Considerations for COVID-19 surveillance in humanitarian settings

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Abbreviations

Africa CDC	Africa Centers for Disease Control and Prevention
ARI	Acute respiratory infections
CBS	Community-based surveillance
CFR	Case fatality ratio
CHW	Community health worker
COVID-19	Coronavirus disease
EBS	Event-based surveillance
EWARS	Early Warning Alert and Response System
GISRS	Global Influenza Surveillance and Response System
IASC	Inter-Agency Standing Committee
IBS	Indicator-based surveillance
ILI	Influenza-like illness
NGO	Non-governmental organisation
PCR	Polymerase chain reaction
PPV	Positive predictive value
RDT	Rapid diagnostic tests
SARI	Severe acute respiratory infections
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
WHO	World Health Organization

1. Introduction

1.1 Background

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and resulting coronavirus disease 2019 (COVID-19) continues to pose a high risk to populations affected by humanitarian crises[1]. Crisis-affected populations are defined as people who are forcibly displaced within or across national borders, or residents, who are affected by armed conflict, exceptional food insecurity and/or natural disasters. While extensive impact has not yet been observed, there are concerns that deaths have been under-detected, due to minimal testing capacity and poor surveillance[2].

The experience with COVID-19 so far in 2020 has shown that the under-detection of suspect cases and deaths hampers COVID-19 control. Ensuring surveillance systems are effective in detecting outbreaks and monitoring trends in COVID-19 is a critical in humanitarian settings. In March 2020, the World Health Organization (WHO) and the Inter-Agency Standing Committee (IASC) proposed a strategy for humanitarian settings[3] of testing, contact tracing, isolation, and quarantine.[4] While more realistic in urban settings where resources are concentrated, in crisis-affected settings there is little capacity to support this strategy, as a result of fragile health systems, limited testing resources, competing health priorities, and insecurity, which all pose significant obstacles.

The purpose of this guidance document is to describe feasible approaches for effective surveillance of COVID-19 in humanitarian settings. We address how to adapt existing surveillance systems, maintain a minimum set of indicators, and optimize limited testing resources. The guidance is aimed at humanitarian health actors and national authorities.

1.2 Objectives and principles for COVID-19 surveillance in humanitarian settings

Surveillance for COVID-19 is defined as the detection of events potentially signalling transmission (i.e., event-based surveillance), monitoring of suspect and confirmed cases (i.e., indicator-based surveillance), and potentially, monitoring of behaviours for infection prevention (i.e., population-based surveys).

The objectives of COVID-19 surveillance in humanitarian settings are to:

i. Detect suspected COVID-19 cases and clusters promptly
ii. Monitor trends in COVID-19 incidence, severity and mortality
iii. Monitor trends in risk behaviours for infection
iv. Monitor trends in prior infection by COVID-19

These principles should guide the implementation of COVID-19 surveillance in humanitarian settings:

i. Efficiency: optimise existing surveillance systems, and avoid resource-intensive activities when they provide only limited insight to influence decision-making (e.g., requirements for exhaustive laboratory confirmation and/or contact tracing, and isolation of suspect cases during widespread transmission).
ii. Facilitate public health action: prioritise early warning and monitoring functions; monitor incidence, severe disease and risk behaviours to ensure identification and intervention for high-risk groups.
iii. Produce immediately usable data: enable rapid, routine, and timely analysis and dissemination.
iv. 'Do no harm': surveillance activities (e.g., screening, quarantine, isolation, contact tracing), should not exacerbate vulnerabilities or heighten stigma in crisis-affected populations[5,3]. For example, persons arriving to camps should be directed toward health and COVID-19 screening and protection services rather than sequestered in unsafe detention. This will help to avoid leveraging political fears of COVID-19 transmission from foreigners, and promote a population health imperative.

In the remainder of this document, we describe the objectives in detail, starting with an overview of surveillance systems typically available in humanitarian settings.

2. Overview of surveillance systems in humanitarian settings

Surveillance for COVID-19 requires the integration of multiple existing systems and alignment with the objectives for COVID-19 surveillance (Table 1).

Table 1: The role of surveillance systems for surveillance of COVID-19 in humanitarian settings

Surveillance system	**Level(s)**	**Surveillance objectives for COVID-19**			
		1. Detect and respond to suspected cases and clusters	2. Monitor trends in transmission, severity and mortality	3a. Monitor trends in risk behaviours	3b. Monitor trends in prior infection by SARS-CoV-2
Indicator-based surveillance ("routine surveillance") *e.g., EWARS*, sentinel surveillance, GISRS**	Health facility	▪ Alerts (single cases or clusters) ▪ Confirmation of local transmission through contact tracing and testing ▪ Testing of health care workers with symptoms	▪ Trends in suspected cases ▪ Trends in SARI and ILI* ▪ Systematic testing to monitor presence of local transmission (i.e., n^{th} suspected or SARI/ILI case)		
Event-based surveillance	Health facility and community	Alerts (rumours of suspected cases or deaths reported through informal channels)			
Mortality surveillance	Health facility and community		Trends in all-cause mortality (e.g., community deaths via burial monitoring)		
Behavioural surveillance	Community			▪ Serial population-based behavioural surveys ▪ Serial qualitative enquiry of risk behaviours	
Serological surveillance	Community				Serial population-based serological surveys

** Abbreviations: Early Warning and Response System (EWARS); Severe Acute Respiratory Illness (SARI); Influenza-Like Illness (ILI); Global Influenza Surveillance and Response System (GISRS), indicator-based surveillance (IBS))*

2.1 Adapting the existing surveillance system for COVID-19

District or local-level humanitarian settings will have a surveillance system in operation, such as an early warning, alert and response system (EWARS), which should have two components: indicator-based surveillance (IBS) and event-based surveillance (EBS). Some settings have community mortality surveillance for detecting and monitoring deaths that occur outside of health facilities. We describe the objectives of IBS, EBS, and mortality surveillance and key considerations for improving each component for COVID-19 surveillance.

2.1.1 Indicator-based surveillance ("routine surveillance")

Indicator-based surveillance (IBS) refers to the routine surveillance of epidemic-prone diseases using cases ascertained with syndromic case definitions among patients who present to health facilities. In some settings, sentinel surveillance for severe acute respiratory illness (SARI) and influenza-like illness (ILI) operate as a vertical system managed by national public health authorities. One example is the Global Influenza Surveillance and Response System (GISRS)[6], which may exist in some crisis-affected settings.

Given the inability to carry out exhaustive polymerase chain reaction (PCR) testing for all suspect cases in humanitarian settings, the recommended basis for COVID-19 diagnosis, trends among suspect cases meeting a syndromic case definition for COVID-19 form a key pillar of COVID-19 surveillance. The minimum requirement for IBS is to detect a weekly increase in the number of persons presenting to health facilities with symptoms compatible with COVID-19. We list other considerations for IBS for COVID-19 Box 1.

2.1.2 Event-based surveillance ("immediate notification")

Event-based surveillance (EBS) refers to the immediate notification of events that potentially signal an outbreak. EBS should be used to detect signals that are suggestive of COVID-19 transmission for example through the community, or by health worker observations of unusual occurrences. In this document, we consider community-based surveillance (CBS) to be a type of EBS, as the signals that it produces require further validation.

EBS should be considered essential, as it balances IBS by:

- Facilitating early detection of rapid and widespread community transmission that may occur before patients start presenting to health facilities in noticeable numbers;
- Providing an additional detection system where a laboratory confirmation of COVID-19 is unavailable.

The use of EBS should be supported and revitalised during an epidemic. To enhance the accuracy of event-based reporting, and a network of potential informants should be rapidly identified and trained to apply signal definitions (Annex 1) and the means to do so (e.g., via a telephone hotline). Signals should be immediately verified as true events, and then responded to. See the WHO/EWARN guidelines (2012) for operational procedures. Considerations for EBS during COVID-19 are listed in Box 1.

Box 1: Advantages, resource needed, and modifications for IBS and EBS for COVID-19 surveillance

	IBS	EBS
Advantages	▪ Uses existing health facility networks ▪ Links directly to testing and contact tracing ▪ Uses a syndromic case definition to enhance specificity of ascertainment of suspect cases	▪ Provides early warning of cases and clusters in the community ▪ Extends surveillance outside of persons presenting to health facilities
Limitations	▪ IBS only captures persons ill enough to seek care at a health facility; it may be a late indication for community transmission ▪ Limited testing capacity reduces accuracy of COVID-19 trend assessment where acute respiratory illness is highly-incident ▪ Positive predictive value (PPV) of syndromic case definitions will change during the epidemic as the incidence of COVID-19 fluctuates ▪ Updated population estimates	▪ Requires some additional setup of a reporting system ▪ Less specific with lower PPV than IBS; each signal requires additional verification ▪ Potentially overwhelming if alert definitions are overly-sensitive and produce many signals
Modifications needed for COVID-19	**1. Use health facility screening points and consultations to apply the case definition:** ▪ All patients should be assumed to be at-risk and screened for compatible symptoms at entry points to all points of care (e.g., health facilities, nutrition centres, antenatal care). ▪ Equip health workers with training and job-aids on COVID-19 case definitions (versus similar case definitions (ILI, SARI)) and the means of reporting suspected cases. **2. Use syndromic case definitions:** ▪ Add syndromic case definitions that are feasible to apply and sensitive (see Annex 1 for definitions proposed by the WHO which integrate syndromic and epidemiological criteria). ▪ Identification of epidemiologic links (e.g., contact with a confirmed case or travel history) will be less meaningful where populations are mobile, and/or transmission is widespread. ▪ IBS can facilitate systematic testing, for example of samples from SARI and ILI cases from sentinel sites that test negative for other pathogens (as recommended by the GISRS)[7]. **3. Conduct weekly analyses to detect unexpected trends and upticks in suspected COVID-19, SARI, ARI, and ILI**. ▪ Unusual increases in SARI cases which require hospitalisation are salient events that may indicate COVID-19 transmission. ▪ Unusual increases in ILI or acute respiratory infections (ARI) may indicate COVID-19 transmission or misclassifications by health workers, and thus should be monitored and investigated. ▪ Weekly analysis can be accelerated to a daily basis if the situation changes quickly.	**1. Identify a reporting network** ▪ Health workers are in a unique position to observe unusual case presentations and clusters, whether during routine work or in their communities ▪ Networks of community health workers/volunteers can detect unusual events in the community ▪ Setting up a community-based surveillance system for COVID-19 among people without health training can be resource-intensive. First, check with national Red Cross societies, and civil society and non-governmental organisations (NGOs) in the area for existing community networks. **2. Integrate EBS into existing investigation and response capacity** ▪ EBS requires a strong link to investigation and response. Each signal must be verified as a genuine COVID-19 event. ▪ Verified events should be directed to the investigation and response mechanism (e.g., rapid response teams) and integrated into daily surveillance activities.

2.1.3 Mortality surveillance

Excess mortality during the COVID-19 epidemic should serve as an indicator of overall epidemic impact and trajectory. If available, weekly all-cause mortality data should be analysed to produce estimates of excess death in comparison to annual or monthly mortality data. However, excess mortality cannot be solely relied on as the main surveillance indicators as it is a lagging indicator of community transmission. We list considerations for mortality surveillance in Box 2.

Box 2: Advantages, resources needed and urgent modifications to mortality surveillance for COVID-19 surveillance

Mortality surveillance
Advantages
▪ Excess mortality provides data that is easily interpretable ▪ Excess mortality can provide a key indicator where there is little to no testing capacity ▪ Excess mortality can be decomposed to age- and sex-specific groups (e.g., impact on ≥60 years age group) ▪ Community deaths likely due to COVID-19 can be monitored to evaluate access to case management
Resources needed
▪ Mortality surveillance suffers from incomplete reporting, especially if communities do not routinely reports deaths, or fear stigma in reporting deaths ▪ As a late indicator of transmission, mortality is less actionable than reports on morbidity ▪ The true proportion of COVID-19 deaths will be difficult to distinguish from deaths from other causes ▪ Updated population estimates
Modifications needed for COVID-19
1. Capture all-cause deaths in the community ▪ Traditional sources of death reporting (e.g., camp registration data, health facilities) should be strengthened and integrated with data from regular home visits to households to capture community deaths ▪ For example, daily or weekly tallies from (i) burial sites, (ii) religious leaders or establishments, or (iii) community health worker information systems can be used ▪ Where comprehensive population coverage is not feasible, a sentinel approach can monitor trends in mortality, rather than total deaths, potentially with better accuracy. **2. Collect primary demographic data to characterise risk groups** ▪ Collect information on age, sex, residence of the deceased, and severity of disease, to enable description of risk groups for severe and fatal COVID-19. ▪ Particularly noteworthy are excess deaths among persons 60 years or older, since they are at increased risk of poor outcomes. **3. Select a basis of comparison** ▪ Camp mortality data or another routine source may be available from previous months or years. Compare weekly or monthly estimates with estimates from the same period in previous years. ▪ If historical data is unavailable, compare weekly data to monitor trends in mortality. ▪ In humanitarian settings, the population size is likely to change during the epidemic. Therefore, it is essential to monitor the total deaths and the population size to understand what may be considered an 'excess death'.

2.2 Role of PCR testing in COVID-19 surveillance

WHO does not generally currently recommend the use of rapid immunodiagnostic tests for diagnosing COVID-19[7], although the use of antigen-based rapid tests can be considered in areas that are experiencing widespread community transmission that have limited PCR testing resources[8]. Reliance on PCR testing for exhaustive confirmation of suspected cases is not possible in most humanitarian settings, as resources are severely limited. However, if testing coverage remains consistent, even if low, and targets the same population, epidemic trends can be monitored, and the true extent of transmission can be inferred.

To optimise the use of limited testing resources for COVID-19 surveillance, the following strategies should be prioritised:

i. Testing of all health care workers with symptoms compatible with COVID-19.
ii. Confirmation of local transmission through contact tracing in the early phase of the epidemic,
iii. Systematic periodic confirmation of COVID-19 transmission (every n^{th} suspected COVID-19 case),
iv. Systematic testing of samples from SARI and ILI cases at selected sentinel sites (depending on the intensity of local transmission, test either all or only negative SARI and influenza samples for SARS-CoV-2. Further guidance from Africa Centers for Disease Control and Prevention (Africa CDC) and WHO can be found here and here).

3 Detecting and responding to suspected COVID-19 cases or clusters

3.1 Early detection of cases and clusters

By the time that COVID-19 cases or deaths are detected in an area, community transmission is likely well-established, and containment is likely not possible[9]. The surveillance system should be able to detect these first cases and clusters in real-time, recognizing that current symptomatic persons reflect transmission that has occurred up to two weeks previously. Detection efforts must be linked with investigation and response, in order to reduce community transmission and support essential case management to prevent severe morbidity.

The foundation for early detection of COVID-19 is the surveillance system's immediate EBS notification capacity and weekly IBS analysis capacity. This capacity includes (i) immediate notification of alerts and rumours and (ii) weekly data analysis to highlight unusual trends in routine surveillance.

Investigation and response should be carried out by dedicated rapid response teams or alternately, a network of trained health facility staff to investigate events in the catchment areas. Considering health facility staff can get quickly overwhelmed with an increasing volume of patients, it is best to train dedicated investigation and response teams.

3.1.1 Signals and sources

Early detection relies on the systematic review of alerts of potential COVID-19 transmission in the community and in health facilities.

A network of sources for signals should be established. These include both health workers (who will be familiar with case presentations) and community members (who will see cases in the community that do not present to health facilities). Risk communication and community engagement strategies to provide an environment where signals can be raised. We show examples of sources and signals in Table 2, with emphasis on sources by their speed of detection.

Table 2: Sources and types of alerts, from most rapid to most delayed, with examples

Source	Types of signals	Examples of signals
Community health workers	Small clusters in the community and potentially in households	▪ A community health worker reports several ill household members
Community leaders/members		▪ A community leader relays a rumour of an unexplained death at home
NGO staff in remote areas	Sudden increases in morbidity in inaccessible/insecure areas	▪ An NGO working in a remote area receives a report of 60 ill persons
Health workers	Clusters of cases presenting to health facilities	▪ A health worker notices a group of older patients with shortness of breath presenting over a short period ▪ A single ill health worker
Health facility surveillance SARI and ILI sentinel surveillance	Weekly increases in cases with compatible symptoms	▪ A weekly increase in unresolved ARI presenting to health facilities ▪ A weekly increase in ARI managed by community health workers
Gravediggers and burial staff	Weekly increases in mortality (a late indicator of transmission)	▪ A weekly increase in burials in the community

3.1.2 Investigation and response to signals

The sources listed in Table 2 should report signals immediately to the alert team. Through a call to the individual making the alert, the alert team should rapidly assess whether there is the potential for transmission (e.g., does the case(s) in question meet the suspect case definition?) in order to verify the signal to be a true event, and rule out false positives. The team should investigate remaining events through a visit to the site, using appropriate infection prevention and control procedures.

Response activities to slow transmission following a verified COVID-19 event should follow the standard outbreak case investigation and response measures, as shown in Table 3.

Table 3: Essential investigation and response measures following a verified COVID-19 alert

Action	Objective
Case investigation, line-listing and descriptive epidemiology of the cases	Investigate whether transmission is already widespread in the community, or is taking off from sporadic cases with a travel or exposure history to confirmed COVID-19 cases.
Active case finding	Under the assumption that community transmission is ongoing, actively search for cases with compatible symptoms. Active case finding includes: • quickly reviewing patient registers in health facilities for current or recent cases, • organising a house-to-house search by community health workers, and • reviewing burial records and statistics to identify recent increases in all-cause mortality.
Reinforcement of control measures, appropriate to the extent of transmission identified	At the household-level (and for neighbouring households), prevent onward transmission through: • Quarantine of mildly-symptomatic persons and their household members • Quarantine household contacts • Isolate and treat severely-/critically-ill persons in designated health facilities • Shielding of at-risk persons separately from other household members • Facilitation of handwashing with water and soap In the broader community (e.g., neighbourhood, block), reinforce prevention measures: ▪ Physical distancing and face coverings/masks when outside the home ▪ Limiting inter-household gatherings ▪ Promoting hand and respiratory hygiene practices ▪ Shielding of at-risk persons separately from other household members

3.1.3 Considerations for contact tracing

Most humanitarian settings will not have sufficient human resources to carry out efficient contact tracing for each identified case, particularly when community transmission becomes established. Therefore, we propose that contact tracing is reserved for specific situations where it will be most impactful, including situations where:

- Containment is possible:
  - identification of imported cases with known chains of transmission before community transmission is established,
  - new geographical areas reporting first cases or clusters

- Groups of vulnerable people are at high risk of exposure to infection, for example, a staff member in a health facility or other patients at a nutrition treatment centre where a case has been found.

4 Monitor trends in COVID-19 related incidence, severity and mortality

Beyond the initial detection and confirmation of COVID-19 in the community, surveillance also provides information to track the epidemic, for planning and resource allocation, and for assessing the impact of control efforts in real-time.

In this section, we describe how surveillance enables monitoring of transmission, severity and mortality related to COVID-19.

4.1 Monitoring the incidence of COVID-19

Changes in incidence can be measured through different types of information. In addition to monitoring incidence in laboratory-confirmed COVID-19 cases, changes in the incidence of **syndromic COVID-19 and other respiratory syndromes** (e.g., SARI, ILI, ARI) may indicate actual changes in COVID-19 incidence. These include sudden or unexpected changes in the weekly number of suspected COVID-19, SARI, ILI, or ARI.

To ensure reliable interpretation of changes in incidence:

- Compare with relevant surveillance data (e.g., SARI, ILI, ARI) from previous years for the same period, to account for seasonal variations,
- Account for changes in the size or demographics of the population under surveillance (e.g., massive displacement into or out of the population; addition/reduction of sentinel surveillance sites),
- Account for changes in the case definitions of COVID-19, SARI, ILI, and ARI, and
- Account for changes in the proportion of health facilities reporting weekly.

The **geographical distribution** of incidence should also be monitored, particularly in the early stages of the epidemic. In addition to identifying spread to new geographical areas, the spatial distribution of cases may indicate linkages to COVID-19 'hot spots' such as camp blocks or inpatient health facilities. Finally, a **description** of the characteristics of suspected cases is essential for understanding the local risk of symptomatic COVID-19 and indicating health-seeking behaviour and access to health care in the population.

Table 4 describes the analysis, interpretation and use of incidence monitoring data. Outputs should be triangulated with other surveillance data to contextualise results and explain anomalies or unexpected findings.

Table 4: Analysis, interpretation and use of incidence monitoring data*

Analysis outputs	What can be interpreted	Use in practice
Epidemic curves for suspected COVID-19, SARI, ILI, and ARI	• The current phase and short-term trajectory of incidence (increasing, plateauing, declining) • How fast the infection is spreading (slope) • The impact of control interventions (flattening or continuing to rise)	• Trends facilitate appropriate pacing of interventions (prevents early over-reaction or delayed response), and division of resources (response in the current phase and preparedness for next phase) • Trends help reveal the impact of control interventions and identify when adaptations may be needed • Incidence data provides the basis for mathematical modelling to calculate key parameters like the time-varying reproduction number
Spatial distribution of suspected COVID-19, SARI, ILI and ARI: • Spot maps (early stages) • Heat map (sustained community transmission, e.g., cases per 10,000 population)	• The geographic spread of the epidemic • Identifies clusters of cases / chronic 'hot spots' of transmission (e.g., camp blocks, inpatient health facilities)	• Identifies clusters of cases linked to areas of residence and congregation (e.g., markets or places of worship), or recent mass population movement
Description of suspected COVID-19, SARI, ILI and ARI cases by age, sex, presence of at least one co-morbidity, displacement status and distance to the nearest functioning health facility, using: • Tabulation, pie or bar charts for proportions • Age/sex pyramids	• Who at higher/lower risk of symptomatic COVID-19? • Who less likely to seek/access care for COVID-19? • These should be regularly analysed to observe changes in characteristics of COVID-19 cases	• Identifies the local risk profile of symptomatic COVID-19 cases (to quantify the expected population at risk of symptomatic COVID-19) • Allows investigation of patterns that may indicate challenges in access to care or changes in health-seeking behaviour, e.g., significant disparities in cases by gender or displacement status

** ILI, SARI and ARI outputs should be compared with that of suspected COVID-19, and with historical data*

4.2 Monitoring the severity of COVID-19

Changes in severity are detected by analysing trends in hospitalisations and deaths among confirmed and suspected COVID-19 cases, and SARI cases. Where data is available, unexpected increases in hospitalisations among high-risk groups (≥60 years, persons with co-morbidities) may indicate:

- Changes in access to health services: increasing severity of cases may indicate crisis-driven disruptions in access to health care with cases presenting at more advanced stages of illness. It may also indicate that existing hospital capacity is nearing saturation or is struggling to provide adequate clinical care.
- A late change in COVID-19 incidence: for example, increased hospitalisations may indicate increased incidence in the preceding two weeks, as the average time from symptom onset to hospitalisation ranges from 2 to 6 days[10,11,12]
- Changes in health-seeking behaviour: for example, a reduction in hospitalisations may indicate changes in health-seeking behaviour where people are intentionally avoiding hospitalisation due to fear, stigma or other factors.

To ensure reliable interpretation of changes in severity:

- Compare with relevant SARI hospitalisation data from previous years for the same period, to account for seasonal variations,
- Account for changes in access to inpatient COVID-19 care, e.g., expansion of hospitalisation capacity,
- Account for changes in coverage of the surveillance system (e.g., addition/reduction of sentinel surveillance sites),
- Account for delayed recording of hospitalisations, by retrospectively updating the number of hospitalisations for preceding weeks and repeating the analysis.

Monitoring severity is also essential for describing the **local risk profile of severe and fatal COVID-19**, in terms of demographics, accessibility to health services and other vulnerabilities related to the humanitarian crises, such as displacement status. Quantifying the expected population at risk of severe and fatal COVID-19 facilitates appropriate prioritisation and allocation of resources.

Table 5 describes the analysis, interpretation and use of severity monitoring data. Outputs should be triangulated with other surveillance data to contextualise results and explain anomalies or unexpected findings.

Table 5: Analysis, interpretation and use of severity monitoring data*

Analysis outputs	What can be interpreted	Use in practice
Description of severe suspected COVID-19 and SARI cases by age and sex (at a minimum), presence of at least one co-morbidity, displacement status, and distance to the nearest treatment facility • Tabulation, pie or bar charts for proportions • Age/sex pyramids	Who is at higher risk of severe COVID-19 (i.e. requiring hospitalisation)?	Identify and quantify the expected population at risk of severe COVID-19 for the planning of targeted prevention interventions (e.g., shielding) and case management services
Description of suspected COVID-19 and SARI deaths by age and sex (at a minimum), presence of at least one co-morbidity, displacement status, and distance to the nearest treatment facility • Tabulation, pie or bar charts for proportions • Age/sex pyramids	Who is at higher risk of dying from COVID-19?	Identify and quantify the expected population at risk of death from COVID-19 for the planning of targeted prevention interventions (e.g., shielding) and case management services
Cumulative hospitalisation incidence rates of suspected COVID-19 and SARI, overall and by age and sex (at a minimum), presence of at least one co-morbidity, displacement status, and distance to the nearest treatment facility	Are hospitalisation trends following the COVID-19 epidemic curve (with an approximate 2-week lag)? If not, why?	Investigate trends that may indicate: • challenges in access to inpatient COVID-19 care, e.g., existing hospital capacity is nearing saturation or is unable to sustain the provision of quality clinical care. • changes in health-seeking behaviour, e.g., cases presenting at more advanced stages of illness
Cumulative death rates of suspected COVID-19 and SARI, overall and by age and sex (at a minimum), presence of at least one co-morbidity, displacement status, and distance to the nearest treatment facility	Are mortality trends following the COVID-19 epidemic curve (with an approximate 3-week lag)? If not, why?	Investigate trends that may indicate: • challenges in access to inpatient COVID-19 care, e.g., existing hospital capacity is nearing saturation or is unable to sustain the provision of quality clinical care. • changes in health-seeking behaviour, e.g., cases presenting at more advanced stages of illness
Case fatality ratio (CFR) among suspected COVID-19 and SARI, overall and by age and sex (at a minimum), by critical versus non-critical status, age, sex, presence of at least one co-morbidity, displacement status, and distance to the nearest treatment facility.	• Is CFR broadly in-line with expected values? If not, why? • Are CFR trends increasing/decreasing?	Indicates clinical care capacity and quality (typically, CFR is high during the early stage of the epidemic, with trends decreasing over time as the number of cases increases, the health workforce gains expertise and health service capacity improves)

**SARI outputs should be compared with that of suspected COVID-19 and with historical data where available*

4.3 Monitoring mortality during a COVID-19 epidemic

Changes in all-cause mortality are a late indicator of COVID-19 incidence. Changes in mortality lag approximately three weeks behind changes in incidence, as the average time from symptom onset to death ranges from 17 to 23 days[13,14].

More importantly, prospectively monitoring all-cause mortality may be the only indicator for tracking the epidemic in settings where there is little testing, health services are compromised, or people are choosing not to report or seek health care (due to stigma or loss of confidence in services). Where pre-epidemic community mortality data is available, monitoring **changes in excess mortality** can help quantify direct COVID-19 mortality and indirect mortality due to the impact of the epidemic and response measures on accessibility to health services.

To ensure reliable interpretation of changes in mortality:

- Compare with mortality data from previous years for the same period, to account for seasonal variations,
- Account for changes in the size and demographics of the population under surveillance (e.g., massive displacement into or out of the population),
- Account for changes in coverage of the mortality surveillance system (e.g., addition/reduction of mortality data sources or surveillance sites),
- Account for delayed recording of deaths, by retrospectively updating the number of deaths for preceding weeks and repeating the analysis.

In addition to the information provided in section 2.1.3, further guidance for mortality surveillance during a COVID-19 epidemic from WHO is available here.

Table 6 describes the analysis, interpretation and use of mortality monitoring data. Outputs should be triangulated with other surveillance data to contextualise results and explain anomalies or unexpected findings.

Table 6: Analysis, interpretation and use of mortality monitoring data*

Analysis outputs	What can be interpreted	Use in practice
Total deaths: The total number of deaths from all causes during the reporting period (by age group and sex, where available) Cumulative crude (all-cause) mortality rates Excess deaths: The total number and percentage above or below the historical average number of deaths during the reporting period (by age group and sex, where available) Cumulative excess mortality rates Community deaths suspected to be due to COVID-19	Are crude mortality trends following the COVID-19 epidemic curve (with an approximate 3-week lag)? If not, why? Are crude mortality trends similar across age groups and sex? If not, why? Are excess mortality trends compatible with trends in deaths of suspected COVID-19 cases? If not, why? Are excess mortality trends similar across age groups and sex? If not, why? Is access to care poor, reflected by increasing numbers of community deaths?	Investigate trends that may indicate changes in health-seeking behaviour, e.g., loss of confidence in health services, stigma related to COVID-19 and consequent underreporting Investigate trends that may indicate disruptions in non-COVID-19 health services, e.g., diversion of resources from non-COVID-19 health services, mobility restrictions affecting physical access to health services Investigate patterns that may indicate gaps in geographical coverage or performance of IBS and EBS
If cause-of-death data are available: Percentage of excess deaths due to COVID-19 Percentage of excess deaths due to SARI*	To what extent are excess deaths attributed to suspected COVID-19 and SARI?	Appropriate division of resources between COVID-19 mitigation and other life-saving public health measures

**SARI outputs should be compared with that of suspected COVID-19 and with historical data where available*

5 Monitoring trends in COVID-19 risk behaviours

Controlling incidence, severity and mortality from COVID-19 relies predominantly on human behaviour. Response measures restricting population movement and aiming for widespread and rapid behavioural changes have featured strongly in COVID-19 responses around the globe.

In humanitarian settings, compliance with preventative behaviours is likely to be further challenged by poor living conditions and lack of resources. Monitoring behaviours related to COVID-19 during the epidemic is a critical component of comprehensive surveillance for:

- Providing a behavioural context for interpretation of observed COVID-19 epidemic trends,
- Monitoring the impact of behaviour change interventions and informing adaptations.

Research, monitoring and evaluation activities are increasingly common parts of humanitarian responses and, especially during an epidemic, are a useful way to facilitate two-way communication[15]. Here, we propose two approaches for monitoring COVID-19-related behaviours in crisis-affected settings: rapid, real-time behavioural surveillance through regular communication with key informants, and serial cross-sectional behavioural surveys of households. Responders in humanitarian settings can adopt either approach or implement both, depending on operational feasibility, resource availability and information needs. Tables 7 and 8 describe the key features of each.

Table 7: Features of rapid real-time behavioural surveillance

Features	Rapid, real-time behavioural surveillance
Purpose	To detect substantial shifts in the prevailing attitudes and behaviours in the population, using a convenience sample
How often?	Weekly or monthly, and adapted based on the intensity of community transmission
Data sources	Key informants (gender-balanced) in the community, e.g., community health workers, EBS informants, community leaders, religious leaders, healthcare workers
Methods and variables	Qualitative inquiry (and direct observation, if feasible), using a short set of open-ended questions which can be administered by telephone or at a safe distance outside of households. Further guidance from the Hygiene Hub on remote qualitative methods for monitoring behaviours can be adapted to different contexts. Variables: • Risk perceptions of COVID-19 • Perspectives of community compliance with core COVID-19-related behaviours: handwashing, respiratory hygiene, mask-wearing, physical distancing outside the home, shielding of high-risk family members inside the home, compliance with social distancing policies (e.g., movement restrictions and banning of mass gatherings), health-seeking behaviour, • Prevalent misinformation/ rumours, • Challenges undermining behaviour compliance (e.g., economic pressures, social norms))), • New measures to encourage or support behaviour compliance (e.g., self-organised community action, public statements/actions by influencers).
Analysis outputs	• Broad patterns in core COVID-19-related behaviours (low, moderate, high compliance) • Emerging rumours/misinformation • Emerging economic and social obstacles to compliance • Emerging opportunities for supporting compliance
Advantages	• Low-resource and does not require formal training • Rapid detection of significant shifts in behaviour patterns • Facilitates real-time adaptation in risk communication and community engagement interventions
Limitations	• Subjective (biased by informant's and data collectors' personal opinions) • Analysis can be labour-intensive if there is a large amount of data • Does not produce robust estimates of population patterns in COVID-19-related behaviours

Table 8: Features of serial cross-sectional behavioural surveys

Features	Serial cross-sectional behavioural surveys
Purpose	To describe and quantify population patterns of COVID-19 risk behaviours and analyse changes over time. It can be implemented through standalone surveys or integrated with serological surveys.
How often?	Variable. Can be implemented based on changes in incidence trends or response measures. However, for surveillance purposes, surveys must be repeated over time to allow for the monitoring of trends.
Data sources	Population-based household survey. For surveillance purposes, the geographical scope of the survey is determined by the coverage of IBS
Methods and variables	Structured administered questionnaire (methods can be adapted from the WHO's behavioural insights tool) which can be administered by telephone or at a safe distance outside of households. Variables: • Risk perception • Self-assessed knowledge • Self-assessed compliance with core COVID-19-related behaviours: handwashing, respiratory hygiene, mask-wearing, physical distancing outside the home, shielding of high-risk family members inside the home, compliance with social distancing policies (e.g., movement restrictions and banning of mass gatherings), health-seeking behaviour • Self-reported enablers and barriers for compliance with core COVID-19-related behaviours • Factors that may affect behaviour: age, sex, presence of at least one co-morbidity, and displacement status.
Analysis outputs	• Risk perceptions, self-assessed knowledge and compliance with COVID-19-related behaviours, by age, sex, presence of at least one co-morbidity and displacement status (tabulation, pie or bar charts for proportions) • Changes in risk perception, knowledge or compliance (compared to previous surveys), by age, sex, presence of at least one co-morbidity and displacement status • Emerging rumours/ misinformation
Advantages	• Changes in behaviour can be quantified and monitored over time • Direct comparison of behaviour and incidence trends • Immediate (automated) data analysis if consistent variables used
Limitations	• Resource-intensive • Lengthy implementation may make results less actionable in a rapidly-changing situation

6 Monitoring trends in prior infection by SARS-CoV-2

6.1 Purpose

Understanding the dynamics of SARS-CoV-2 in the local population is critical for informing the adaptation of control efforts throughout subsequent waves of the epidemic. Although, there is insufficient evidence on the presence and duration of immunity conferred by past infection[16], serological surveys may provide valuable information on immune responses at a population level. Since SARS-CoV-2 is a novel virus, baseline seroprevalence in a population is expected to be zero, and seropositivity can be used to make inferences about the extent of past or current infection in the population.

Serological surveys play an important surveillance role in enhancing situational awareness, given insufficient diagnostic testing in many resource-poor settings[1]. However, humanitarian actors in different settings are advised to decide on the added value of seroprevalence information for action in their specific context, balanced against the potential harms of the surveys, and the optimal use of available resources.

For surveillance in humanitarian settings, serial serological surveys serve two primary purposes:

- monitor temporal and geographical trends of SARS-CoV-2 infection in the population, to provide context for interpretation of incidence trends, and

- describe and monitor the local distribution of infection and (presumed) immunity to SARS-CoV-2, by age, sex, presence of at least one co-morbidity known to be associated with increased risk of severe illness from COVID-19 and displacement status, to inform targeted interventions.

6.2 Main features

Serial serological surveys should be conducted on a representative sample of the population of interest, to enable appropriate interpretation of trends and adaptations to population-wide response measures. The geographic scope of the survey is determined by the coverage of surveillance and must remain consistent in subsequent surveys to allow for monitoring of trends.

The baseline survey should be conducted, at the earliest, 21 days after widespread community transmission is thought to have likely been established, to ensure that new infections have had time to develop a detectable antibody response. Subsequent surveys should be repeated at least 3 weeks apart, in response to potential changes in susceptibility and immunity (e.g., massive displacement in or out of the geographic area, subsequent waves of the epidemic), or unexpected trends in incidence.

Where resources are scarce, serological surveys may focus on inferring the extent and distribution of infection in workers in health facilities, who are at high risk of exposure to SARS-CoV-2 and may potentially fuel community transmission, or, alternatively, they may be abandoned if they cannot be done with sufficient geographic resolution in the general population to be informative[1], or if scarce resources are deemed to be better used to enhance other surveillance activities, e.g. geographical expansion or increasing frequency of testing in IBS.

At a minimum, the following data is used to describe infection in the local population:

- Presence or absence of antibodies against SARS-CoV-2 in serum samples
- Demographics: age, sex, displacement status, residence
- Clinical history: a history and timing of compatible symptoms since COVID-19 was first detected in the population, the presence of co-morbidities known to be associated with a higher risk of COVID-19. Clear clinical history needs to be taken prior to sampling to identify people who are likely to have current COVID-19
- History and timing of potential exposure to SARS-CoV-2: occupation, history of contact with suspected/confirmed COVID-19 cases, travel history

While WHO does not recommend SARS-CoV-2 antibody tests for confirmation of COVID-19 immunity to inform targeted interventions, they can be used in serological surveys to measure past infection in the population[7]. Rapid diagnostic tests (RDT) on serum samples are feasible in humanitarian settings where access to sophisticated laboratories is limited. Despite imperfect sensitivity and specificity of RDTs for antibody detection, their use in serial serological surveys in the same geographic area will provide consistent information on trends. While the WHO has not yet officially approved specific antibody-based RDTs, updated information on the performance of independently-evaluated commercial tests can be found here.

Table 9 describes the analysis outputs and interpretation of serial cross-sectional serological surveys for surveillance purposes.

The WHO's seroepidemiological investigation protocol for COVID-19 virus infection provides guidance on serological surveys. The protocol can be adapted and contextualised according to the capacity and resources available in any particular setting.

Table 9: Analysis and interpretation of serial cross-sectional serological surveys for surveillance*

Analysis output	What can be interpreted
Attack rates (proportion of seropositive persons): overall and by age group, sex, (at a minimum), presence of at least one co-morbidity, displacement status, and history of potential exposure to SARS-CoV-2	• An estimate of the extent of SARS-CoV-2 infection in the population, overall and by age group, sex, (at a minimum), presence of at least one co-morbidity, displacement status, and history of potential exposure to SARS-CoV-2 • Trends of SARS-CoV-2 infection in the population, overall and by age group, sex, (at a minimum), presence of at least one co-morbidity, displacement status, and history of potential exposure to SARS-CoV-2 • Are trends compatible with trends observed in clinical COVID-19 surveillance? If not, why?
The proportion of symptomatic and asymptomatic persons: ○ out of all those tested ○ out of all seropositive persons If the sample is sufficiently large: by age, sex, (at a minimum), presence of at least one co-morbidity, displacement status, and history of potential exposure to SARS-CoV-2	• Who is at higher/lower risk of symptomatic COVID-19 (risk factors associated with symptomatic SARS-CoV-2 infection)? • Trends of symptomatic/asymptomatic COVID-19 in the population, overall and by age group, sex, (at a minimum), presence of at least one co-morbidity, displacement status, and history of potential exposure to SARS-CoV-2

**assuming a population-based survey*

7 Conclusion

COVID-19 trends in low- and middle-income countries have so far, been difficult to discern with certainty, due to low testing capacity, inapparent illness, and poor access to health care in general. However, the absence of exhaustive testing capacity for COVID-19 in humanitarian settings cannot justify weak surveillance and response. COVID-19 surveillance in humanitarian settings is likely to be challenged by numerous factors, including limited testing resources. We propose that appropriate and effective surveillance for mitigation and control of COVID-19 in humanitarian settings can be achieved by improving existing surveillance systems, and adding high-yield surveillance activities.

We suggest that surveillance system staff should leverage existing surveillance systems, have specific and action-oriented goals, rapidly analyse and react to diverse information sources, and should avoid triggering or exacerbating vulnerabilities in the population under surveillance. In addition to early detection and rapid response, we propose that COVID-19 surveillance should monitor incidence, severity, mortality, protective behaviours and past infection trends. We describe practical ways to optimise existing systems to enable COVID-19 surveillance, and demonstrate ways in which incidence, severity and mortality data can be used to infer information about the epidemic and the population's response. Finally, we propose the use of behavioural and serological surveillance to generate additional actionable information to support response design and implementation.

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Annex 1. Syndromic and community case definitions of COVID-19, SARI and ILI

1. WHO – COVID-19 syndromic (suspect) case definitions (last updated March 20, 2020)

Source: *Global surveillance for COVID-19 caused by human infection with COVID-19 virus*

A. A patient with acute respiratory illness (fever and at least one sign/symptom of respiratory disease, e.g., cough, shortness of breath), AND a history of travel to or residence in a location reporting community transmission of COVID-19 disease during the 14 days prior to symptom onset;

OR

B. A patient with any acute respiratory illness AND having been in contact with a confirmed or probable COVID-19 case (see definition of contact) in the last 14 days prior to symptom onset;

OR

C. A patient with severe acute respiratory illness (fever and at least one sign/symptom of respiratory disease, e.g., cough, shortness of breath; AND requiring hospitalisation) AND in the absence of an alternative diagnosis that fully explains the clinical presentation.

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2. WHO SARI and ILI case definitions (last updated January 2014)

Source: *WHO surveillance case definitions for ILI and SARI*

ILI case definition

An acute respiratory infection with:

- measured fever of ≥ 38 C°
- and cough;
- with onset within the last 10 days.

SARI case definition

An acute respiratory infection with:

- history of fever or measured fever of ≥ 38 C°;
- and cough;
- with onset within the last 10 days;
- and requires hospitalisation.

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3. COVID-19 community case definitions (Norwegian Red Cross, currently used by the Somaliland and Senegal Red Cross)

Source: *Community-based surveillance (CBS) for COVID-19*

A. Cough and difficulty breathing which can start with fever, running nose, tiredness, headache, or feeling unwell

Related diseases: COVID-19, acute respiratory illnesses, tuberculosis

B. Cluster of people (3+) suddenly sick or died with the same signs of illness.

Related diseases: any disease including COVID-19

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4. COVID-19 community case definitions (Inter-Agency Standing Committee, example to be adapted)

Source: *Public Health and Social Measures for COVID-19 Preparedness and Response In Low Capacity And Humanitarian Settings*

A. Fever + dry cough + difficulty in breathing
B. Unusual cluster of illnesses or deaths in a community
