GLOBAL TASK FORCE ON CHOLERA CONTROL

Identification of Priority Areas for Multisectoral Interventions (PAMIs) for cholera elimination

Guidance Document

2023

EXECUTIVE SUMMARY

Countries with limited to no cholera outbreaks in recent years because of successful multisectoral interventions for cholera control are progressing towards the cholera elimination goal. However, these countries remain at risk for cholera reemergence if vulnerability factors for cholera outbreaks persist. To eliminate cholera as a threat to public health in a sustainable manner, those countries should maintain their efforts to prevent cholera outbreak reemergence by reducing and mitigating cholera vulnerabilities. In accordance with the Global Roadmap to End Cholera by 2030, it is therefore recommended that countries aiming to eliminate cholera as a threat to public health develop a **National Cholera Plan (NCP) for cholera elimination.**

This guidance document describes the method recommended by the Global Taskforce on Cholera Control (GTFCC) to **identify priority areas for multisectoral interventions (PAMIs) for the sustainable elimination of cholera as a threat to public health**. As an indicative guiding principle, this might correspond to countries where cholera outbreaks were reported in less than five percent of the NCP operational geographic units of the country over at least the past five years.

The adequate identification of PAMIs is critical to maximize the potential impact of NCP implementation in mitigating the vulnerabilities to cholera reemergence. This guidance document recommends a three-step process for the identification of PAMIs for cholera elimination:

- The **first step is a preparatory phase** to collect supporting information. This requires documenting the cholera situation in recent years and identifying relevant cholera vulnerability factors according to the country-specific context;
- The **second step aims to score each vulnerability factor and calculate a cholera vulnerability index** for each NCP operational geographic unit;
- The **third step is for country stakeholders to validate a final list of PAMIs**. A vulnerability index threshold value is determined, above which all NCP operational geographic units are considered PAMIs.

The final list of PAMIs shall consist of NCP operational geographic units:

- where cholera outbreaks were reported in recent years,
- as well as those that have a vulnerability index value above the country-specific vulnerability index threshold.

This guidance document is accompanied by GTFCC Excel-based tool which automatizes the calculation of the cholera vulnerability index based on the scores of country-specific vulnerability factors.

As a general principle, PAMI analysis should be updated when a new version of an NCP is developed (typically every five years). Earlier updates may be considered if there are significant changes in cholera epidemiology or vulnerability factors.

DEFINITIONS

Cholera outbreak: At least one confirmed cholera case locally acquired in an NCP operational geographic unit.

Confirmed cholera case: Any person infected with Vibrio cholerae O1 or O139 identified by presumptive identification (culture/seroagglutination) or PCR.

Elimination: Elimination of a disease as a threat to public health, defined in the Global Roadmap to End cholera by 2030, as: "*any country that reports no confirmed cases with evidence of local transmission for at least three consecutive years and has a well-functioning epidemiologic and laboratory surveillance system able to detect and confirm cases*".

National cholera plan (NCP): Country-specific document that states a country's goal regarding cholera control or elimination and details operational aspects of multi-year and multisectoral cholera intervention planning.

(Country-specific) NCP operational geographic unit: Geographic unit that corresponds to the lowest administrative level where resources are allocated, and decisions for cholera interventions are made. The corresponding administrative level is country-specific.

Priority areas for multisectoral interventions (PAMIs): Subset of NCP operational geographic units that may be targeted for at least one intervention over the implementation period of an NCP.

(Cholera) vulnerability index: Numeric index calculated for each NCP operational geographic unit of a country, based on the scoring of country-specific cholera vulnerability factors. It is used to rank and triage all NCP operational geographic units according to their priority level for planning cholera interventions. The vulnerability index is calculated by summing the score of vulnerability factors.

(Country-specific) vulnerability index threshold: Vulnerability index value above which NCP operational geographic units are classified as priority areas for multisectoral interventions (PAMIs) for cholera elimination. The appropriate vulnerability index threshold shall be determined by each country based on stakeholder consensus including by considering the resources available for the implementation of the NCP.

(Cholera) vulnerability: Predisposition due the combination of cholera vulnerability factors to be adversely affected by the occurrence and spread of a cholera outbreak.

ABBREVIATIONS AND ACRONYMS

GTFCC	Global Taskforce on Cholera Control
IDP	Internally Displaced Person
JMP	WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene
NCP	National Cholera Plan for control or elimination
OCV	Oral Cholera Vaccine
PAMIs	Priority Areas for Multisectoral Interventions
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation and Hygiene
WHO	World Health Organization

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Epidemiology Working Group of the GTFCC

Members of the GTFCC Epidemiology Working Group

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INTRODUCTION

The Global Roadmap to End Cholera by 2030 calls for a multisectoral approach for cholera control or elimination targeting priority areas for multisectoral interventions (PAMIs, formerly referred to as "hotspots"). Identifying PAMIs is therefore a key early step for the development of a National Cholera Plan (NCP).

This guidance document is intended for countries which aim to **develop an NCP for the elimination of cholera as a threat to public health**. As an indicative guiding principle, this might correspond to countries where confirmed cholera outbreaks were reported in less than five percent of NCP operational geographic units of the country cumulatively over a period corresponding to at least the past five years.

Of note, countries that are ready to transition from a cholera control objective to a cholera elimination objective are expected to have developed capacities to detect, confirm, and report cholera outbreaks as a result of the implementation of an NCP for cholera control.

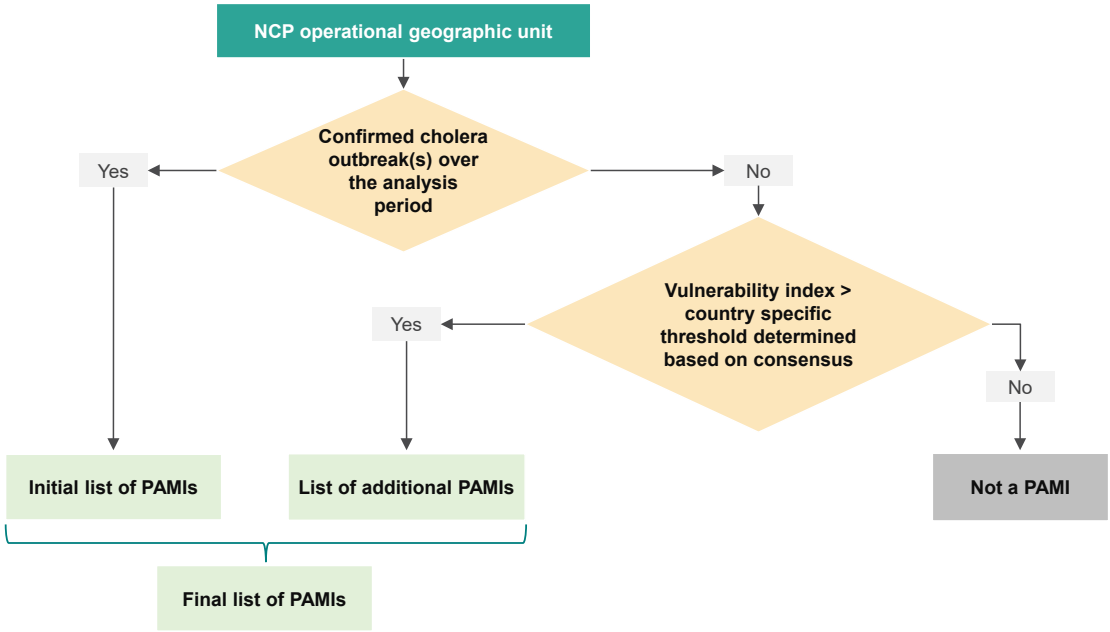
This guidance document describes the method recommended by the Global Taskforce on Cholera Control (GTFCC) for the identification of PAMIs for cholera elimination which is based on the occurrence of confirmed cholera outbreaks in recent years and on a cholera vulnerability index derived from the assessment of cholera vulnerability factors (Figure 1).

This guidance document is accompanied by:

- an GTFCC Excel-based tool which supports the calculation of the cholera vulnerability index based on the vulnerability factors scores;
- a data template which shows how to structure the data for use in the Excel-based tool;
- a training dataset which aims to illustrate the use of the Excel-based tool.

Countries with high to moderate cholera transmission in roughly the last five years and aiming to develop an NCP for cholera control are invited to use the GTFCC-recommended method to identify PAMIs for cholera control.

Figure 1. Overview of decision process to select PAMIs for cholera elimination



GENERAL PRINCIPLES

1. How does PAMI identification contribute to cholera elimination planning?

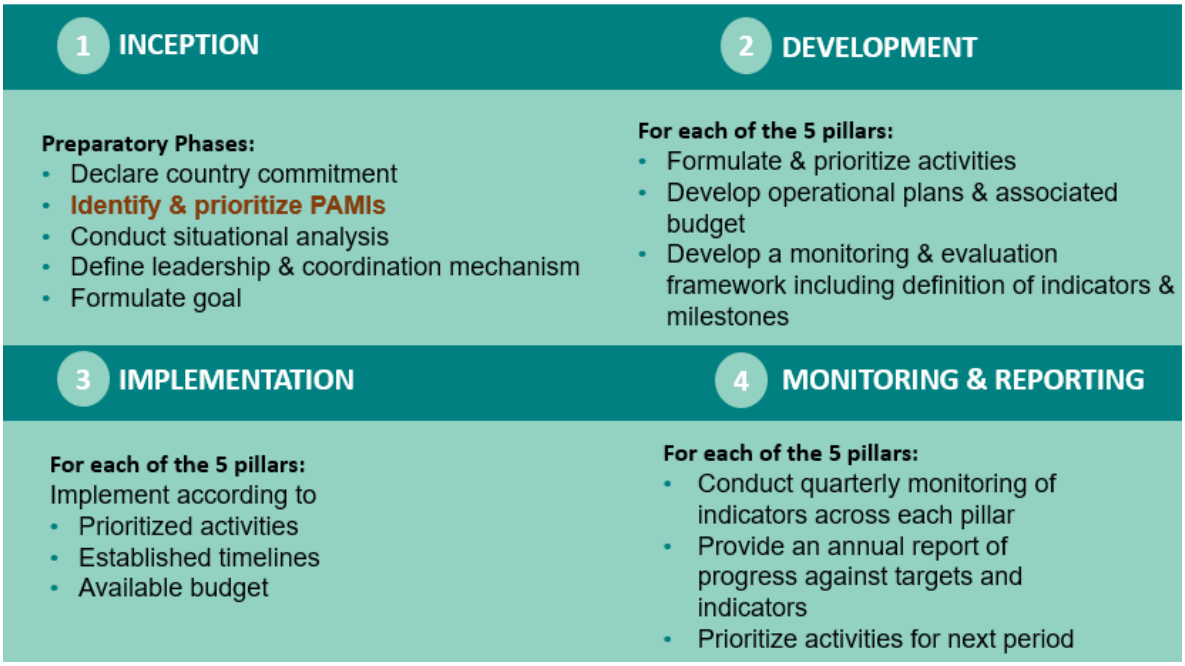
An NCP is a context-specific document that states a country's goal regarding cholera control or elimination and details operational aspects of multi-year, multisectoral cholera intervention planning in PAMIs. Detailed GTFCC guidance for the development of an NCP is available here.

The PAMI identification is part of the initial phase of the NCP development process, which consists of four phases:

1) inception
2) development
3) implementation
4) monitoring and reporting

The identification of PAMIs shall be undertaken during the NCP inception phase (Figure 2).

Figure 2. Summary of the four phases in the development of a National Cholera Plan



The identification of PAMIs is an essential step used to triage the NCP operational geographic units with higher cholera vulnerability, which should be considered in priority for interventions planning in the NCP development phase.

Evidence-based PAMI identification contributes to increase effectiveness of NCPs by optimizing allocation of resources in operational geographic units with higher cholera vulnerability assessed through cholera vulnerability factors.

2. General process

The identification of PAMIs is a three-step process:

- **Step 1:** collection and preparation of epidemiological data and data on selected vulnerability factors (and corresponding measurable indicators) in all NCP operational geographic units
- **Step 2:** scoring of NCP operational geographic units for each vulnerability indicator/measurable indicator and calculation of the vulnerability index
- **Step 3:** validation by stakeholders across multiple sectors of the final list of PAMIs taking into consideration the occurrence of confirmed cholera outbreaks and the vulnerability index values.

3. Periodic updates

As a general principle, PAMI analysis should be updated when a new version of an NCP is developed (typically every **five years**). Earlier updates may be considered if there are significant changes in cholera epidemiology or vulnerability factors.

STEP 1: COLLECT AND PREPARE SUPPORTING INFORMATION

1. Overview

Activities undertaken for the data collection and preparation at the first step of the PAMIs identification for cholera elimination are outlined in Figure 3.

Figure 3. Overview of step 1 (collection and preparation of supporting information)

1. Define scope of analysis	• Define the analysis period • Define the administrative level of NCP operational geographic units
2. Compile population and epidemiological data	• Collect population data corresponding to the last year of the analysis period • Collect surveillance data by NCP operational geographic unit and over the analysis period regarding: - the occurrence of confirmed cholera outbreak(s) - the number of confirmed cholera cases imported from other countries or from other NCP operational geographic units in the country
3. Identify relevant country-specific vulnerability factors and define measurable vulnerability indicators	• Assess the relevance of the generic vulnerability factors • Identify any additional country-specific vulnerability factors • Define a measurable vulnerability indicator for each selected vulnerability factor
4. Collect and prepare data for the assessment of vulnerability indicators	• Identify the most up-to-date and comprehensive data source for each measurable vulnerability indicator • Compile data for each vulnerability indicator • Determine how to address missing data

2. Definition of analysis period and administrative level of NCP operational geographic units

○ Analysis period

The identification of PAMIs for cholera elimination should consider cholera surveillance data for **at least the past five years** (longer periods may be considered according to cholera epidemiology and history in the country). Measurable vulnerability indicators should be assessed according to the most up-to-date information available.

○ NCP operational geographic unit

The geographic units for the identification of PAMIs for cholera elimination should be the **NCP operational geographic units**. The corresponding administrative level is country-specific and corresponds to the lowest administrative level at which resources are allocated and decisions taken for cholera interventions are made. Typically, this may correspond to the administrative levels two or three.

3. Collection of population and cholera surveillance data

Table 1 describes the data that should be collected for each NCP operational geographic unit over the analysis period.

The list of geographic units can be obtained from the national cholera surveillance system or from the attribute table of the geographic information system file (e.g., shapefile) of NCP operational geographic units.

Data on the occurrence of confirmed cholera outbreak(s) (i.e., at least one confirmed cholera case locally acquired in the NCP operational geographic unit considered) and on the occurrence of confirmed cholera cases imported from other countries or from other surveillance should be compiled for each NCP operational geographic unit and year over the analysis period. If there are uncertainties to classify confirmed cholera cases as imported or locally acquired, it is recommended to follow a conservative approach and to classify the corresponding cases as locally acquired.

Population data should be gathered for each NCP operational geographic unit for the last year of the analysis period.

Table 1. Data for the calculation of the vulnerability index

Category	Data by NCP operational geographic unit	Timeframe
Administrative	List of NCP operational geographic units	Most recent
	Geographic units in geospatial vector data format for geographic information system (e.g., shapefile)	Most recent
Demography	Population	Last year of the analysis period
Surveillance	Occurrence of confirmed cholera outbreak(s) (i.e., at least one confirmed cholera case locally acquired in the NCP operational geographic unit considered)	Over the analysis period
	Number of confirmed cholera cases imported from other countries or from other NCP operational geographic units in the country	
Context-specific vulnerability factors	Presence/absence of corresponding measurable indicators	Most recent

4. Selection of vulnerability factors and definition of measurable vulnerability indicators

○ Principle

The vulnerability index aims to triage NCP operational geographic unit(s) that may be more vulnerable to cholera reemergence. This index comprises multiple cholera vulnerability factors, each of which contributes to at least one cholera outbreak phase (i.e., introduction of *V. cholerae*, onset of a cholera outbreak, spread of a cholera outbreak, see Annex Ⅰ. Vulnerability factors contribution to cholera outbreak phases).

An **indicative list of generic vulnerability factors** is as follows, NCP operational geographic units with:

- Confirmed cholera imported case(s) in the NCP operational geographic unit considered
- Cross-border areas adjacent to frequently cholera-affected areas or identified PAMIs in neighbouring country(ies)
- Location along major travel routes with transportation hubs
- Major population gatherings
- High population density locations or overcrowded settings
- High-risk populations
- Hard-to-access populations
- Population that received oral cholera vaccine (OCV) more than three years ago
- High-risk for extreme climate and weather conditions
- Complex humanitarian emergency
- Unimproved water
- Unimproved sanitation
- Limited access to hygiene

○ Selection of generic vulnerability factors from the indicative list

To support the inclusion of a given vulnerability factor from the indicative list of generic vulnerability factors, it is recommended to perform a scoping review of factors associated with cholera outbreaks in the country and to consult cholera experts and national stakeholders involved in cholera and outbreak-prone diseases prevention and control.

Should any of these factors not be considered relevant in the local context and not retained for PAMI identification, it is recommended to provide a brief rationale in the report on the identification of PAMIs for cholera elimination (Annex Ⅱ. Template report on the identification of PAMIs for cholera elimination).

○ Identification of additional vulnerability factors

Some countries may wish to include vulnerability factors that are not included in the indicative list of generic vulnerability factors. When including an additional factor to the vulnerability index, there should be a documentation in the PAMI identification report on how it is associated with any of the three cholera outbreak phases (i.e., the introduction of *V. cholerae*, the onset of a cholera outbreak, and the spread of a cholera outbreak ; see Annex Ⅰ. Vulnerability factors contribution to cholera outbreak phases).

○ Definition of measurable vulnerability indicators and identification of suitable data sources

Each vulnerability factor must be associated with a "measurable vulnerability indicator" that enables the assessment of the factor and its inclusion in the calculation of the vulnerability index. Indicative examples of vulnerability indicators for the generic vulnerability factors are provided in Table 2.

For each measurable vulnerability indicator, data source(s) available in the country should be reviewed and assessed to select the most reliable and comprehensive data source with the highest data coverage to avoid missing data and potential biases.

Depending on the data sources available in the country, consideration may also be given to:

- proxy indicators (including at upper geographic level);
- ad doc survey(s) to collect necessary data;
- expert knowledge for a qualitative assessment.

For most vulnerability factors, the corresponding measurable vulnerability indicator should be assessed as presence or absence of the vulnerability considered, however the three WASH-related indicators may be based on the percentage of population living in areas with a certain JMP access level (see more details in Table 2 and Annex Ⅲ. Examples of WASH measurable indicators based on the JMP definitions).

When assessing each vulnerability indicator, it is important to consider the interaction and potentially amplifying effect of having multiple vulnerability factors present at once.

○ Collection of data to assess vulnerability indicators

Data for the assessment of measurable vulnerability indicators should be collected for each NCP operational geographic unit.

National authorities may need to coordinate with the authorities of neighboring countries to identify NCP operational geographic units that are cross-border with frequently cholera-affected areas or to identified PAMIs in neighboring countries.

○ Management of missing information

Data on measurable vulnerability indicators should be collected for all the NCP operational geographical units to prevent bias in the calculation of the vulnerability index.

Three main situations with missing information might be encountered during the collection of data on measurable vulnerability indicators and the following options should be considered to address them:

- **Missing information for a measurable vulnerability indicator for most NCP operational geographic units.** By definition, measurable vulnerability indicators should be defined to ensure high data coverage in NCP operational geographic units. If there is substantial data missingness, the indicator should be redefined in a way that maintains an association with the vulnerability factor of interest and expands data coverage across all units.
- **Missing information for a vulnerability indicator at the NCP operational geographic unit level**. It is possible that vulnerability indicator data are only available at upper geographic level compared to the selected NCP operational unit geographical level (e.g., admin 1 level indicator value available but no disaggregated indicator value at admin 2 level). In such situations, it is acceptable to use the indicator value from the direct upper geographic level although this decreases the discrimination power of the vulnerability index across NCP units (e.g., all admin 2 geographic units will inherit the same indicator value from the admin 1 geographic unit in which they are located).
- **Incomplete (or of suboptimal quality) information for a vulnerability indicator for some NCP operational geographic units**. Different complementary options could be considered to address this, including conducting an *ad hoc* survey to collect missing information or asking subject matter experts to provide a qualitative assessment of the corresponding indicator to fill the data gap.

If information remains partially missing at step 1 even after applying the above-described techniques, this shall be addressed at **step 3 of the PAMIs identification process** by assessing qualitatively the presence/absence of the vulnerability factor(s) in the corresponding NCP operational geographic unit(s) based on participants' opinion during the stakeholder validation workshop (See more in Step 3: Stakeholder validation).

A real-world example of how to identify measurable vulnerability indicators and address missing data is presented in Annex Ⅳ. Vulnerability factors considered for the identification of PAMIs for cholera elimination in Mali.

Table 2. Indicative list of generic cholera vulnerability factors and examples of measurable indicators

#	Generic vulnerability factor	Example of measurable indicator	Comments
1 |	**Confirmed cholera imported case(s) in the NCP operational geographic unit considered**	NCP unit with at least one confirmed cholera case imported (from another country or another NCP operational geographic unit reported during the analysis period): yes/no	An imported cholera case is defined as a confirmed cholera case infected outside of the NCP operational geographic unit of interest. This indicator aims to represent the pattern of introduction of cholera imported cases from other locations.
2 |	**Cross-border areas adjacent to frequently cholera-affected areas or identified PAMIs in neighbouring country(ies)**	Cross-border NCP unit adjacent to areas frequently affected by cholera outbreaks or classified as PAMI in neighbouring country(ies): yes/no	The PAMI status of cross-border geographical units is described in the NCP of neighbouring countries (if available). The cholera situation in cross-border geographical units is described in epidemiological reports/updates of neighbouring countries. Consultation with neighbouring countries is recommended to assess this indicator.
3 |	**Location along major travel routes with transportation hubs**	NCP unit located along transportation pathway(s) with transportation hub(s): yes/no	The definition of “transportation hub” should be adapted according to the national settings (e.g., transportation infrastructure type, population density, pattern of population movements, transportation hubs across international borders …). As an example, this indicator can be specified as follows: “NCP unit with at least one city greater than 200,000 population located on three or more main transportation pathway/travel routes”.

Notes: The abbreviation NCP unit in the table corresponds to NCP operational geographic unit(s). When scoring vulnerability indicators, it is important to consider the interaction and potentially amplifying effect of having multiple vulnerability factors present at once.

…/…

#	Generic vulnerability factor	Example of measurable indicator for PAMI identification	Comments
4 |	**Major population gatherings**	NCP unit hosting major population gathering(s): yes/no	The population gatherings to be considered might include religious or pilgrimage gatherings, large-scale seasonal marketplaces/animal markets, seasonal nomadic/pastoralist population gatherings and occupational-related population movement and gatherings (e.g., seasonal agricultural worker gathering), and shall be adapted to the country context.
5 |	**High population density locations or overcrowded settings**	NCP unit with high population density locations or overcrowded settings: yes/no	The definition of high population density shall be adapted to the country context. The overcrowded settings to be considered might include major urban slums, major refugees or internal displaced persons camps, and shall be adapted to the country context.
6 |	**High-risk populations**	NCP unit with high-risk populations: yes/no	The specific at-risk populations to be considered might include seasonal workers/fishermen/miners in informal settlements, and shall be adapted to the country context.
7 |	**Hard-to-access populations**	NCP unit with hard-to-access populations: yes/no	A hard-to-access population is a population living in an area that is not regularly accessible to health and humanitarian actors for the purpose of sustained health services. Hard-to-access populations can be found under the following conditions: - natural or human-made physical characteristics (e.g., remote location, climate, lack of transportation infrastructure, natural disaster), - social, political, or cultural factors (e.g., insecurity, conflict, borders, and other regulatory barriers).

Notes: The abbreviation NCP unit in the table corresponds to NCP operational geographic unit(s). When scoring vulnerability indicators, it is important to consider the interaction and potentially amplifying effect of having multiple vulnerability factors present at once.

…/…

#	Generic vulnerability factor	Example of measurable indicator for PAMI identification	Comments
8 |	**Population that received oral cholera vaccine (OCV) more than three years ago**	NCP unit with a population vaccinated more than three years ago (two-doses OCV campaign with a coverage for both round >70%): yes/no	Where OCV campaigns were implemented providing the population with short-term immunity, it is reasonable to assume that local cholera vulnerability factors existed and might have been targeted by multisectoral interventions further to vaccination campaigns. In the absence of appropriate improvement of WASH service levels, a unit that has received OCV remains vulnerable to the reemergence of cholera outbreaks.
9 |	**High-risk for extreme climate and weather conditions**	NCP unit exposed to extreme climate and weather condition(s): yes/no	During extreme weather conditions, cholera transmission may increase among specific populations (e.g., pastoralists during drought period, population located in flood-prone areas) and the ability of the public health response to control outbreaks locally may be significantly reduced.
10 |	**Complex humanitarian emergency**	NCP unit located in an area under a complex humanitarian emergency: yes/no	According to the United Nations High Commissioner for Refugees, "*a complex emergency can be defined as a humanitarian crisis in a country, region or society where there is a total or considerable breakdown of authority resulting from internal or external conflict, and which requires an international response that goes beyond the mandate or capacity of any single agency and/or the ongoing UN country program*." Such conditions render the affected populations at an increased risk of health emergencies, including infectious disease outbreaks such as cholera, due to sub-optimal epidemiologic surveillance and limited response capabilities.

Notes: The abbreviation NCP unit in the table corresponds to NCP operational geographic unit(s). When scoring vulnerability indicators, it is important to consider the interaction and potentially amplifying effect of having multiple vulnerability factors present at once.

…/…

#	Generic vulnerability factor	Example of measurable indicator for PAMI identification	Comments
11 |	**Unimproved water**	NCP unit with: ▪ more than 30% of the population using unimproved water facility type (= % of population with unimproved service level + % of population using surface water): yes/no **OR** ▪ more than 15% of the population using surface water: yes/no	A high proportion of the population using unimproved water facility type may increase vulnerability to cholera transmission. The access to **unimproved water facility type** can be defined according to the JMP service ladder for drinking water and corresponds to sum of the percentage of population using **unimproved water source** (JMP drinking water ladder category: "Unimproved") and the percentage of population **using surface water** (JMP drinking water ladder category: "Surface water").
12 |	**Unimproved sanitation**	NCP unit with: ▪ more than **50%** of the population using unimproved sanitation facility type (= % of population with **unimproved sanitation** service level + % of population practicing open defecation) : yes/no **OR** ▪ more than 30% of the population practicing open defecation: yes/no	A high proportion of the population using unimproved sanitation facility type may increase vulnerability to cholera transmission. The access to **unimproved sanitation facility type** can be defined according to the JMP service ladder for sanitation and corresponds to sum of the percentage of population using **unimproved sanitation facilities** (JMP sanitation ladder category: "Unimproved") and the percentage of population practicing **open defecation** (JMP sanitation ladder category: "Open defecation").
13 |	**Limited access to hygiene**	NCP unit with more than 50% of the population with no handwashing facility on premises: yes/no	Limited access to hygiene facilities may increase vulnerability to cholera transmission. No handwashing facility on premises corresponds to the percentage of population with **no handwashing facility on premises** (JMP service ladder for hygiene category: "No facility").

Notes: The abbreviation NCP unit in the table corresponds to NCP operational geographic unit(s). When scoring vulnerability indicators, it is important to consider the interaction and potentially amplifying effect of having multiple vulnerability factors present at once.

STEP 2: VULNERABILITY INDEX SCORING

At step 2, measurable vulnerability indicators are scored, and a cholera vulnerability index is calculated for each NCP operational geographic unit (Figure 4).

Figure 4. Overview of step 2 (vulnerability index scoring)

1. Score vulnerability indicators	• Score each vulnerability indicator for each NCP operational unit (yes=1, no=0)
2. Calculate vulnerability index	• Sum the score of all vulnerability indicators for each NCP operational unit
3. Document	• Document the methods and outcomes of steps 1 and 2 in preparation of step 3

1. Scoring of measurable vulnerability indicators

For each NCP operational geographic unit, measurable vulnerability indicators are scored as follows:

- **absence** of the vulnerability factor in an NCP operational geographic unit (i.e., measurable indicator equal to “no”) corresponds to a **score of zero point;**
- **presence** of the vulnerability factor in an NCP operational geographic unit (i.e., measurable indicator equal to “yes”) corresponds to a **score of one point;**
- for the three **WASH-related indicators**, an NCP operational geographic unit is **scored with one point if the indicators exceed their respective cut-off values** (therefore qualifying as “unimproved” or “limited access”) and zero points if below.

Scoring principles are illustrated for generic cholera vulnerability factors in the Table 3. Similar scoring principles shall apply to any additional country-specific vulnerability factor included in the identification of PAMIs for cholera elimination (i.e., yes or presence equal to one point, no or absence equal to zero point).

2. Calculation of the cholera vulnerability index

As a general principle, the vulnerability index for each NCP operational geographic unit is calculated by the unweighted sum of points of all selected cholera vulnerability indicators (Annex Ⅰ. Vulnerability factors contribution to cholera outbreak phases).

Table 3. Scoring of cholera vulnerability factors

#	Generic vulnerability factor	Example of measurable indicator for PAMI identification	Score (points)	
			0	1
1 |	Confirmed cholera imported case(s) in the NCP operational geographic unit considered	NCP unit with at least one confirmed cholera case imported (from another country or another NCP operational geographic unit reported during the analysis period): yes/no	No	Yes
2 |	Cross-border areas adjacent to frequently cholera-affected areas or identified PAMIs in neighbouring country(ies)	Cross-border NCP unit adjacent to areas frequently affected by cholera outbreaks or classified as PAMI in neighbouring country(ies): yes/no	No	Yes
3 |	Location along major travel routes with transportation hubs	NCP unit located along transportation pathway(s) with transportation hub(s): yes/no	No	Yes
4 |	Major population gatherings	NCP unit hosting major population gathering(s): yes/no	No	Yes
5 |	High population density locations or overcrowded settings	NCP unit with high population density locations or overcrowded settings: yes/no	No	Yes
6 |	High-risk populations	NCP unit with high-risk populations: yes/no	No	Yes
7 |	Hard-to-access populations	NCP unit with hard-to-access populations: yes/no	No	Yes
8 |	Population that received oral cholera vaccine (OCV) more than three years ago	NCP unit with a population vaccinated more than three years ago (two-doses OCV campaign with a coverage for both round >70%): yes/no	No	Yes
9 |	High-risk for extreme climate and weather conditions	NCP unit exposed to extreme climate and weather condition(s): yes/no	No	Yes
10 |	Complex humanitarian emergency	NCP unit located in an area under a complex humanitarian emergency: yes/no	No	Yes
11 |	Unimproved water	NCP unit with ▪ more than **30%** of the population using unimproved water facility type (= % of population with **unimproved** service level + % of population using **surface water**): yes/no OR ▪ more than 15% of the population using surface water: yes/no	Does not meet any of the two criteria	Meets one or more criteria
12 |	Unimproved sanitation	NCP unit with ▪ more than 50% of the population using unimproved sanitation facility type (= % of population with unimproved sanitation service level + % of population practicing open defecation): yes/no OR ▪ more than 30% of the population practicing open defecation: yes/no	Does not meet any of the two criteria	Meets one or more criteria
13 |	Limited access to hygiene	NCP unit with more than 50% of the population with no handwashing facility on premises: yes/no	Does not meet the criteria	Meets the criteria

Notes: When scoring vulnerability indicators, it is important to consider the interaction and potentially amplifying effect of having multiple vulnerability factors present at once.

It is possible to give more importance to one or more vulnerability factor(s) considering the outcomes of the scoping review and expert consultations on country-specific cholera vulnerability factors or according to respective contribution of vulnerability factor to outbreak phases. This can be performed by multiplying the indicator score (1 or 0) by a numeric value representing the relative importance of the corresponding factor in the country-specific context (i.e., numeric weight). The vulnerability index for each NCP operational geographic unit is then calculated as the sum of weighted scores. For instance, if a vulnerability factor contributes to two outbreak phases, the relative weight may be increased from one to two.

If a weighting approach is used for the calculation of the vulnerability index, the rationale to give more importance to specific vulnerability factor(s) should be justified and documented in the report on the identification of PAMIs for cholera elimination (Annex Ⅱ. Template report on the identification of PAMIs for cholera elimination). Specific weight by vulnerability factor can be applied in the GTFCC Excel-based tool and practical details provider in the GTFCC Excel-based tool user guide.

It should be noted that it is inappropriate to compare vulnerability index values across countries particularly when the indexes encompass different numbers and types of vulnerability factors.

3. Documentation

Prior to the stakeholder validation (Step 3: Stakeholder validation), key supporting documents should be prepared:

- a **method summary** about the selection of vulnerability factors and the calculation of the vulnerability index including weighting (if performed);
- a **data documentation table** reporting the definition of each vulnerability measurable indicator accompanied with a concise data summary containing a data description (type, source, data of collection, …), a data quality assessment, and any potential limitations and missing information found (for examples, refer to the data documentation table in Annex Ⅱ. Template report on the identification of PAMIs for cholera elimination);
- a **result table** with the occurrence of confirmed cholera outbreaks over the analysis period, the vulnerability indicator scores, and vulnerability index value for each NCP operational geographic unit (to that end, sheet 'R.4| Table PAMIs export' of GTFCC Excel-based tool can be used);
- **maps** representing the occurrence of confirmed cholera outbreaks over the analysis period, vulnerability indicator scores, and vulnerability index value by NCP operational unit.

STEP 3: STAKEHOLDER VALIDATION

1. General objectives and key activities

○ Objective

A stakeholder consultation (e.g., workshop) should be conducted to reach a consensus on the final list of PAMIs. The expected outcomes of the validation process conducted among stakeholders are:

- vulnerability index value for each NCP operational geographic unit (if not obtained at step 2 due to any remaining missing information that could not be addressed at step 1);
- vulnerability index threshold value;
- final list of PAMIs.

NCP operational geographic unit priority ranking based on vulnerability index value generated at step 2 should be used to engage multisectoral stakeholders in a validation workshop.

During the workshop, stakeholders are expected to validate (and complement as necessary) the information used at steps 1 and 2, agree on a vulnerability index threshold value, and finalize the list of PAMIs.

The final list of PAMIs shall comprise all NCP operational geographic units where confirmed cholera outbreaks occurred over the analysis period as well as all NCP operational geographic units with a vulnerability index value above the country-specific vulnerability index threshold.

○ Key activities of step 3

Activities undertaken in step 3 are outlined in Figure 5 and described in the following sections.

Figure 5. Overview of step 3 (stakeholder validation)

1. Plan and organize a stakeholder consultation	• Identify relevant stakeholders • Coordinate the organization of the consultation (e.g., workshop)
2. Facilitate stakeholder consultation	• Share supporting materials (i.e., data documentation and results tables generated at step 2) • Assess qualitatively based on the participants' opinion the presence/absence of any vulnerability factor(s) in any NCP operational geographic unit(s) where, on exceptional basis, it could not be determined at previous steps due to missing information • Achieve consensus on vulnerability index threshold considering feasibility and potential impact of NCP
3. Document PAMI identification in a report	• Prepare a report to document the methods applied and outcomes of PAMIs identification consistent with the report template presented in Annex Ⅱ. Template report on the identification of PAMIs for cholera elimination
4. Launch next steps of NCP development	• Coordinate the launch of next steps of NCP development.

2. Participants

The validation process should include input of both national-level and local-level stakeholders and experts across multiple sectors, including water, sanitation, hygiene, health, and finance. A consultative format in the form of a **participative workshop** is recommended.

Multi-stakeholder involvement in this process aims to maximize buy-in and multisectoral engagement in subsequent steps of NCP development and implementation to eliminate cholera.

3. Materials

Before conducting the stakeholder consultation, all participants should receive the outcomes generated at the end of **step 2**:

- **method summary**,
- **data documentation table**,
- **result table and map(s)** with the occurrence of confirmed cholera outbreaks over the analysis period, the scores of measurable vulnerability indicators (including any remaining missing information), and vulnerability index values for all NCP operational geographic units.

4. Review process

Participants should review the selected vulnerability factors, the definition of the corresponding measurable indicators, and the method of calculation of the vulnerability index.

Participants should assess qualitatively the presence/absence of any vulnerability factor(s) in any NCP operational geographic unit(s) where, on exceptional basis, it could not be determined at previous steps, and a consensus should be reached among participants. As a result, there should be no unscored vulnerability factors for any NCP operational geographic unit.

Country stakeholders should define the **vulnerability index threshold by consensus** after considering the feasibility of targeting all PAMIs as part of the NCP. This decision is made by considering the resources available to support NCP implementation and the size of the target population. All NCP operational geographic units with a vulnerability index greater than the vulnerability index threshold should be included in the **final list of PAMIs**.

5. Final list of PAMIs and next steps

○ Final list of PAMIs

The final list of PAMIs shall consist of NCP operational geographic units:

- where confirmed cholera outbreak(s) were reported over the analysis period **and,**
- those that have a vulnerability index value above the (country-specific) vulnerability index threshold.

○ Report

Once the final list of PAMIs is validated, the PAMI identification process should be documented in a comprehensive report, which should follow the template provided in the Annex Ⅱ. Template report on the identification of PAMIs for cholera elimination. This report intends to support the next phases of NCP development.

○ Next steps

Using the outcomes of PAMIs identification, national authorities shall develop an NCP for cholera elimination focusing on preventing re-emergence of cholera transmission.

Indicative activities, but not limited to, are**:**

- sustain nationwide **cholera surveillance and laboratory capability for early detection and confirmation** of cholera cases;
- maintain nationwide ability of Public Health sector to **provide effective response** to halt cholera outbreaks;
- **mitigate vulnerability to cholera in PAMIs** to decrease the likelihood of cholera reemergence through mid- and long-term interventions. Sustainable improvement of WASH services is one of the key recommended priority interventions in PAMIs for cholera elimination.

Of note, preventive OCV campaigns are not considered relevant interventions to achieve sustainable cholera elimination.

ANNEX I. VULNERABILITY FACTORS CONTRIBUTION TO CHOLERA OUTBREAK PHASES

The indicative list of generic cholera vulnerability factors was proposed by considering their expected contribution to the following cholera outbreak phases: introduction of *V. cholerae*, onset of a cholera outbreak, spread of a cholera outbreak.

The Table 4 presents an overview of the expected contribution of generic vulnerability factors to cholera outbreak phases.

The indicative list of generic cholera vulnerability factors is not exhaustive and additional country-specific vulnerability factors may be considered. To assess the relevance of any additional country-specific vulnerability factors, it is recommended to evaluate their expected contribution to any of the cholera outbreak phases.

Table 4. Contribution of generic vulnerability factors to cholera outbreak phases

Generic vulnerability factor	Expected contribution to cholera outbreak phases		
	Introduction	Onset	Diffusion
Confirmed cholera imported case(s) in the NCP operational geographic unit considered	✓		
Cross-border areas adjacent to frequently cholera-affected areas or identified PAMIs in neighbouring country(ies)	✓		
Location along major travel routes with transportation hubs	✓		✓
Major population gatherings	✓		
High population density locations or overcrowded settings		✓	✓
High-risk populations		✓	✓
Hard-to-access populations		✓	
Population that received oral cholera vaccine (OCV) more than three years ago		✓	✓
High-risk for extreme climate and weather conditions		✓	✓
Complex humanitarian emergency		✓	✓
Unimproved water		✓	✓
Unimproved sanitation		✓	✓
Limited access to hygiene		✓	✓

ANNEX Ⅱ. TEMPLATE REPORT ON THE IDENTIFICATION OF PAMIS FOR CHOLERA ELIMINATION

The Figure 6 presents a template to document the identification of PAMIs for cholera elimination.

Figure 6. Template report on the identification of PAMIs for cholera elimination

BACKGROUND

- Summary on cholera situation and control efforts in the country including information on any previous identification of cholera hotspots/PAMIs
- Concise description of national cholera surveillance system and testing capacities for cholera
- NCP status and key targets for cholera elimination as public health threat

IDENTIFICATION OF VULNERABLE AREAS

Step 1. Supporting information

- Analysis period and administrative level of the NCP operational geographic unit
- Description of confirmed cholera outbreak(s) over the analysis period
- Rationale about the non-selection of any generic vulnerability factors (if applicable)
- Rationale about the selection of any additional country-specific vulnerability factors (if applicable)

Step 2. Vulnerability index scoring

- Data documentation table reporting the definitions each measurable indicator with concise data description (type, source, data quality assessment and potential limitations) used for the corresponding indicator and describing how gaps in data coverage were addressed
- Description of the method of calculation for the vulnerability index (i.e., score, weighting procedure and, if so, justification for weights)
- Result table with the occurrence of confirmed cholera outbreaks over the analysis period, the vulnerability indicator scores, and vulnerability index value for each NCP operational geographic unit
- Maps representing confirmed cholera outbreaks over the analysis period, vulnerability indicator scores, and vulnerability index value by NCP operational unit

Step 3. Stakeholder validation

- Format of the stakeholder consultation and list of participants
- Rationale for the selection of the vulnerability index threshold
- NCP operational geographic units table with population, occurrence of cholera outbreak, values for each vulnerability factors score, vulnerability index value, and PAMI status
- Map of PAMIs

WAY FORWARD

- Description of next steps of the NCP process including provisional timelines

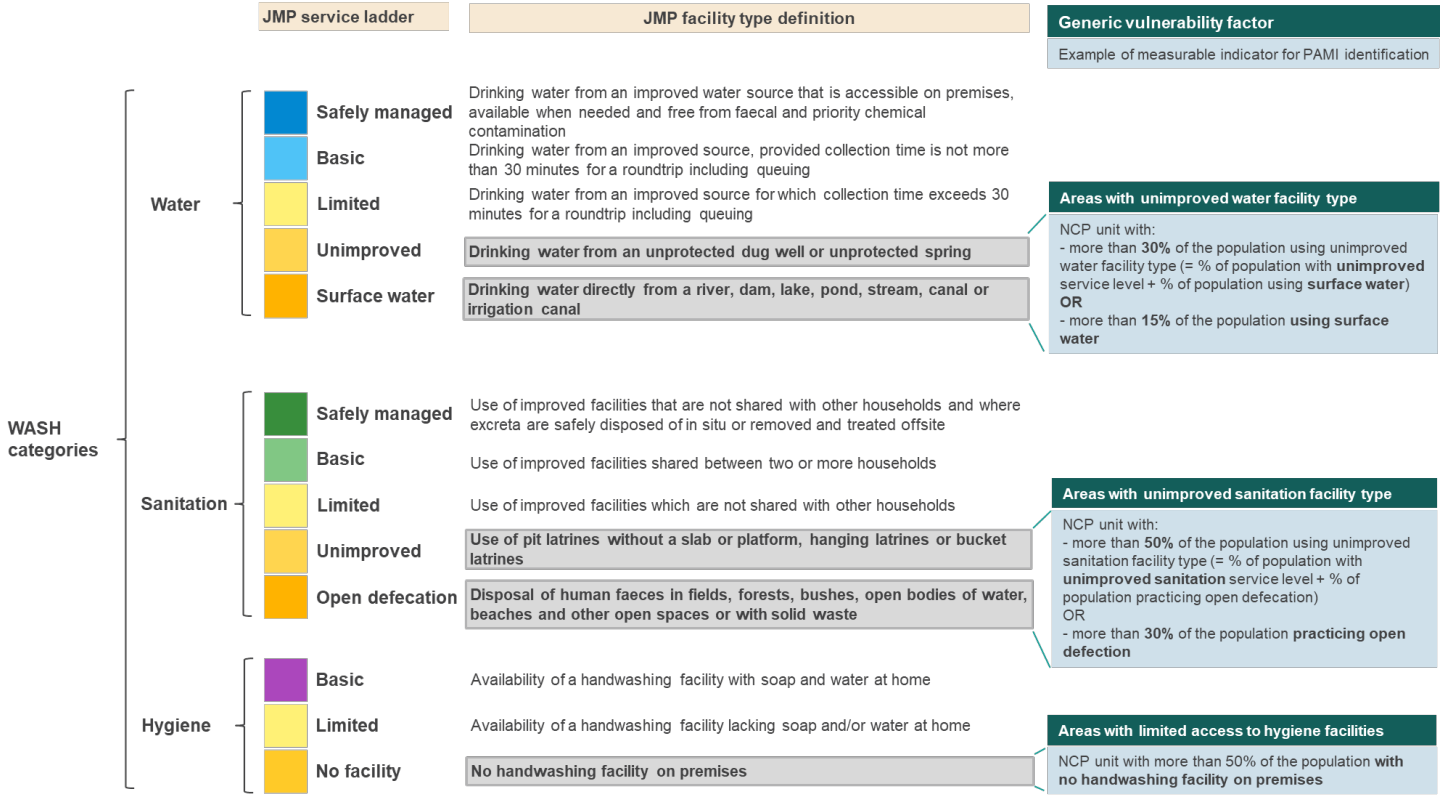
ANNEX

- Sources for all data used in process of PAMIs identification

ANNEX Ⅲ. EXAMPLES OF WASH MEASURABLE INDICATORS BASED ON THE JMP DEFINITIONS

The WHO/UNICEF Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene compiles estimates of progress on drinking water, sanitation and hygiene (WASH) according to harmonized WASH service definitions. The assessment of WASH vulnerability factors for the purpose of PAMI identification may be based on these JMP definitions (JMP service ladder for drinking water, JMP ladder for sanitation, and JMP service ladder for hygiene). The Figure 7 summarizes proposed WASH measurable indicators for the identification of PAMIs for cholera elimination based on the JMP service ladder.

Figure 7. WASH-related vulnerability factors and measurable indicators for PAMI identification based on the JMP WASH service definitions



ANNEX Ⅳ. VULNERABILITY FACTORS CONSIDERED FOR THE IDENTIFICATION OF PAMIS FOR CHOLERA ELIMINATION IN MALI

This annex aims to illustrate the necessary adaptation of the GTFCC method for the identification of PAMIs for cholera elimination in each country-specific context.

The Table 5 lists the vulnerability factors selected in the pilot study performed in Mali in 2022 for the identification of PAMIs for cholera elimination. These vulnerability factors corresponded to the expected main determinants of cholera epidemics in sub-Saharan areas defined according to the Mali specific context. The NCP operational geographic unit level was the health district (admin 3 level) and the analysis period was 2017-2022.

The vulnerability factors relevant in Mali were discussed and validated with national and regional experts at the early stages of PAMIs identification. Underlying datasets for each selected vulnerability factor were verified and a data quality assessment performed (i.e., assessment of the reliability of the data source, accessibility, time coverage, check for outliers and missing data, consistency check with alternative data source(s) when possible).

A definition for each measurable indicator was developed consistent with the data available (see column “Measurable indicator” in Table 5).

The guiding principles to obtain the best possible assessment of each measurable indicator were the following:

- use data at the NCP operational geographic level, when feasible;
- select reliable data source within the range of the study period as much as possible;
- if no data source readily available for a vulnerability factor use a relevant proxy or conduct a survey to collect the missing information.

The main data challenges encountered for the data preparation, and how they were addressed, are described in the column “Comments” in Table 5.

Table 5. List of vulnerability factors considered for the identification of PAMIs for cholera elimination in Mali (pilot study, 2022)

Vulnerability factor	Measurable indicator	Data type and source	Comments
Confirmed cholera imported case(s) in the NCP operational geographic unit considered	Health district with at least one confirmed cholera case imported (from another country or another health district)	- National cholera surveillance (Mali and Niger)	- **None**
Cross-border areas adjacent to frequently cholera-affected areas or identified PAMIs in neighbouring country(ies)	Health district bordering a district in a neighboring country for which community transmission of cholera has been reported between 2017 and 2022	- WHO Offices of the countries bordering Mali	- **Reliable data source readily available at NCP unit level**
Location along major travel routes with transportation hubs	Health district with an agglomeration greater than 50,000 inhabitants and located at the crossroads of at least three primary roads	- GIS regional layer on transport routes (three road classes: primary, secondary, and tertiary) from the Office for the Coordination of Humanitarian Affairs (OCHA) - Demographic data on main agglomerations from the General Population and Housing Census, Mali, 2009	- **Reliable data source readily available at NCP unit level** - In the absence of a recent census, the estimated population of main cities in 2021 was estimated by extrapolation by applying an annual growth rate of 3.36% - The regional geographic information layers of transportation routes have been combined with demographic data in GIS software
Major population gatherings	Health district bordering or crossed by the navigable part of a major river	- Based on literature and national experts on commercial traffic on the Niger and Senegal rivers, the navigable parts of the Niger and Senegal were integrated into the GIS	- **Proxy indicator at NCP unit level** - This indicator has been considered as a proxy of major population gathering due to major seasonal commercial exchanges and population gathering on navigable part of Niger and Senegal rivers in Sahel region
High population density locations or overcrowded settings	Health district with agricultural areas or mining areas with overcrowded population	- No comprehensive data readily available. Information collected through an ad hoc survey conducted by WHO country office	- **Ad hoc survey at NCP unit level** - Required an ad hoc survey coordinated by the WHO country office

…/…

Vulnerability factor	Measurable indicator	Data type and source	Comments
High-risk populations	Health district with a percentage of Internally Displaced Persons (IDP) population greater or equal to five percent of the total district population	- Number of IDPs from the Displacement Tracking Matrix monitoring project supported by the International Organization for Migration (IOM) (report: Baseline Assessment Round 74 published in October 2022)	- **Reliable data source readily available at NCP unit level** - The distribution of the percentage of IDP population in relation to the total of the health district population has been assessed and a discriminative threshold of five percent was defined by consensus during the validation workshop
Hard-to-access populations	Not applicable	- No specific national database available	- **Proxy indicator at NCP unit level** - In the context of Mali in 2022, vulnerability factor “Hard-to-access populations” is partially covered by vulnerability factor “areas affected by complex humanitarian emergencies” (see below)
Population that received oral cholera vaccine (OCV) more than three years ago	Not applicable	- Not applicable	- **Not applicable** considering that no previous OCV campaign was conducted in the country
High-risk for extreme climate and weather conditions	Health district with a high-risk of flood defined by health district with at least one municipality with a risk between 5 and 12	- Risk of major flooding event is derived from the study of floods in Mali 2006-2013 (REACH report in collaboration with the Directorate General of Civil Protection of Mali, and the support of UNICEF)	- **Reliable data source readily available at NCP unit level** - The distribution of the flood risk has been assessed and discriminative range of risk values defined in accordance with the high-risk category proposed in the REACH report
Complex humanitarian emergency	Health district with at least fifteen events in 2022	- Geolocated events (battles, explosions, demonstrations, riots, looting, destruction of property and violence against civilians) in 2022 were extracted from the database "ACLED Armed Conflict Location & Event Data Project”	- **Reliable data source readily available at NCP unit level** - The presence of conflicts is considered as an indirect proxy of a suboptimal response to outbreaks due to the high access constraints and challenging work settings for health sector actors in conflict zones. - Discriminative threshold of 15 events by health district was defined by consensus during the data validation workshop - GIS platform allowed to attribute to geolocated events to each health district

…/…

Vulnerability factor	Measurable indicator	Data type and source	Comments
Unimproved water	Health district with unimproved water facility type	- This indicator corresponds to the percentage of access to drinking water of the population according to the functional modern water points by "*cercle*"* (source: Ministry of Energy and Water, National Directorate of Hydraulics)	- **Reliable data source readily available at upper geographic level** - The information according to JMP definitions was only available at regional level and led to use a more discriminative proxy at "cercle"* level using specific national database.
Unimproved sanitation	Health district with unimproved sanitation facility type	- This indicator corresponds to the sum of the percentage of the population with unimproved sanitation service and the percentage of the population practicing open defecation by region, hereby defined as "limited access to sanitation" (source: Demographic and Health Survey, 2018)	- **Reliable data source readily available at upper geographic level** - This indicator corresponds to the WASH related categories used by the JMP and is only available by region in Mali. No information was available at "cercle"* or at district level in national surveys. Therefore, health districts located within the same region have an identical estimated value for this indicator.
Limited access to hygiene	Health district with limited access to hygiene facilities	- Vulnerability categories were defined based on the percentage of the population without basic handwashing facilities with soap and water at home by region (source: Demographic and Health Survey, 2018)	- **Reliable data source readily available at upper geographic level** - This indicator corresponds to the WASH related categories used by the JMP and is only available by region in Mali. No information was available at "cercle"* or at district level in national surveys. Therefore, health districts located within the same region have an identical estimated value for this indicator.

**: "Cercle" is an intermediate administrative entity between the "region" level and "health district" administrative level. Consequently, health districts located within the same cercle have the same estimated value.*