health Information System (KHIS) administrative files and shape files were used to geolocate the level 2 units. For the county level, the OCHA shapefile was used.[23]

Population data for each unit is based on the national census of 2019. UNHCR provides the refugee population, not included in the 2019 census.[24] The Kenya National Bureau of Statistics estimates growth rates, specific to county and sub-county. The KHIS department provided the population per sub-county and year, including the refugee populations.

To facilitate the discussion during the PAMI validation workshop, it was decided to divide the country into eight regions (former provinces).

b. Definition of the analysis period

Given the COVID-19 pandemic, cholera surveillance may have been affected during the 2020-2021 period. Consequently, 6 years were selected, from January 1, 2018, to December 31, 2023, for the analysis of PAMIs.

c. Cholera surveillance system

Kenya has developed a cholera surveillance system that monitors disease incidence, identifies outbreaks, and provides data for the development of effective prevention and control strategies. The surveillance of cholera is under the responsibility of the Division of Disease Surveillance and Response of the Ministry of Health.

i. Cholera and diarrhea surveillance

The Disease Surveillance and Response Unit (DSRU) is part of the Division of Disease Surveillance and Response (DDSR) which is under the Directorate of Public Health in the MOH Kenya. DSRU's mission is to provide leadership, participate in public health surveillance, and preparedness, and provide early detection and timely response to outbreaks and other events of public health importance.

The previous national guideline on cholera control, published in 2002, has been replaced by a new cholera management guideline aligned to GTFCC's current guidelines and finalized in 2023.[25,26] In the meantime, the GTFCC and WHO guidelines were used to update the practice of the field professionals.[27]

In areas where a cholera outbreak has not been confirmed, a suspected cholera case is defined as any person aged two years and older presenting with effortless acute watery diarrhea (three or more loose or watery stools within 24 hours) and severe dehydration or who has died from effortless acute watery diarrhea.

Any cholera-suspected case should be notified to the next level as case-based information within 24 hours. It corresponds to an alert threshold, serving as an early warning system. The case will be managed and treated according to national cholera management guidelines. The county team will conduct a case-based investigation and conduct contact tracing to identify similar cases not previously reported. They will obtain stool specimens from the index suspected case and any other five patients within five days of the onset of acute watery diarrhea, and before antibiotic treatment is started to confirm the outbreak.

Laboratory confirmation of cholera is done by culture or Polymerase Chain Reaction (PCR), as recommended by WHO guidelines When a suspect case is confirmed by a laboratory test, the action threshold is triggered to activate the response. The response includes:

- Establish a treatment centre in the locality where cases occur,
- Strengthen case management including treatment,
- Mobilize the community early to enable rapid case detection and treatment,
- Survey the availability of clean drinking water,
- Collaborate with the community leaders to limit the number of attendants at funerals or other large gatherings for ceremonies or other reasons.

- Reduce sporadic and outbreak-related cases through continuous access to safe water.
- Promote safe preparation of food (especially seafood, fruits, and vegetables).
- Promote safe disposal of human waste.

One confirmed case is sufficient to declare an outbreak.

In areas where a cholera outbreak is declared, a suspected cholera case is defined as any person presenting with or dying from effortless acute watery diarrhea. In addition, a probable case is a suspected case with an epidemiological link to a confirmed case, or a patient positive on a Rapid Diagnostic Test (RDT). The confirmed cholera case is defined as a suspected case with *Vibrio cholerae* O1 or O139 confirmed by culture or PCR.

All these steps are described in the new cholera management guideline.[25] Coordination is ensured by the national and county incident management teams. They are multidisciplinary and multisectoral teams. Its composition is described in the cholera management guideline.

During an outbreak, the confirmed, suspected, and probable cases are reported via national line listing form (MOH 503) from health facility to sub-county, to county, and then national (Kenya MoH) as part of the IDSR strategy.[6,28]

The line list includes case identification, demographic information, clinical information, laboratory confirmation and epidemiological information, treatment, and management.

In parallel, event-based surveillance exists and relies on community health promoters and other actors for the detection, reporting, and monitoring of health events in the community. Suspected cholera cases identified through event-based surveillance should be referred to a health facility.

ii. Cholera testing strategy

The surveillance system is supported by laboratory testing, which is used to confirm suspected cases of cholera and identify the causative strain of *Vibrio cholerae*. The confirmation is done by culture and/or PCR. After an outbreak is declared, the new guideline recommends the following testing strategy:

- If RDT is available:
    - First three suspected cases per day per health facility by RDT
    - Three RDT-positive suspected cases per week per sub-county by culture/PCR
- If RDT is unavailable, the first three suspected cases per week per health facility using culture/PCR.

In addition, antimicrobial susceptibility testing is performed for the five first confirmed cases per sub-county and then at least three confirmed cases per sub-county and month. Whole genome sequencing is performed on a subset of confirmed cases, but this is not required for public health intervention.

The country has an established laboratory network with regional laboratories to support counties in conducting certain tests.[12]

The Division of National Laboratory Services (DNLS), National Microbiology Reference Laboratory (NMRL), serves as the National Reference Laboratory for cholera testing (culture or PCR) and quality control in Kenya. In addition to testing performed by the NMRL, confirmation and testing is also performed by the laboratory at the Centers for Disease Control and Prevention–Kenya Medical Research Institute (KEMRI).

About 40 county reference laboratories and four sub-county laboratories have the infrastructure and basic equipment to perform cholera culture and antimicrobial susceptibility testing. Nevertheless, they regularly face reagents and supply shortages. They participate in the National External Quality Assessment program. In addition, 15 para-public laboratories, faith-based and private laboratories have culture capacities.

Most of these laboratories have the equipment to perform PCR but they face challenges due to the lack the reagents, supplies, and human resources.

Last year, the DNLS trained 24 county reference laboratories and 6 sub-counties laboratories in Garissa on cholera diagnosis (sample collection, packaging and transportation, RDT, culture, and sensitivity). All the level-2 and 3 laboratories were trained on the use of RDT Kits.

d. Data source & methodology

The PAMI working group decided to use the cholera IDSR line list for the analysis of indicators, as the database was the most complete and allowed to analyse patients' demographic characteristics. The variables necessary for the four indicators were present in the line list.

i. Country analysis

Case definition

Cases: All cholera-confirmed, probable, and suspected cases are registered in the line list and were included without distinction. They are quoted as cholera cases, later in the document.

Death: Any deaths attributed to cholera, in the community or the health facility were analysed, as soon as reported in the line list.

If no outcome was registered in the line list, the outcome was considered as alive.

Tests: A patient was considered as tested if any of the following variables was completed: date of test, type of test performed (either RDT or culture), and result of test (positive or negative or pending). If only the laboratory names or an ambiguous answer were reported, a test was considered performed if at least two variables were filled.

A test was considered positive if a clear indication of positivity was filled in the result variables or the patient status (confirmed). Missing test results were considered for the number of tests performed.

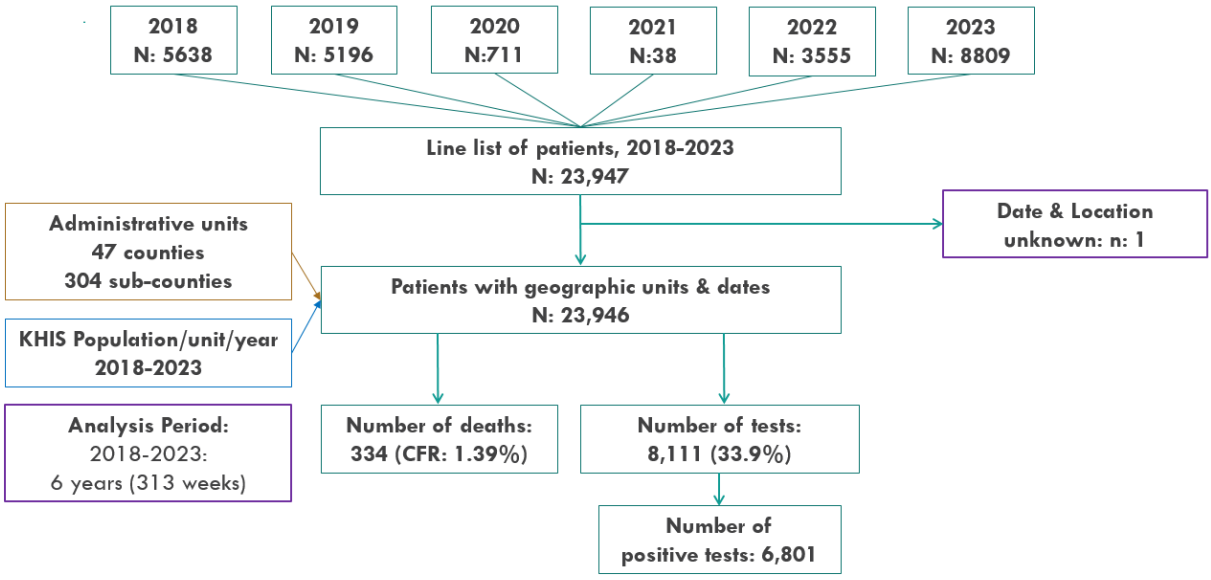
Date: Cases were assigned to the date of onset of illness or if missing, the date they sought care at a health facility, the date of laboratory test, or the date of the outcome (death/discharge). If no date was available, a review was done looking at the line list order and the location information. A review of the date in the line list was performed to identify errors linked to an incorrect date format.

The analysis is based on a weekly analysis of these variables. The system ISO 8601s, starting on Monday was used to assign epi-weeks.

Administrative units: Cases were assigned to the sub-county recorded in the line list. If missing, the ward, village, or health facility location was used to infer the sub-county. The group verified the adequation between the county and sub-county.

The key parameters used for the analysis are summarized in the Figure 3.

Figure 3 Flowchart of patients registered in IDSR cholera line list, Kenya, 2018-2023



Indicator

The indicators were calculated following the definition of the 2023 GTFCC guideline, presented above (Table 1). For the PAMIs analysis for Kenya, the four recommended indicators were computed.[2]

Method score

In line with the GTFCC guideline, epidemiological indicators were scored in four point-based categories defined using the 50th (median) and the 80th percentiles of their distributions. The

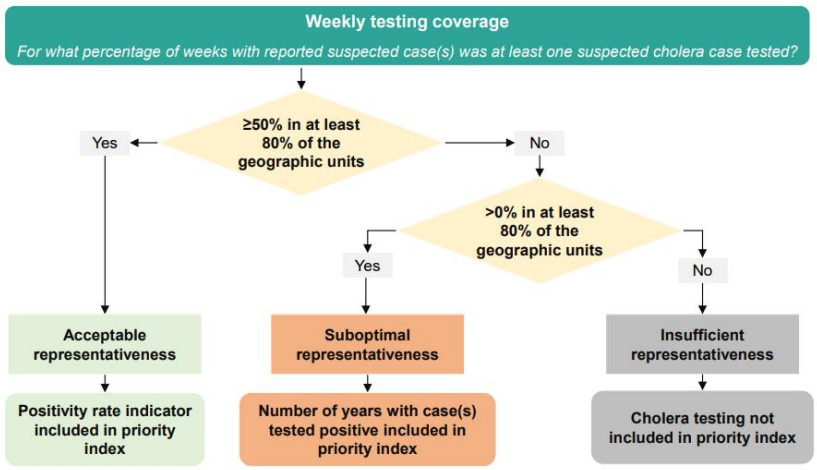
distribution thresholds (median and 80th percentile) were calculated out of geographic units where at least one cholera case was reported over the analysis period (Table 2).

Table 2 Score values by epidemiological indicators, GTFCC PAMIs for cholera control, 2023 Guidance Document [2]

Epidemiological indicator	Score			
	0 points	**1 point**	**2 points**	**3 points**
Incidence	No case	>0 and <median	≥median and <80th percentile	≥80th percentile
Persistence	No week with ≥ 10 cases	>0 and <median	≥median and <80th percentile	≥80th percentile
Mortality	No death	>0 and <median	≥median and <80th percentile	≥80th percentile

For testing, a preliminary analysis was conducted to assess the representativeness of the testing among all the geographic units. (Figure 4)

Figure 4 Assessing which cholera test-related indicator should be included in the priority index calculation, GTFCC PAMIs for cholera control, 2023 Guidance Document [2]



A suboptimal representativeness of the weekly testing coverage was concluded. Therefore, the analysis used the number of years with case(s) tested positive as the positivity testing indicator. This indicator is scored “0” if no test was positive during the analysis period, or “1” if at least one positive test was reported during one of the studied years, and “2” if positive test(s) was reported for more than 1 year.

The priority index for each unit is the sum of the scores. The maximum score obtained could be 11, considering the sub-optimal testing indicator.

2. Step 2. Stakeholder validation

a. Stakeholders' involvement

On the 5th to 7th of March 2024, an onsite workshop was held during the three-day workshop, to discuss the initial PAMI results and validate a final list of PAMIs. The workshop included 75 participants with representation from the national government, county governments, and partner institutions. Updates on the surveillance and WASH situations were presented on the first day. After these general presentations, the methodology, results, and limitations were presented and discussed during two plenary sessions. On the second day, key vulnerability factors, chosen by the working group were presented and discussed. Groups per region reviewed the list of sub-counties and their calculated priority index. Following the group comments, the assembly debated different scenarios for defining the priority index threshold, as well as additional sub-counties to consider as PAMIs.

The assembly chose a priority index threshold of six and validated a final list of PAMIs at the end of the workshop.

The agenda, the presentations, the DDSR report, and additional documents are available in Appendix 8.

b. Vulnerability factors

To support the discussion and validation of the PAMIs, vulnerability factors, selected by the PAMI working group, were presented during the workshop. Even if the vulnerability assessment is not meant to be performed in all geographic units, the vulnerability factors were prepared for the whole country at the sub-county level.

The GTFCC proposed an indicative list of vulnerability factors, but the final choice should be country-specific. After consultation with the group, we selected from the GTFCC six vulnerability factors, related to environmental, population, or WASH risks. (Table 3)

Location adjacent to cross-border cholera-affected areas: The borders with Tanzania, Uganda, South Sudan, Ethiopia, and Somalia were considered. Reports on previous PAMI identification were reviewed.[29–33] The sub-counties adjacent to cross-border PAMIs have been identified and classified as presenting this additional risk ("Yes" in the GTFCC tool). The sub-counties adjacent to PAMIs in Kenya were not included in the risk factors but were discussed during the workshop, after selecting the priority index threshold.

Areas with high population density: The density of the population was calculated using the area surface of each administrative unit and the 2023 estimated population. A cut-off at the 80th percentile was chosen to define the presence of high density for the administrative unit.

Areas with high-risk populations: The vulnerable population included fishermen, mining communities, nomad-pastoralists, and refugees. The information was collected from the PAMI group and literature review. The results were classified as present or absent. Some units had several high-risk populations; only one group was displayed on the map.

Areas at high risk for extreme climate and weather conditions: Drought and flood risks were considered. After a review of the literature and reports, information was not available at sub-county level. Information was deduced from the Disaster Risk Profile report from The World Bank.[34] Information was classified as present or absent.

Areas with more than 30% of the population using unimproved water facility type and Areas with more than 50% of the population using unimproved sanitation facility type: the data were collected from the 2019 Census. The recommended threshold of 30% of access to unimproved water or sanitation facilities, was chosen to define its presence in the administrative units.

Following the JMP standard, we merged the different categories, used during the 2019 Census.[35]

For drinking water, the unimproved facilities included unprotected wells and springs, and surface water. For sanitation, the unimproved facilities included pit latrines without slabs, hanging latrines, bucket latrines, and open defecation.

Table 3 Description of the selected vulnerability factors, Kenya, 2024

Component	Indicator name	Data provider	Data collection year
Population	High population density	KNBS	2023
Vulnerable groups	Fishermen, mining population, pastoralists- nomads Refugees	Literature review UNHCR	*2024*
Cholera risk	Cross-border areas adjacent to frequently cholera-affected areas	Literature review	*Different according to the country*
Climate	Extreme climate and weather conditions	World Bank	*2019*
WASH	People using unimproved sanitation services (% of the population)	KNBS	*2019 Census*
WASH	People using unimproved drinking water services (% of the population)	KNBS	*2019 Census*

Abbreviations: KNBS: Kenya National Bureau of Statistics, WASH: Water, Sanitation and Hygiene, UNHCR: United Nations High Commissioner for Refugees, NA: not applicable

Some vulnerability factors are proposed in the GTFCC method but have not been retained.

Population that received oral cholera vaccine in the last 3 years: The only reactive campaigns were carried out in February 2023 and August 2023, with a single-dose approach. (Appendix 1) The OCV campaigns were conducted, according to the experts, after the peak of the epidemic. We considered the bias in the calculated indicator to be minor.

Major population gatherings: the information was not available before the PAMI workshop, and the information gathered during the workshop was not exhaustive.

Areas affected by complex humanitarian emergencies: the border with Somalia, especially in the northeast of Kenya, are subject to insecurity. The insecurity in these areas was discussed during the workshop, especially the difficulties for the surveillance and the implementation of interventions.

Areas with more than 50% of the population with no handwashing facility on premises: WASH data collected as part of the 2019 census did not include hygiene or handwashing access. The information was not available at sub-county level by other sources.

III. RESULTS

1. Step 1. Priority index

From January 2018 to December 2023, the line list registered 23,947 cholera cases, of all ages. One case was excluded due to missing date and location. (Figure 3) The key parameters are presented in Table 4.

Table 4 Overview of the Key Parameters, Kenya, 2024

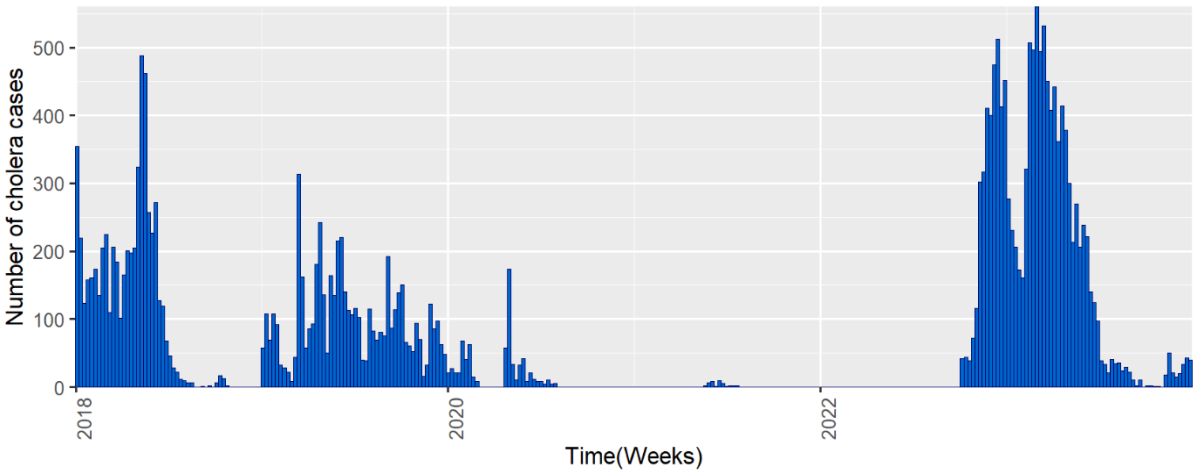
Data description	Sub-county
Number of administrative units*	304
Study period: start year	01/01/2018
Study period: end year	31/12/2023
Study period: number of years	6
Number of administrative units with at least one cholera case	153
Total number of cases	23,946
Total number of deaths	334
Total number of tested cases**	8,111
Total number of positive tests**	6,801
Total number of weeks	313

*After the merge of the new sub-counties, ** Rapid Diagnostic Test or culture Test

a. Country analysis

During the studied period, three epidemic periods were identified. The two first outbreaks happened in 2018 and 2019-2020, with no complete interruption between them. (Figure 5) In 2021, a lower-intensity outbreak happened in the middle of the year. Since the last quarter of 2022, a long epidemic has been underway and continues to this day. These last outbreaks presented two peaks with a decrease concomitantly with the OCV reactive campaigns conducted in February and August 2023. After a decrease since the third quarter of 2023, the number of cases increased again at the end of 2023 during end-of-year floodings.

Figure 5 Weekly distribution of cholera cases, all ages, registered in the reference line list, Kenya, 2018-2023

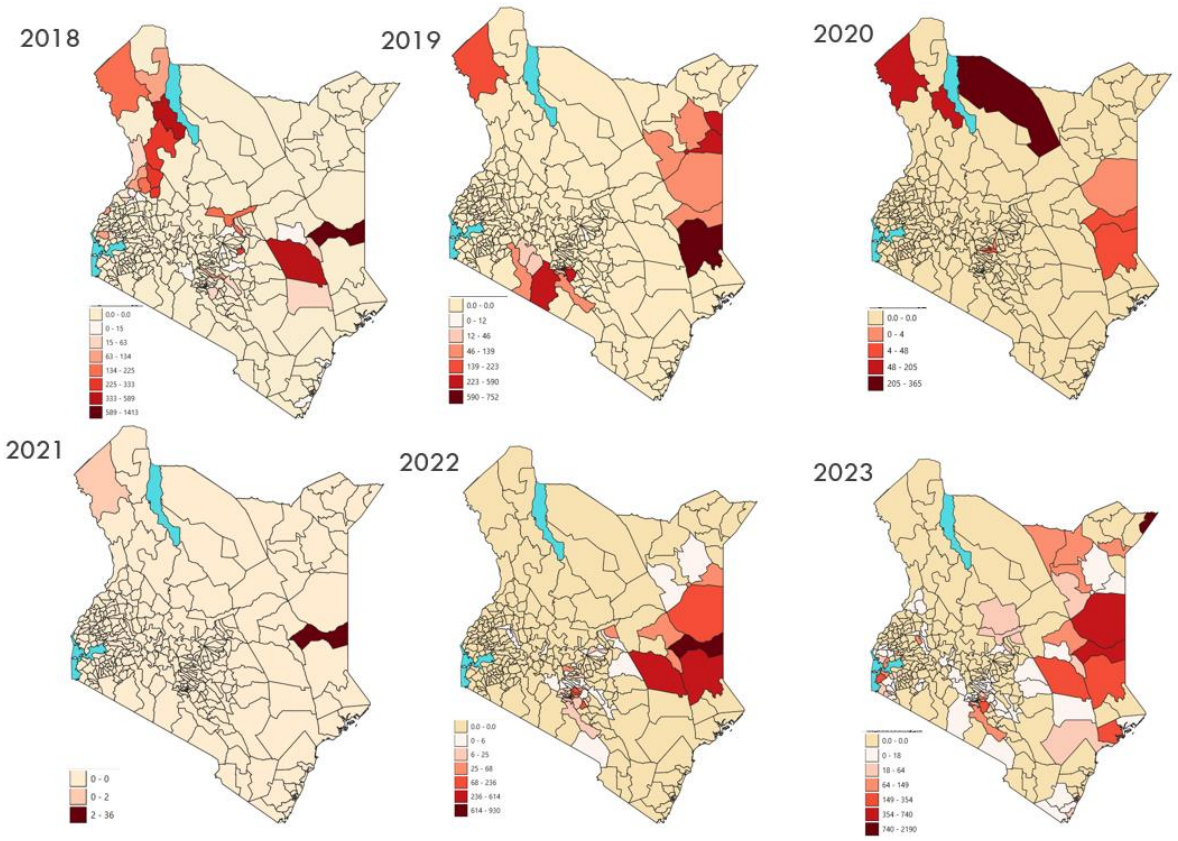


The government response to the COVID-19 pandemic may have had an impact on reporting in 2020 and 2021 (heightened hand hygiene, school closures, working remotely as far as possible in March 20201, and nationwide curfew in May 2020). The effects of these measures were considered homogeneous throughout the country. National experts estimated that, despite the measures, a cholera epidemic would have been identified if it had occurred, as the surveillance system was functioning.

Thirty-six counties and 153 sub-counties reported cases during the studied period. (Figure 6)

Figure 6 Distribution of the cholera cases per sub-county and per year, 2018-2023, Kenya.

(To note: the color gradient is specific to each year)



For the units reporting cases, the four indicators were calculated for each sub-county, and their distributions were analyzed. The medians and the 80th percentiles were at 4.04 cases and 16.20 cases for 100,000 pers.y for the incidence. For the mortality, the median was at 0.24 deaths for 100,000 pers.y and the 80th percentile at 0.47 deaths for 100,000 pers.y. For the persistence, the median was at 2.2% and the 80th percentile at 8.5%. (Table 5)

During the analysis, the weekly testing coverage was found at 71.9% of the sub-counties. Considered as sub-optimal for the cholera test positivity indicator, we retain the number of years with cases

tested positive, as cholera test positivity indicators. Seventy-five sub-counties presented tested positive for one year and 78 for at least two years.

Table 5 Threshold of the cholera PAMI indicators, Kenya, 2018-2023

Epidemiological indicator	Threshold	
Incidence (per 100,000 person-years) *	Median	**4.04**
	80th percentile	**16.20**
Persistence (% of weeks) *	Median	**2.2**
	80th percentile	**8.5**
Mortality (per 100,000 person-years) *	Median	**0.24**
	80th percentile	**0.47**

** Calculated out of geographic units with indicator value >0*

The geographic distribution of the four indicators was presented during the workshop. The maps can be found in Appendix 5 and in the workshop presentations (Appendix 8).

b. Initial priority index list

The priority index for each unit was calculated as the sum of the four indicator scores. The analysis was presented in the GTFCC PAMI tool (Appendix 6).

The distribution of the sub-counties per priority index is presented in Tables 6 and 7, and Figure 7.

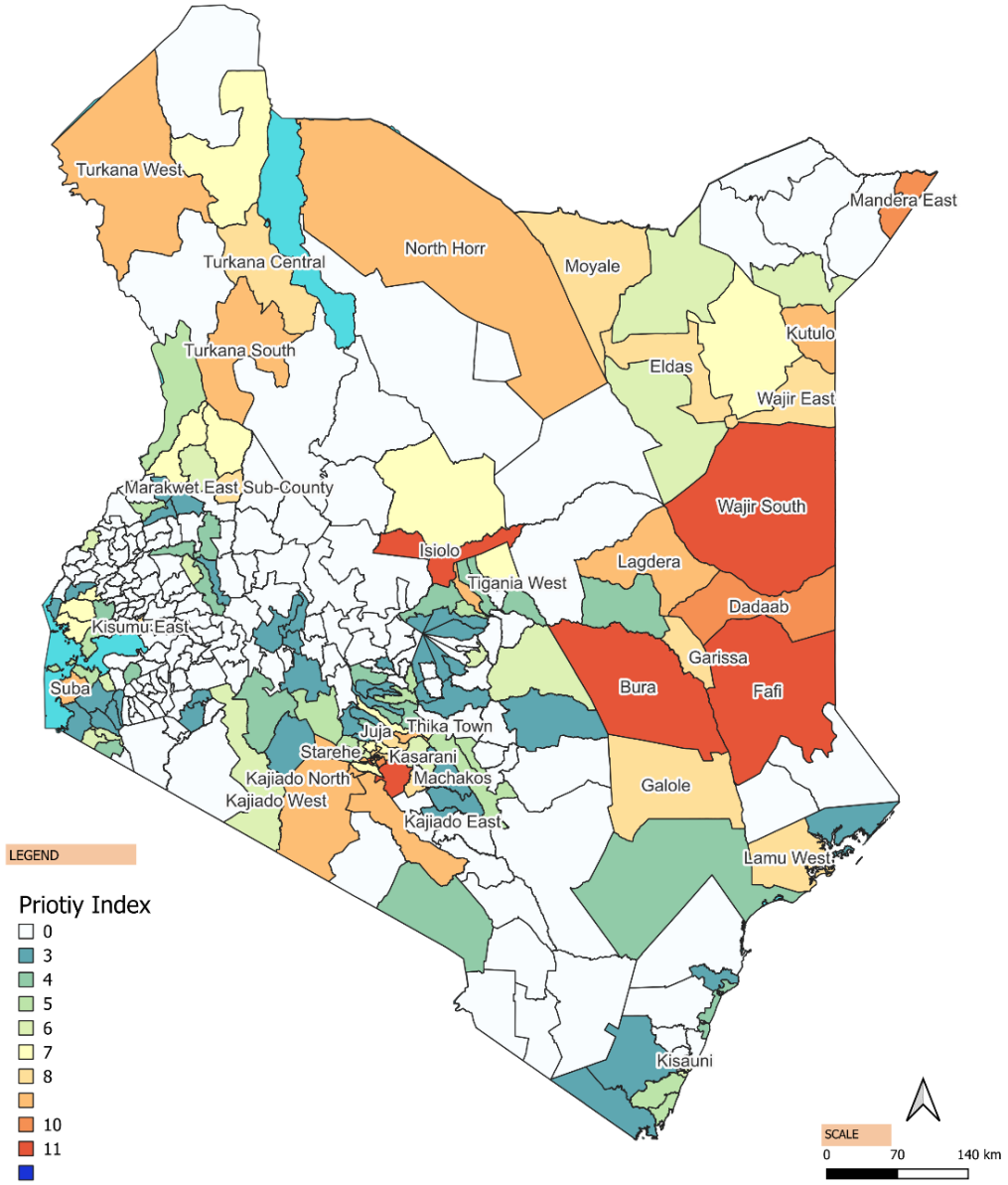
Table 6 Summary of the sub-counties and the population stratified by priority index, Kenya, 2018-2023

Priority index values	Number of geographic units	Cum. number of geographic units	Rel. % of num. of geographic units	Total population	Rel. % of population	Cum. % of population
11	7	7	**2.3%**	1,480,432	**3.0%**	3.0%
10	5	12	**1.6%**	1,540,503	**3.1%**	6.0%
9	15	27	**4.9%**	3,112,718	**6.2%**	12.2%
8	16	43	**5.3%**	3,278,023	**6.5%**	18.8%
7	17	60	**5.6%**	3,259,214	**6.5%**	25.3%
6	18	78	**5.9%**	3,017,289	**6.0%**	31.3%
5	15	93	**4.9%**	2,728,465	**5.4%**	36.7%
4	20	113	**6.6%**	3,602,240	**7.2%**	43.9%
3	40	153	**13.2%**	6,539,059	**13.0%**	56.9%
0	151	304	**49.7%**	21,600,638	**43.1%**	100.0%
Grand Total	**304**		**100.0%**	**50,158,580**	**100.0%**	

Table 7 Summary of the cases, deaths, and positivity rate, stratified by priority index, Kenya, 2018-2023

Priority index values	Num. of cases	Rel. % of num. of cases	Cum. % of num. of cases	Num. of deaths	Rel. % of num. of deaths	Cum. % of num. of deaths	Average of positivity rate	Mean of number of years
11	5,255	**21.9%**	21.9%	94	**28.1%**	28.1%	81.7	3.4
10	6,779	**28.3%**	50.3%	47	**14.1%**	42.2%	84.5	3.6
9	4,426	**18.5%**	68.7%	87	**26.0%**	68.3%	78.2	2.3
8	3,388	**14.1%**	82.9%	46	**13.8%**	82.0%	74.9	2.3
7	1,688	**7.0%**	89.9%	19	**5.7%**	87.7%	69.2	2.2
6	1,427	**6.0%**	95.9%	26	**7.8%**	95.5%	53.5	1.7
5	482	**2.0%**	97.9%	8	**2.4%**	97.9%	81.0	1.9
4	318	**1.3%**	99.2%	7	**2.1%**	100.0%	60.1	1.6
3	183	**0.8%**	100.0%	0	**0.0%**	100.0%	57.7	1.0
0	0	**0.0%**	100.0%	0	**0.0%**	100.0%	0.0	NA
Grand Total	**23,946**	**100.0%**		**334**	**100.0%**		**33.6**	**1.8**

Figure 7 Map of the administrative units by priority index, Kenya, 2018-2023, Cholera line list.



2. Step 2. Stakeholder validation

During the stakeholder workshop, the initial list of PAMIs was discussed using the national and county maps and the Excel tool summarizing all the priority indexes and the vulnerability factors (Appendix 6). Limitations, related to the methodology and available data, were also discussed.

a. Additional information sources and vulnerability factors

i. Vulnerability factors

Six vulnerability factors were selected. Maps of the selected indicators are presented in Appendix 7. They were reported in the Excel file as present. (Table 8)

Table 8 Number and percentage of the selected vulnerability factor indicators above the selected threshold, among the 304 administrative level 2 units, Kenya, 2024

Component	Indicator name	*Units with risk present (N: 304)* N (%)
Population	High population density	61 (20.1)
Vulnerable groups	Fishermen, mining population, pastoralist-nomads Refugees	63 (20.7)
Cholera risk	Cross-border areas adjacent to frequently cholera-affected areas	25 (8.2)
Climate	Extreme climate and weather conditions	21 (6.9)
WASH	People using unimproved sanitation services (% of the population)	69 (22.7)
WASH	People using unimproved drinking water services (% of the population)	162 (53.3)

Abbreviations: WASH: Water, Sanitation and Hygiene

b. Stakeholder workshop (Step 2)

The meeting minutes, with the list of participants, and the presentations are in Appendix 8.

The priority index of the 304 sub-counties was presented and discussed during plenary and group sessions.

i. Priority index threshold

Following the feedback of the different groups, different scenarios were presented with a priority index threshold at 8, 7, and 6. The priority-index 6 threshold was finally selected. Therefore 78 sub-counties (25.7%) were identified as PAMIs, including 31.3% of the national population, 95.9% of the cases, and 95.5 % of the deaths related to cholera.

ii. Specific areas

The different groups identified 29 (9.5%) additional sub-counties as PAMIs, based on different reasons.

The main reason to upgrade these sub-counties as PAMIs were:

- The recent change in the administrative boundaries, impacting the cholera case reporting in the sub-counties.
- Under-reporting of cholera cases in units where insecurity prevails (surveillance difficulties, access to health facilities).

- Sub-counties neighbouring PAMIs
- Movement of population leading population to seek care in other sub-counties.
- Cyclical nature of the epidemic in the country: past outbreaks or very recent sub-county cholera cases not captured by the study period.
- Increase of climate-related events in the past years (heavy rains, floods, droughts).
- Transport corridors.

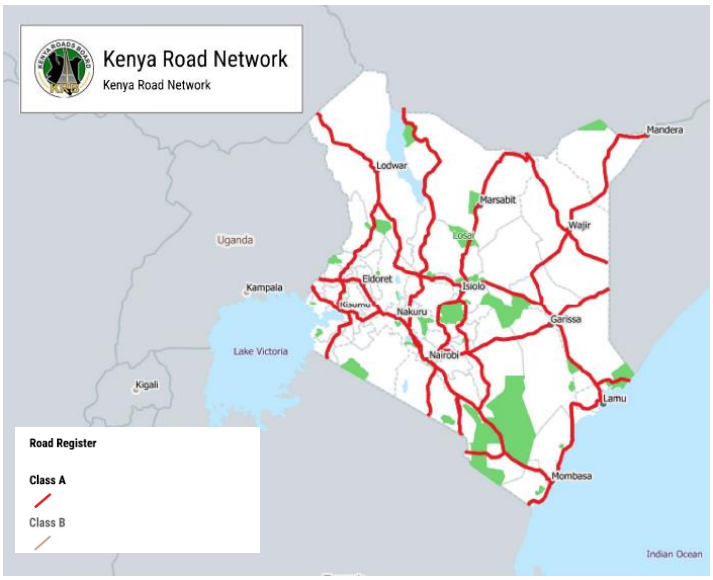
The explanations for each additional PAMI are presented in the GTFCC tool, in the additional sheet called “Final List _Comments”.
The priority index of the additional sub-counties was:

- 5 for 5 sub-counties
- 4 for 6 sub-counties
- 3 for 6 sub-counties
- 0 for 12 sub-counties.

The workshop assembly considered the priority index of these additional PAMIs was underestimated due to the reasons mentioned above (administrative boundaries change, insecurity…). The assembly also questioned the choice of the vulnerability factors. Data relating to certain selected vulnerability factors were considered obsolete, for example, hotspots in neighboring countries or acute emergencies, given climate change and recent events, or incomplete Finally, proximity to PAMIs, based on the priority index, was only assessed during the workshop, after the decision on the priority index threshold had been taken.

Location along major travel routes with transportation hubs, proposed as a vulnerability factor by the GTFCC, was not retained by the working group, but the assembly stressed its importance, for the cholera epidemiology and future interventions. (Figure 8)

Figure 8 Road network, Kenya, 2024



Source: Kenya Road Board[36]

c. Final list of PAMIs

A consensus about a final list was reached. One hundred and seven sub-counties were selected as PAMIs. They represented 35.2% of the units and covered a population of 40.0% (Tables 9 & 10).

Table 9 Number of units and population, stratified by PAMI decision (Priority index and workshop discussions), Kenya, 2024

PAMI Decision	Nber of Units	Rel. % of units	Cumulative % of units	Population*	Rel. % of population	Cumulative % of population
PAMI_PI	78	25.7	25.7	15,688,178	31.3	31.3
Additional PAMI	29	9.5	35.2	4,294,545	8.6	39.8
No PAMI	197	64.8	100.0	30,175,858	60.2	100.0
Grand Total	**304**	**100.0**		**50,158,580**	**100.0**	

Abbreviations: PI: priority index
**Use of the mean of the populations per sub-county, from the GTFCC Tool*

Table 10 Number of cases and deaths, stratified by PAMI decision (Priority index and workshop discussions), Kenya, 2024

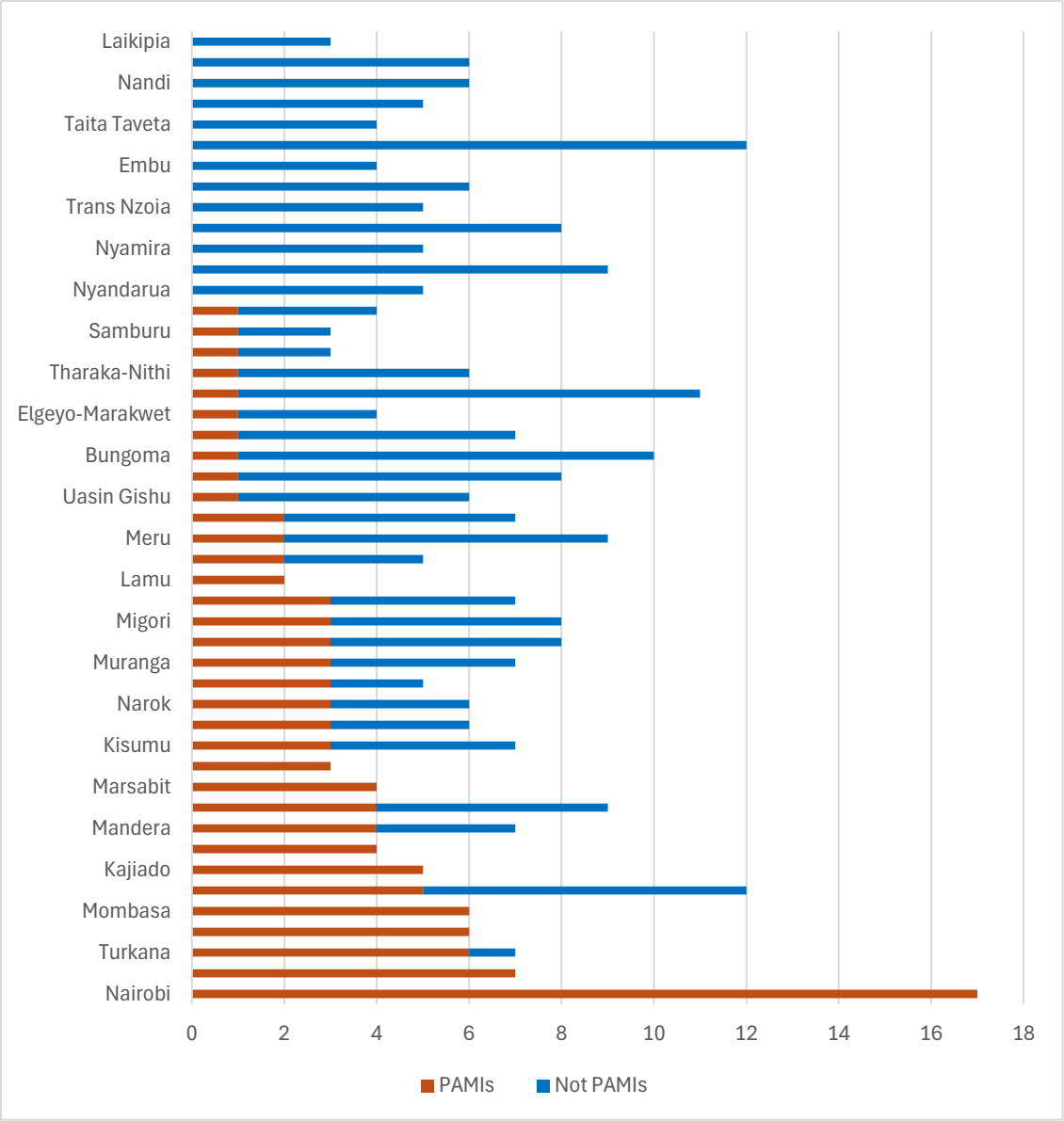
PAMI Decision	Nber of Cases	Rel. % of cases	Cumulative % of cases	Nber of Deaths	Rel. % of deaths	Cumulative % of deaths
PAMI_PI	22963	95.9	95.9	319	95.5	95.5
Additional PAMI	338	1.4	97.3	3	0.9	96.4
No PAMI	645	2.7	100.0	12	3.6	100.0
Grand Total	**23946**	**100.0**		**334**	**100.0**	

Abbreviations: PI: priority index

The number of PAMIs and the concerned population were discussed during and after the workshop. All the PAMIs were considered important to inform the NCP and to reach the objectives, decided by the Kenyan government and its partners.

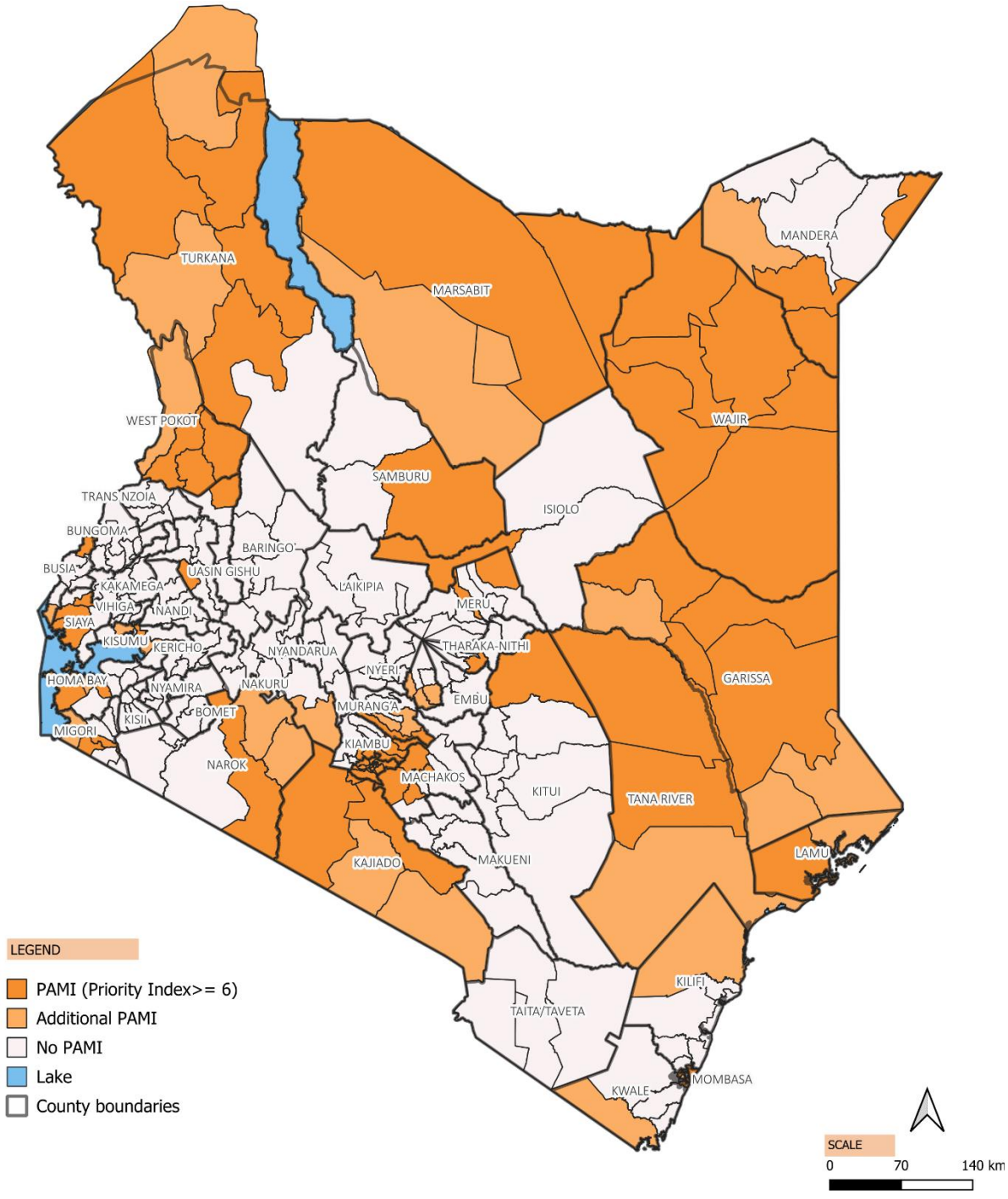
For nine counties, all the sub-counties were considered as PAMIs. (Figure 10) Five counties had half or more of their sub-counties considered as PAMIs and 20 had less but included at least 1 PAMI. Thirteen counties did not have any area classified as PAMI.

Figure 9 Distribution of the sub-counties by PAMI decision, stratified by county, Kenya 2024



The geographic distribution of the sub-counties selected as PAMIs was presented. (Figure 11)

Figure 10 Map of the final list of PAMIs, Kenya, 2024



3. Limitations

Limitations, related to the methodology and available data, were presented, and discussed, before and during the stakeholder workshop.

The case definitions in the 2023 cholera management guidelines match the WHO ones. Nevertheless, the errors and misdiagnoses may have happened as not all suspected or probable cholera cases were tested, following the international recommendations during cholera outbreaks. The incidence, mortality, and persistence may be over-estimated, due to the inclusion of non-cholera cases in the line list.

In addition, no verification was performed to assess if tests were performed for the first cases of an outbreak period and then at least for three probable cases every week during the outbreak time. Laboratory confirmation by culture is limited in the country. Access to RDT may be also a challenge for remote areas or during long outbreaks. For the analysis, we used the sub-optimal indicator for testing positivity due to lack of representativeness, using the GTFCC threshold. The testing indicator may be underestimated in the areas with low access to RDTs or to laboratories able to perform the culture tests. The transport of samples was discussed during the workshop and was a challenge in a lot of areas.

The line list included the cases reported at the health facility. Community cases or patients with mild symptoms may not have been reported; incidence may be underestimated. Mortality may be also impacted, as severe cases may not have the time to reach the specialized facility. In addition, the line list is filled by public health facilities. Military hospitals or private facilities were not systematically reporting cases in the national system. Due to non-operability between systems, it was not also possible to verify with other sources if cholera cases may have been registered in other monitoring systems (laboratory system or KHIS system). Nevertheless, the line list was the database that appeared the most complete. Inclusion in the surveillance system of community surveillance has been discussed during the inception meeting and was already planned.

The catchment area of the health facility may differ according to the location and their level and specialization (e.g. cholera treatment centre). These may also be related to the number of actors in the area, sensitized to cholera response for example in the refugee camps and surrounding areas, or urban areas versus rural or remote areas.

We retrospectively analysed routine programmatic data, which is prone to suboptimal quality and completeness. Reporting was unequal between the studied years. The format of the line list was changing over the different years. We noted an improvement in data quality and completeness over

the years which will support future analyses. An important work to standardize the line list based on the WHO line list template was done.

Patients with missing information on location and date were reviewed with the national experts. This inference of location and date may have overestimated some sub-counties that were affected by a large outbreak and may have underestimated the persistence, as missing dates were inferred from weeks already known with cases.

An algorithm to identify a test performed or positive was applied, requiring valid test results or at least two complementary pieces of information (date of test, type of test, test done, result of test, confirmation variable). Logical judgment was used to make this uncertainty less impactful. This potentially overestimated the number of tests performed but did not directly impact the positivity indicator as only the number of years with positive tests was used. So missing results or uncertainty concerning the tests done has not impacted the final indicator score.

The government measures during the COVID-19 pandemic in 2020 and 2021 have also affected the reporting, even if considered as homogenous in the whole country.

IV. WAY FORWARD

The PAMI mapping report will inform the next decisions following the NCP.

The NCP presented the global strategic approach:

- Development of a multiyear plan for OCV preventive campaigns for the sub-counties identified as PAMIs; the GAVI submission is planned in April 2024,
- WASH intervention to be prioritized in the PAMIs,
- Prioritisation of hard-to-reach areas with limited health and WASH facilities for community awareness and practice of hygiene
- Improvement of national surveillance
    - Validation of the new Cholera guideline and dissemination with training of the different level health professionals
    - Enhance regional laboratory capacities,
    - Implementation of the standardized line list during a cholera outbreak,
- A health awareness campaign in the community, schools, media, and social media before the peak season with a focus on priority areas

Some activities have already been launched.

The analysis and mapping of the cholera PAMIs will be reviewed regularly. GTFCC recommends updating the PAMIs list every three to five years, in line with work to update the NCP.

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APPENDICES

Appendix 1: Previous Oral Cholera Vaccination Campaigns

The cholera vaccination campaigns were not considered as vulnerability factors. Kenya conducted the first OCV reactive campaigns in February and August 2023. Due to the OCV shortage worldwide, only one dose was administered.

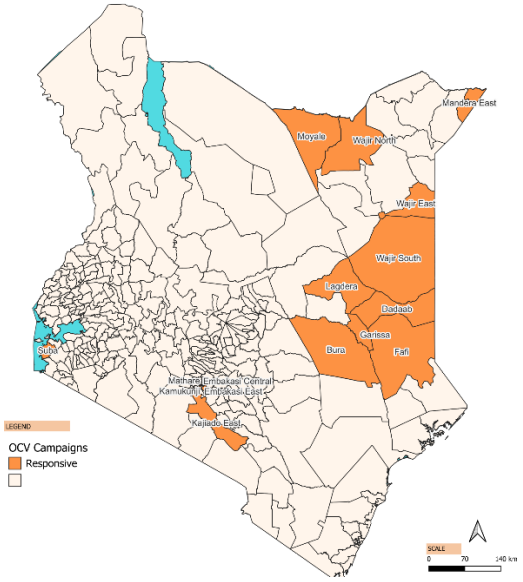
Date	Location: county †	Reason for vaccination campaign	Target Categories	Target population	Number of doses administered
Feb-23	Garissa, Nairobi, Wajir, Tana River	Response	population above 1y.o	2,050,484	1 dose
Aug- 23	Garissa‡, Homa Bay, Kajiado, Machakos§, Marsabit, Nairobi, Wajir, Mandera	Response	population above 1y.o		1 dose

† Only selected sub-counties were concerned by the OCV campaigns. The full list available in the following documents

‡ New arrivals since the Feb 2023 campaign

§ Special populations within institutions in Machakos Town sub-county

Figure 1: Map of the OCV vaccination campaigns, February and August 2023, Kenya, Source: DDSR



Additional information can be found in the following reports:

February OCV Campaign:

Feb 2023 OCV campaign report.pdf

OCV Coverage Survey Report July 20

August OCV Campaign:

REACTIVE ORAL CHOLERA VACCINE C

The August post-vaccination coverage survey report is still under validation.

Appendix 2: Inception Meeting

Contact list of the different meetings

Attendance list-inception meeting.

Minutes of the inception meeting

Notes of the inception meeting_14(

Presentations

PAMI and OCV proposal_Kenya_Marc

Cholera hotspot and NCP_Kenya_March 20

Appendix 3: National health care system and cholera reporting flow

For the health system, there are two distinct levels of government, but interdependent, which ensure consultation and cooperation to implement health care:

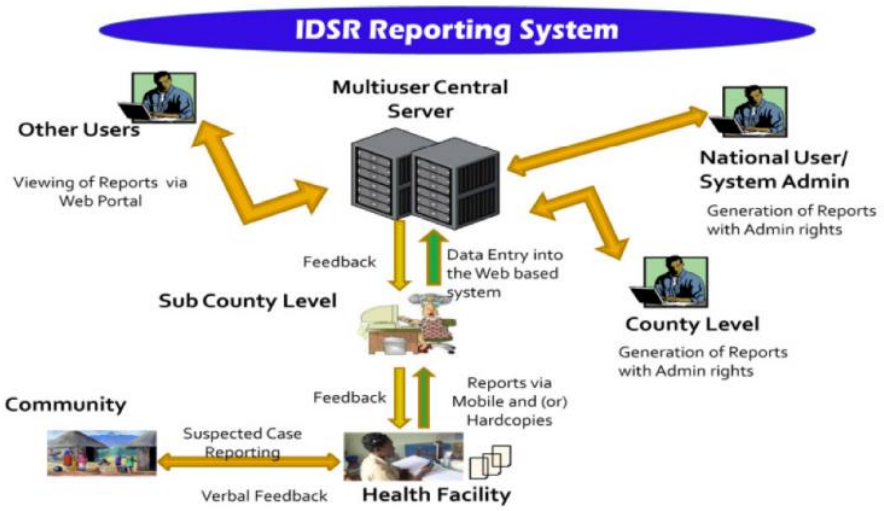
- National Government: leadership in policy & regulations, capacity building, vaccine procurement, resource mobilization, and technical assistance to counties among other functions.
- 47 County Governments: delivery of health services in counties, including immunization services.

In addition, health care is provided by non-governmental organizations, faith-based organizations, and the private sector.

Figure 1: Schema of the national health care system, Kenya, 2024

National hospitals (Tier 4)	Provide specialised care, intensive care and life support by medical doctors and specialists
County Referral hospitals (Tier 3)	Provide specialised care, intensive care and life support by medical doctors and specialists
Sub-County hospitals (Tier 3)	Provide comprehensive medical and surgical services by medical super-intendents
Health centres (Tier 2)	Provide comprehensive primary health care by clinical officers
Dispensaries (Tier 2)	Provide outpatient services for simple ailments by nurses
Community Health Units (Tier 1)	Provide child medical care, vaccinations, first aid care by trained volunteers

Figure 2: Schema of the reporting flow in the national health care system, Kenya, 2024



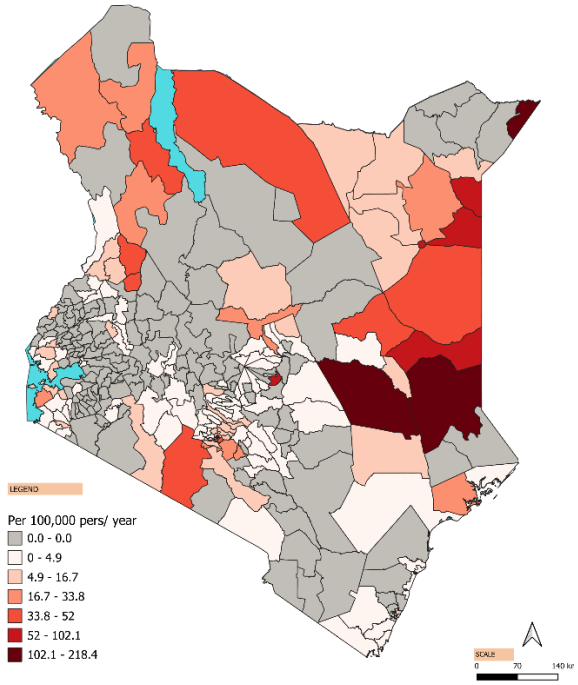
Appendix 4: Decisions about the merge of administrative units

The following sub-counties were merged (population data and cases) to correspond to the geographic units of the KHIS shapefile and to ensure 6-year population data.

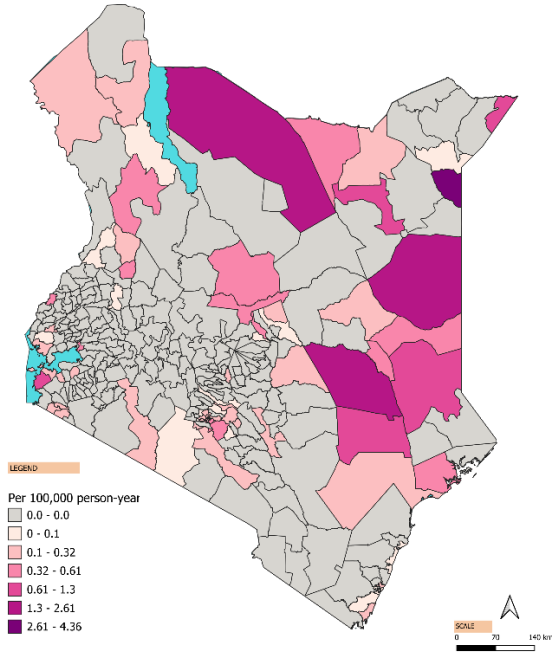
Concerned sub-counties	Final name of the sub-county
Buuri West & East	Buuri
Dadaab host & camps	Dadaab
Gatanga & Ithanga	Gatanga
Kacheliba & Pokot North	Pokot North
Kiharu & Kahuro	Kiharu
Kinango & Samburo	Kinango
Loima & Lokiriama	Loima
Lamu West & Central	Lamu West
Mbeere South & Mwea	Mbeere South
Mbita & Suba central	Mbita
Pokot South & Kiplomo	Pokot South
Tigania East & Central	Tigania East
Turkana West & Lokichoggio	Turkana West
Turkana South & Aroo	Turkana South
Turkana East & Suguta	Turkana East

Appendix 5: Epidemiological Indicators

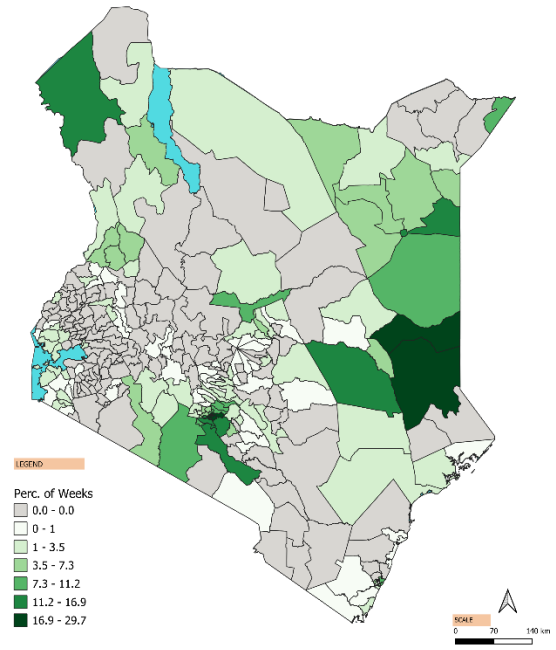
Incidence



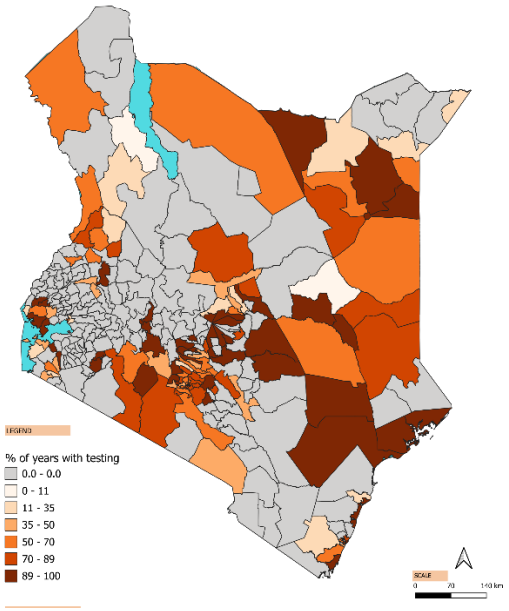
Mortality



Persistence



Testing



Appendix 6: GTFCC tools and summary of the additional PAMIs

20240317-gtfcc-pami
-cholera-control-Keny

Appendix 7: Vulnerability Factors Maps

Figures 1 & 2: Density of Population per km2 and presence of the vulnerability factors

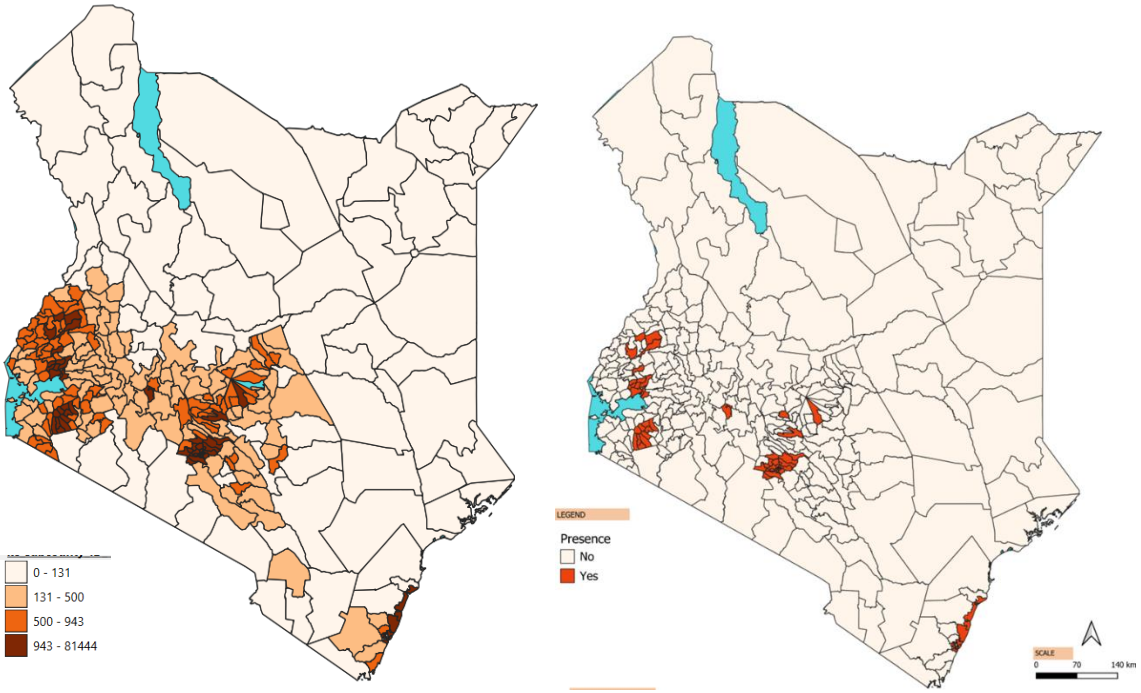
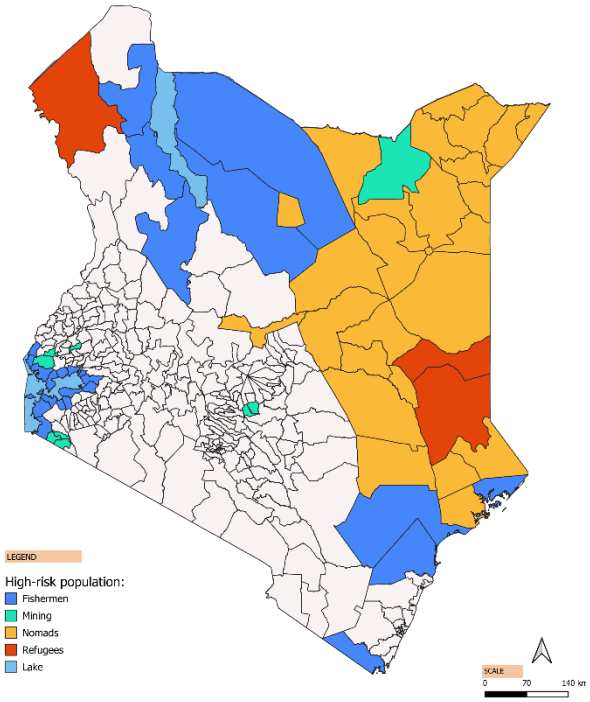
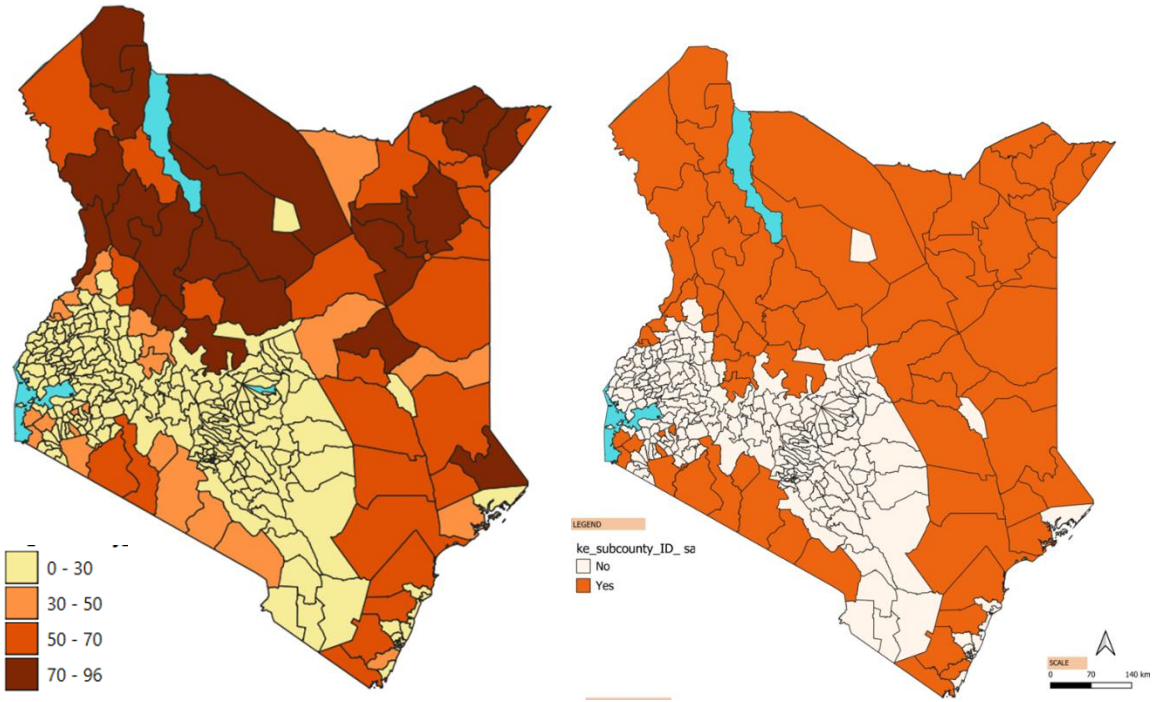


Figure 3: Presence of high-risk groups



Figures 4 & 5: Percentage of access to unimproved sanitation and presence as vulnerability factors (> 30%), Kenya, 2019 KBS Census



Figures 6& 7 Percentage of population with access to unimproved water and presence of vulnerability factors, factors (≥ 30%), Kenya, 2019 KBS Census

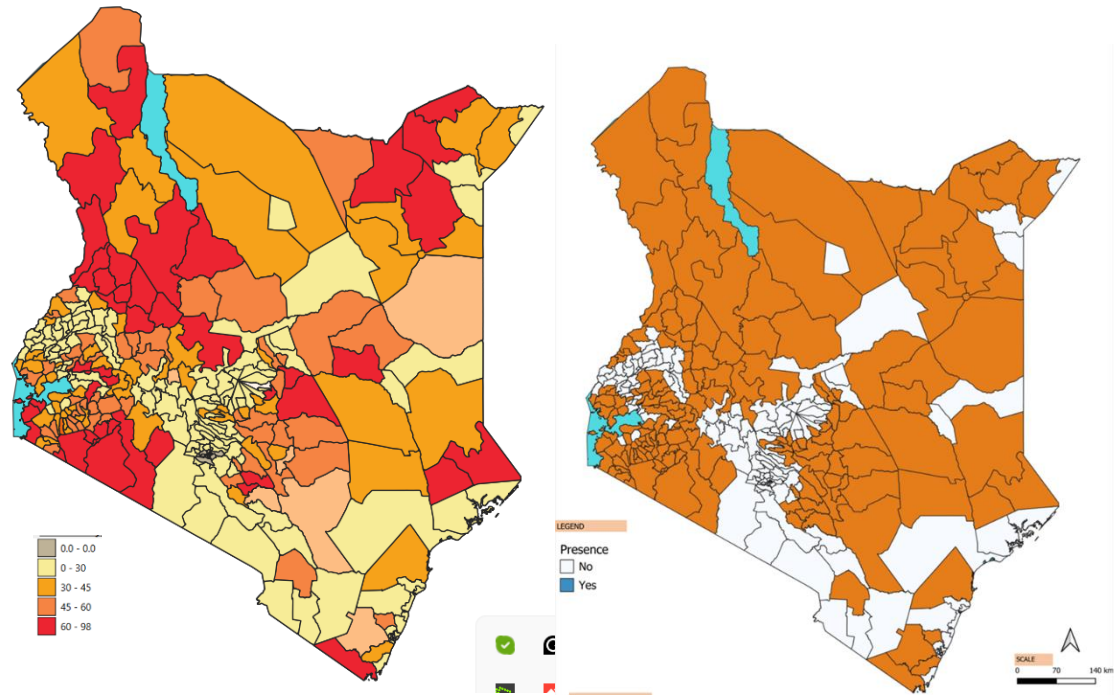


Figure 8: Sub-counties bordering hotspots in neighboring countries, Kenya, 2024

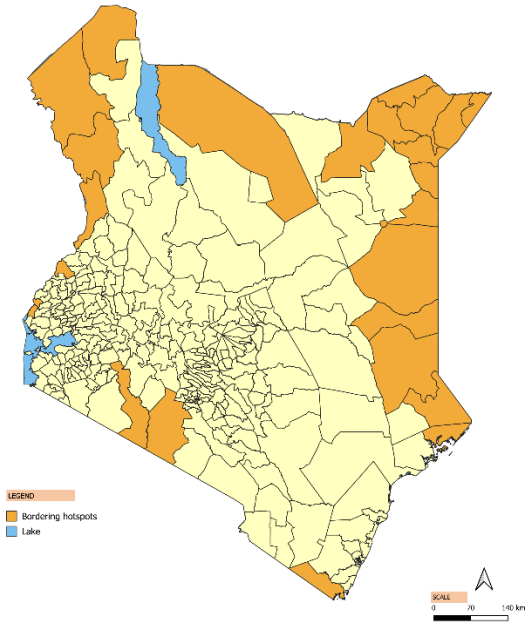
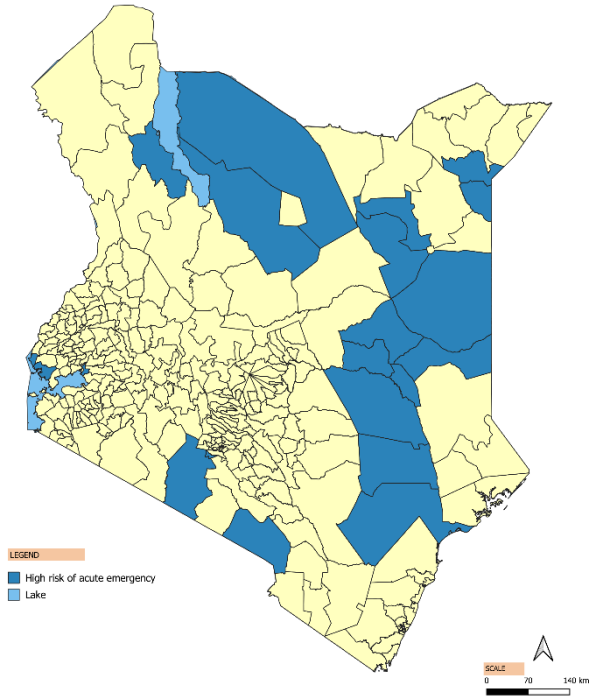


Figure 9: Climate extreme, Kenya, World Bank, 2019



Appendix 8: Workshop Materials

List of participants

ATTENDANCE_PAMI VALIDATION WORKSH

Meeting report

A REPORT_PAMI VALIDATION WORKSH

All the workshop materials are available:

PAMI_Validation_Workshop_ March 2024