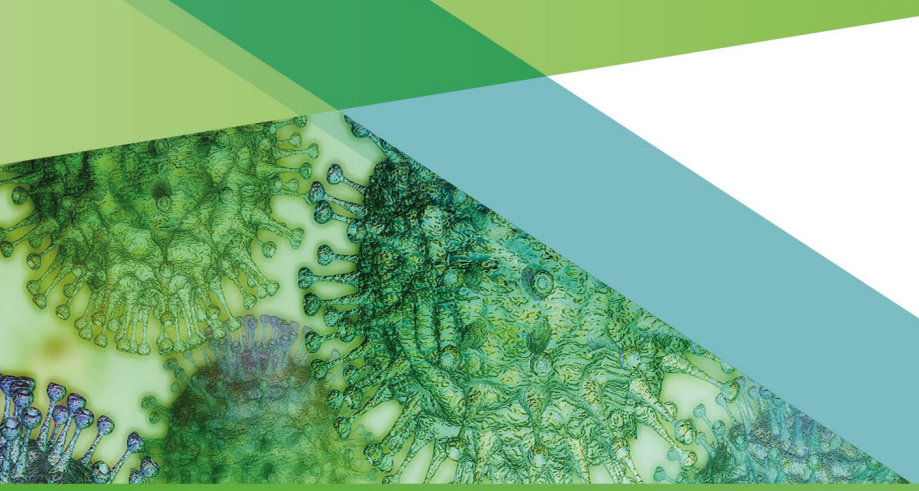

ECDC TECHNICAL REPORT

Conducting in-action and after-action reviews of the public health response to COVID-19

June 2020

Introduction

The unprecedented events of the COVID-19 pandemic have placed enormous strain on the health and economic systems of countries worldwide. In roughly 20 EU/EEA countries, it appears that physical distancing measures have had an impact and that the initial wave of transmission has started to decline [1]. Given that the COVID-19 pandemic is not expected to end for at least several more months, there is a need to assess what has happened so far, to identify strategic priorities, and to exchange lessons learned [1-3]. This will help to optimise the response to the next phases of the COVID-19 pandemic, by providing an evidence-based approach to identifying and implementing new actions based on the lessons learned. It may also help identify appropriate de-escalation strategies [4]. During later phases of the pandemic, countries will be advised to review their full response to COVID-19. Systematically identifying and acting upon lessons from the COVID-19 pandemic will be of the utmost importance to guide preparedness and response planning and strengthen health systems in the coming years.

Scope and purpose of this document

This document aims to support the implementation of after-action reviews (AARs) and in-action reviews (IARs) focused on the public health response to COVID-19. After-action reviews are structured, qualitative reviews of the actions taken during the response to identify best practices, gaps and lessons learned. After-action reviews may address all dimensions of a public health response, or they may just focus on the detail of particular elements. Similar to AARs, IARs seek to identify best practice and lessons learned, but they seek to apply these insights in a tighter time-scale to improve the outcome of an ongoing response. In-action reviews may also include a 'forward-look' to assess strategic options in the upcoming phases of the pandemic.

This document is designed to complement existing ECDC and WHO documentation about AARs, and it draws on ECDC guidance documents related to emergency preparedness planning and response, in particular, documents published in the context of COVID-19. It is intended to support IARs and AARs by highlighting the basic planning and implementation stages. Following a brief overview of AAR and IARs, Part 1 reviews the main phases for planning and conducting AARs and IARS: designing, planning and implementing. Part 2 discusses specific considerations relating to IARs and AARs focused on COVID-19. This includes a comprehensive list of 'trigger questions' for COVID-19 (presented in Annex 3). These have been prepared to guide the design and facilitation of IARs/AARs focused on the public health response to COVID-19. The trigger questions are informed by multiple sources including ECDC Rapid Risk Assessments for COVID-19; ECDC Technical Guidance on COVID-19; WHO Guidance for After Action Review and its associated database of trigger questions [5]; lessons learned from three European case studies of preparedness planning for MERS-CoV [6]; options for public health response as identified and available during the outbreak [7]; WHO's Joint External Evaluation Tool [8]; the joint ECDC/WHO Guide to revision of national pandemic influenza preparedness plans - lessons learned from the 2009 A(H1N1) pandemic [9] and the WHO Interim Guidance on strengthening preparedness for COVID-19 in cities and other urban settings [10].

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Target audience

Public health authorities in EU/EEA Member States, the United Kingdom, EU candidate and potential candidate countries and European Neighbourhood Policy countries.

Background after-action and in-action reviews

This document covers both after-action reviews (AARs) and in-action reviews (IARs). While substantial literature exists on the practice of AARs, much less is available on IARs. The general idea behind this document is that while the same principles apply for both, an IAR is necessarily smaller in scale and scope, and conducted within a shorter period.

After-action reviews

An AAR seeks to review actions undertaken during the response to an event of public health concern by objectively observing, analysing gaps and/or best practices and identifying areas for improvement in preparedness and response activities [5]. An AAR or IAR does not seek to apportion blame. Instead, an AAR/IAR seeks to identify learning opportunities and to contribute to the cycle of continuous quality improvement in emergency preparedness and response planning [11].

After-action reviews typically seek to address five common questions:

- What happened during the response (and what was supposed to have happened)?
- Why did it happen?
- What can be learned?
- What should change?
- Have changes taken place?

In-action reviews

While an AAR will seek to identify good practice and areas for improvement over longer time-periods, the scope and duration of the response to COVID-19 may create the need for targeted and relatively rapid reviews of response operations. To accommodate this, we have introduced the term in-action review (IAR). The purpose of an IAR should be to quickly identify readily-implementable actions to immediate and pressing issues that will improve the current response. An IAR therefore shares similar principles to AARs as well as to other related approaches, such as intra-action reports [13].

Ideally, an IAR may include not only a rapid review of what has already happened during a response, but also a look-ahead towards emerging issues that may require a shift or modification of the response strategy.

Thus, in seeking to be relevant to an ongoing response, an IAR can be viewed as a speedier, streamlined version of an AAR (Table 1).

Table 1. Comparison of AARs and IARs

	After-action reviews (AARs)	In-action reviews (IARs)
Objective	Seeks to address in detail: • What happened? • Why did it happen? • What can be learned (from good practices, gaps, and challenges)? • What should change? • Have changes taken place?	Seeks to quickly address: • What is happening? • What emerging issues are on the horizon? • What can be learned (from good practices, gaps, and challenges)? • What should change? An IAR does not replace the need for an AAR.
Scope	Can address all aspects of an emergency response, or can focus on specific areas	Best suited to focus on 1–2 specific response areas
Timeframe for implementation	Target - three months after completion of an emergency response.	Within the response; to be conducted and implemented with very minimal time commitment.

Part 1. Designing and implementing after-action and in-action reviews

There are, broadly speaking, four key phases for conducting AARs and IARs: design, preparation, implementation, and dissemination (Figure 1).

Ideally, an AAR should follow all responses to public health emergency events, irrespective of the perceived success of the response and without seeking to allocate blame to individuals or organisations. It is generally recommended to conduct an AAR reasonably soon after an event to ensure that key stakeholders are engaged, accessible and that they have a good memory of the event.

Figure 1. Phases for conducting AARs and IARs

Design	Prepare	Implement	Disseminate
Define the scope of the AAR/IAR, including which response area to assess.	Collect information on the event in question relevant to the scope of the AAR/IAR.	Conduct AAR/IAR workshop(s) according to preferred methodology (e.g. event-storming, interviews, facilitated look-back).	Collate findings in a final report documenting methodologies, results, conclusions; ensure summaries of good practices and lessons learned, supported by evidence where available.
Conduct stakeholder analysis to ensure appropriate stakeholders and sectors are involved.	Prepare trigger questions and interview questionnaires (if required).	Debrief all participants with preliminary findings	Distribute final report as widely as is feasible and appropriate.
Select an appropriate AAR/IAR methodology based on best practices in AARs.	Brief and train (if required) team members, including facilitators.	Evaluate the AAR/IAR itself among participants	Develop an action plan for implementing key recommendations.
Define the AAR/IAR team	Gather necessary material for workshop(s) and interviews.		
Develop a detailed agenda			
Select date and venue for workshops and/or interviews.			
Estimate and allocate budget.			

Box 1. Guidance documents and tools to assist the design and implementation of AARs

- WHO Guidance for AAR [5]
- ECDC report on best practices in conducting AARs to enhance public health preparedness [11]
- WHO Country Implementation Guidance on After Action Reviews and Simulation Exercises [14]
- Intra-action report documentation [13]
- Facilitated look-backs [15]
- Published examples of AARs [16-18].

1. Design

1.1 Define the scope and objectives

The planning for an AAR/IAR should be initiated several months in advance and at least two-to-three weeks before implementation. Smaller-scale AARs or IARs might require less planning, but could be more challenging to organise amidst an ongoing outbreak.

The responsibility for initiating, planning and preparing an AAR/IAR should be clearly defined and assigned to staff members skilled in conducting AARs and/or monitoring and evaluation processes. Ideally, the steps, roles and responsibilities in planning for an AAR/IAR should be established during routine public health emergency preparedness planning ahead of any public health event to enable rapid implementation during or after a disease outbreak. An AAR/IAR involving several departments or institutions can be led by a cross-sectoral AAR/IAR team with clearly-defined mandates and responsibilities (see 1.4 Set up the team).

The first step in planning for an AAR/IAR is to define the scope in order to select an appropriate AAR format and methodology (see 1.3 Select the methodological approach), as this will inform decisions on the duration, budget, facilitation and selection of participants and trigger questions [5]. The scope of an AAR or IAR should be defined by such aspects as:

- the scale of the event;
- the number of public health response areas selected for review;
- the anticipated availability of key participants (see 1.2 Identify stakeholders); this may be particularly important to consider during an IAR, where time is of the essence;
- which phases of an emergency response are selected for review (e.g. alert phase, the control phase, all phases).

1.2 Identify stakeholders

It is recommended that a wide and appropriately diverse range of stakeholders in technical and managerial roles at appropriate administrative levels (local to national) should participate, taking into consideration the scope and objectives of the AAR or IAR [5]. A stakeholder matrix can help identify experts and institutions to participate in the AAR or IAR. Moreover, planners can use the matrix to document the stakeholder selection process, which improves the methodological validity of AARs [16]. An example of a stakeholder matrix is presented in Annex 1.

1.3 Select the methodological approach

The selection of an appropriate format and methodology for AARs or IARs will depend upon the overall objectives. For both AARs and IARs, important factors to consider include:

- the scope and objectives;
- the immediacy of improvements required and the type of review planned;
- best practice standards in designing and reporting AARs (Figure 2);
- the human and financial resources available to manage and conduct the AAR/IAR;
- the timing of the AAR/IAR in the context of ongoing response activities;
- the desired range of staff and stakeholder participants;
- the cultural context (e.g. which might determine factors such as whether open discussion would be possible in larger, plenary formats).

In general, the AAR principles and methodologies also apply to IARs, but in case of the latter, the methodology may need to be streamlined and consolidated to be efficiently and quickly undertaken.

There is no standard format for conducting an AAR or IAR; a wide range of methodologies are typically deployed [11, 19]. The WHO Guidance for AARs introduces tools and resources for the planning and implementation of the four main AAR formats [5]:

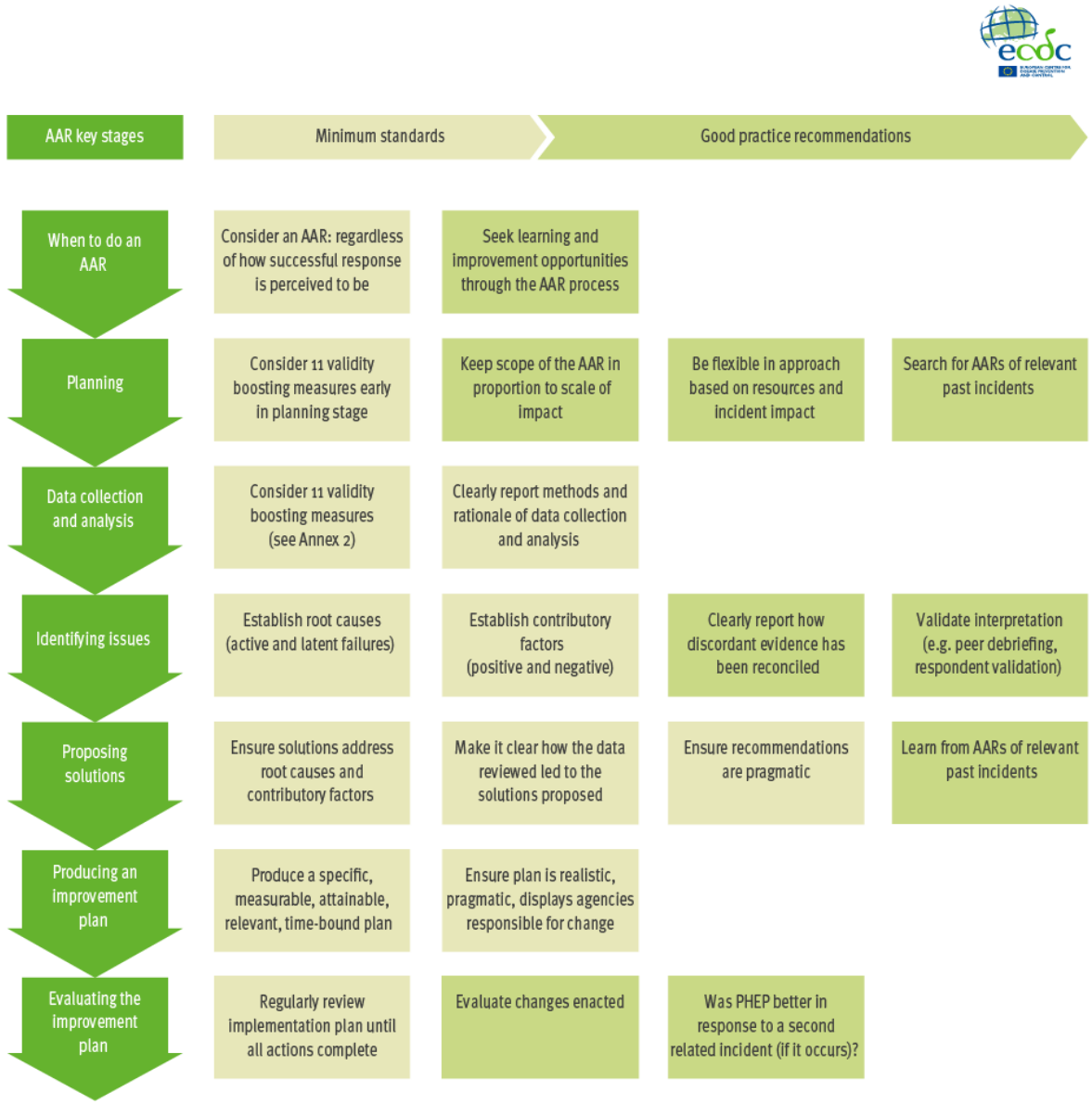
- debrief
- working group
- key informant interview
- mixed-method (including the three above).

Other approaches that have been commonly deployed in AARs include workshops, documentary review, formal public consultations, focus groups, questionnaires, site visits and facilitated look-backs [11].

Irrespective of the methodologies selected, attention should be paid to the methodological validity of an AAR/IAR. ECDC's best practice recommendations for conducting AARs suggest that AARs ideally combine mixed methodologies and principles from qualitative research such as triangulation, negative case analysis, peer

debriefing and respondent validation so as to enhance their validity (Annex 2) [11]. These recommendations have been combined into a best-practice framework for undertaking an AAR (Figure 2).

Figure 2. Best-practice framework for conducting an AAR



1.4 Set up the team

The AAR/IAR scope and format will determine the size, members and roles of the team. The AAR/IAR team should include actors from all departments, institutions and sectors participating in the AAR/IAR or engage with them during the planning, preparation and implementation process. The AAR team could also include external experts, (e.g. from ECDC or WHO) in the case of assisted AARs.

Example of AAR/IAR team composition:

- AAR/IAR leaders (typically senior staff from a public health institute who may eventually be responsible for implementing the action plan identified in the AAR/IAR);
- Lead facilitator or interviewer (ideally somebody independent);
- Group facilitators and interviewers;
- Subject matter experts;
- Note takers;
- Report writers.

The terms of reference of an AAR team are available in Annex 6 of WHO's Guidance for AAR [5]. The composition of the AAR team should be flexible and responsibilities might overlap; not all the roles described will be required and one person can fulfil several roles. Due to time restraints and other limitations during an ongoing outbreak, it might not be feasible to involve all relevant actors, departments and sectors in the IAR team.

Box 2. Recommended learning

The AAR/IAR team members should possess the knowledge and skills required to successfully manage and facilitate an AAR or IAR (see 2.3 Brief team members). For this purpose, WHO has designed an AAR E-learning Course for health professionals interested in reviewing a health emergency response. After following the short course, AAR planners should be able to identify the necessary resources for conducting an AAR, distinguish roles and responsibilities of AAR team members and facilitate an AAR in the working group format.

1.5 Develop the agenda for in-person meetings

The design of the agenda, like the choice of methodology, is necessarily commensurate to the scope of an IAR/AAR. Agenda and concept note templates for different methodological formats (debrief, working group, interviews) are available in the WHO AAR Toolkit [20].

In-action reviews and AARs can be successfully implemented in any time frame. They could range from a half-day in-person meeting to a more comprehensive four or five day agenda comprising working groups, interviews, and plenary sessions.

To provide an example here, a mixed-method AAR format was applied over a four-day period in four European countries to look into the response to an abnormally strong season of West Nile virus. Figure 3 provides an example of the agenda followed during the in-person phase of this AAR.

Figure 3. Example of the in-person phase of an AAR, which took place over four days with working group and interview sessions

<table>
<tr><th>Day 1</th><th>Day 2</th><th>Day 3</th><th>Day 4</th></tr>
<tr><td>(Arrival of team)</td><td rowspan="2">Interview session 1</td><td rowspan="2">Interview session 3</td><td rowspan="2">Buffer period/elaboration of findings</td></tr>
<tr><td>Welcome and briefing</td></tr>
<tr><td rowspan="3">Working group session</td><td rowspan="3">Interview session 2</td><td rowspan="3">Interview session 4</td><td rowspan="2">Debriefing and validation</td></tr>
<tr><td>Conclusion and closing remarks</td></tr>
<tr><td>(Departure of team)</td></tr>
</table>

1.6 Select date and venue

An AAR should be conducted reasonably soon after the public health event (within three months of the official declaration of the end of an event as recommended by WHO), and the planning should start approximately one month before the actual AAR takes place. This will give planners enough time to specify the size and structure of the AAR, which will inform the logistical decisions. An IAR will require a more flexible planning approach in order to identify a suitable date and venue, as travel restrictions and/or physical distancing measures might not allow for physical meetings. Therefore, planners could consider possibilities for conducting AARs/IARs virtually by means of video-or teleconferences and phone interviews.

1.7 Estimate and allocate the budget

The AAR budget should be estimated at an early stage, as soon as the format and number of participants have been decided upon. The AAR or IAR scope and agenda should be compliant with the project budget, in particular in resource-limited settings. Budget templates are available in the WHO AAR toolkits for different AAR formats (debrief, working group, interviews) and can be combined and customised to match the desired AAR/IAR format [20]. Typically, the budget involves the costs for facilitators, attendance of participants, a venue and conference room.

2. Preparation

2.1 Collect background information

Collecting and reviewing relevant background information on the public health event in the context of the IAR or AAR is an important step in order to prepare facilitation tools such as trigger questions [5].

The effort required for the collection of background information is expected to be commensurate with the scope of the IAR/AAR. Relevant background information can include national pandemic preparedness plans; past evaluations or AARs; trajectory of the outbreak and timeline of response activities; risk and situational assessments and relevant media reporting. For a full-scale AAR, a substantial amount of time may need to be invested in this stage to ensure that the later phases of the AAR are well prepared. Where it is possible to begin collecting background information during the public health event, this is to be encouraged.

2.2 Prepare questionnaires

Trigger questions are used to guide discussions with a group or with individuals and are organised according to which area of the public health response is being examined. As WHO notes, questions should be tailored to the context of an AAR, and should be open-ended as their primary aim is to generate discussion. The purpose of the list of trigger questions provided in Annex 3 is to facilitate the design of AARs or IARs focused on the public health response to COVID-19. It is important to stress that an AAR/IAR need not address all response areas identified in Annex 3, and there may be other response areas not covered here.

2.3 Brief team members

Coordination meetings with all AAR/IAR team members should be scheduled several days before the AAR/IAR to familiarise the team with the objectives, agenda, roles and responsibilities. If necessary, AAR/IAR team members should be trained in their roles by the lead interviewers/facilitators or the AAR leaders (see Box 2 in Section 1.4 for recommended learning). The WHO Guidance for AAR recommends that interviewers should not have been involved in the response under review to ensure confidentiality and open feedback [5]. The lead facilitator should ideally be external to the response, but other facilitators could be selected from internal or external sources.

Moreover, interviewers and facilitators should:

- Be familiar with the background information;
- Have sound knowledge of the technical areas under review;
- Be familiar with the AAR/IAR methodology and interview guide;
- Remain impartial and not influence group or individual feedback;
- Have excellent interpersonal and communication skills;
- Be fluent in the language used by participants;
- Have some authority among participants;
- Have the ability to drive critical discussion.

2.4 Gather material for workshops and interviews

The AAR/IAR lead, lead facilitators and interviewers are responsible for gathering all the necessary materials (e.g. background information, interview guide, material for working groups) for the AAR/IAR sessions. Background and guidance material should be distributed to the AAR/IAR team before the preparatory meetings.

3. Implementation

3.1 Conduct workshops

In-action reviews

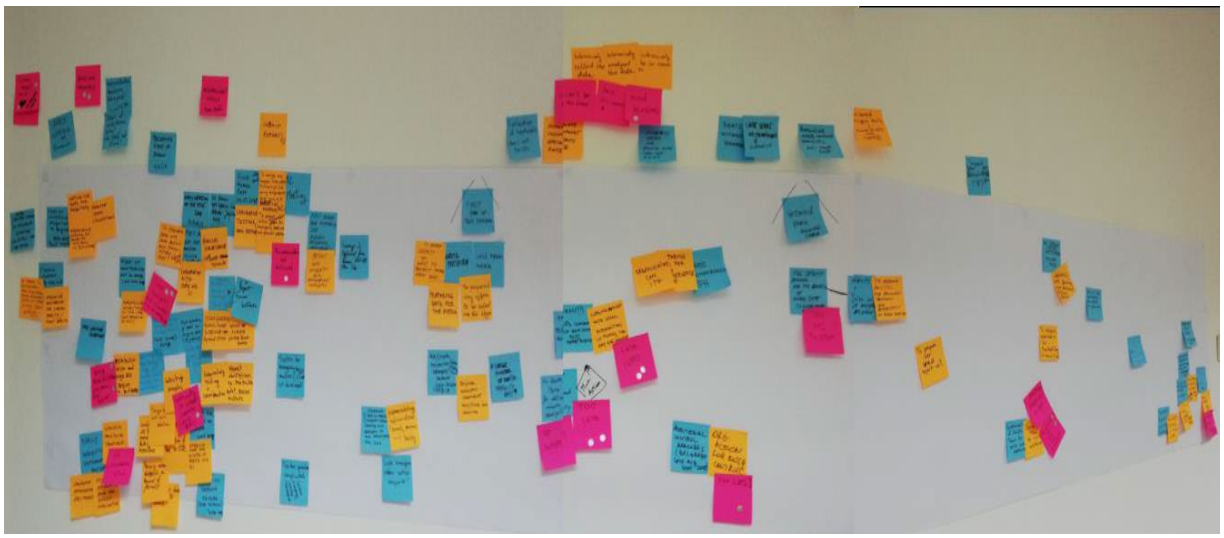
The workshop format for an IAR will necessarily be designed to be completed within a rapid timescale. A working group process, such as an 'event-storming' workshop [21] or a debriefing workshop [20], would be the most suitable. In both approaches, a facilitator would enable group discussion, with the aim being to identify immediate actions to be implemented during the response. WHO has toolkits available for working group processes [20]. In an 'event-storming' workshop, participants would collectively construct a timeline of the key events relevant to the response areas under discussion (see Figure 4). They would then identify aspects of the response that did not function smoothly, or for which improvements are required. The participants collectively prioritise these challenges. Following completion of this exercise and plenary discussion, participants plot a series of actions to be implemented against two axes: impact of improvement, and ease of implementation. This enables the prioritisation of key actions.

After-action reviews

After-action review workshops may take place over several days (see Figure 3). Following extensive preparatory desk-work, an AAR would begin with an initial plenary discussion to explain the scope and objectives of the overall AAR and to discuss participant expectations. Participatory plenary discussions, such as 'event-storming' workshops, would then aim to create a constructive, interactive group dynamic (Figure 5) [21]. An initial timeline of events is reconstructed from the perspective of the participants, and key actions taken by the sectors represented are plotted onto this timeline. Key challenges are then identified, and participants collectively prioritise the most pressing challenges.

In an AAR for a large public health response such as the response to COVID-19, an initial participatory workshop will raise issues that need to be explored in depth. In order to ensure that data collection for an AAR is triangulated and is based upon prolonged contact with relevant experts, it is suggested that the plenary workshop be complemented by semi-structured interviews. The number of interviews to be conducted should be guided by the scope of the AAR, as well as the extent to which they boost its validity. For example, by ensuring multiple data sources and triangulation, and identifying and reconciling viewpoints that contradicts initial findings (see Annex 2). The interviews allow for a more in-depth review of the event and the common barriers that emerged from the 'event storming' session [16]. Interview data can be collected directly in the interview questionnaire (see 2.2 Prepare questionnaires) by both the interviewer and the note taker. It is important that a debriefing session is held with the interview team as soon as possible after each interview. Debriefing sessions reflect on the interview, noting any interesting observations, resolving any uncertainties and agreeing on the main themes that emerged from the interview [16]. Interviewers and note-takers should exchange notes and synthesise them in a single interview form to be shared within the AAR team. Before the validation session on the last day of the AAR, the interview notes should be checked for any pending issues. Following the interviews, the AAR should ensure that the data is stored according to confidentiality and data security agreements.

Figure 4. Detail from an 'event-storming exercise'



Source: ECDC

Figure 5. **Simplified 'event-storming' process**

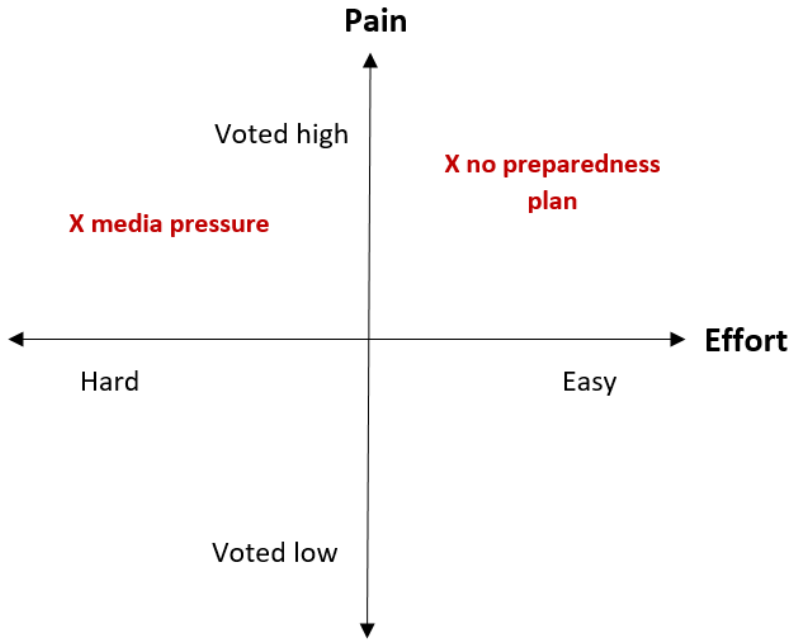
Key event Action	**Step 1: Reconstruction of key events, decisions and actions in a timeline**
	1. Facilitator explains event storming and the use of sticky notes 2. Participants stick key events and actions along an imaginary timeline on plotter paper 3. Participants discuss the temporal order of key events and actions
Pain point	**Step 2: Identification of pain points**
	4. Participants identify pain points along the timeline of events 5. Participants agree on the most common pain points 6. Discussion to achieve a broad common understanding of the whole process.

Analysis options

In general, interview data is analysed by employing qualitative data analysis techniques. Thematic analysis is commonly applied to qualitative interview data in order to identify common patterns and themes. For good methodological practice, it is important that analytical processes and procedures are grounded in theoretical frameworks and well-documented in the final AAR report.

To better understand the greatest challenges encountered during the response, the lead facilitator can map the most important pain points on a chart (Figure 6). Through a voting process, participants can decide on the most important pain points ('pain level', y-axis) and discuss the anticipated effort to address these challenges ('effort', x-axis).

Figure 6. **Example of pain point mapping**



This information should feed into the interview sessions, where interviewers can collect more in-depth information on key events and pain points. Detailed documentation or thorough analysis of the processes identified is not required during the simplified event storming session. AAR facilitators may choose to add an analysis session at the end of the event storming exercise to assess the speed of the outbreak by evaluating the following time intervals [5]:

- Time interval to detection (from outbreak start to outbreak detection);
- Time interval to laboratory confirmation (from outbreak detection to laboratory confirmation);
- Time interval to public communication (from outbreak detection/laboratory confirmation to public communication);
- Time interval to response (from outbreak detection to outbreak intervention).

In addition, AAR participants may engage in a discussion on the impact of their response interventions by interpreting the timeline of activities against the epidemiological curve for the disease [5]. The level and type of analysis applied in the plenary session will depend on the scope and chosen format of the review.

Box 3. Tips for facilitators

- Remind participants to focus on key events and the 'bigger picture';
- Be aware that larger-scale events might be more difficult to reconstruct with more side events/actions;
- Inform participants that every contribution is accepted, as the perception of key events may vary depending on different vantage points;
- Allow for open discussions about the timeline, order and importance of events;
- Remain flexible and anticipate chaos but consider options to sort the sticky notes:
  - Highlight key milestones on the timeline
    - Outbreak start
    - Outbreak detection
    - Outbreak notification
    - Outbreak verification
    - Laboratory confirmation
    - Outbreak intervention
    - Public communication
    - Outbreak end.
  - Identify and separate process flows
    - Sort the sticky notes into different parallel lanes along the timeline (e.g. one lane for surveillance, one for inter-sectoral communication)
    - Use different colours for different key stakeholders (e.g. sectors, agencies).

3.2 Debrief the participants

After-action and IAR review team debriefings should take place at the end of the workshop or in interview sessions to discuss content and build a shared understanding around the collected data. The AAR/IAR team should also debrief the participants and discuss inconsistencies, contradicting insights, overlaps and gaps in the identified processes. Peer-debriefing and respondent validation are important aspects that enhance the overall validity of AARs, and can be achieved at this stage.

After the AAR/IAR has been completed, it is suggested that a final team debriefing is conducted to:

- reflect on the overall planning, preparation and implementation;
- establish roles, responsibilities and timelines for the follow-up actions;
- discuss how to improve the AAR/IAR process;
- discuss and finalise an executive summary for senior management.

3.3 Evaluate the AAR/IAR

Following the AAR/IAR, an evaluation survey can be conducted among the participating stakeholders to determine their views on whether the objectives were met and how the AAR/IAR format could be improved in the future. A short questionnaire can be prepared by the AAR/IAR lead and/or facilitators on the basis of ECDC's 11-item tool for assessing AAR methodological rigour [11]. An AAR evaluation form template is provided in WHO's AAR toolkits [20].

4. Dissemination

4.1 Prepare the AAR/IAR report

The final report should summarise the AAR/IAR methods, results, and conclusions with summaries of good practice and lessons learned [5]. The key output of an AAR should be an action plan for the implementation of recommendations and follow-up actions identified through the AAR/IAR (see 4.3 Develop an action plan) [5]. A report template is available in Annex 10 of the WHO Guidance for AAR and in the WHO AAR toolkits for different formats [5,20].

While full participant consensus on the findings from an AAR may not always be possible, particularly for IARs/AARs that include a wide range of stakeholders, all participants are ideally given the opportunity to comment on the overall conclusions, either through discussion or by providing written comments on a draft version of the report.

4.2 Disseminate the final report

The decision on the dissemination of the final AAR/IAR report should be made during the planning phase and in agreement with senior management. Making the AAR or IAR report publicly available could support both national and international preparedness and response efforts for current and future public health emergencies, and could encourage other countries to implement AAR/IARs.

4.3 Develop an action plan

The action plan can be included in the final AAR/IAR report or prepared separately. It should identify the following activities including responsibilities and timelines [5]:

- activities for immediate action that require few resources;
- activities for medium and longer-term implementation that require more resources and should be incorporated into other planning processes.

The activities identified are prioritised according to the urgency with which they should be implemented to improve preparedness and response capacities, and how easy it is to implement changes. Activities addressing imminent risks to the public health response, such as those identified through an IAR, should be given the highest priority. Once the final report and action plan have been disseminated, the follow-up and implementation should be closely monitored. To ensure accountability, it is crucial that both the implementation and monitoring of follow-up activities are assigned to specific persons or authorities, depending on the financial and human resources required. WHO's Guidance for AARs emphasises the importance of documenting progress as an opportunity to demonstrate the added value of conducting an AAR, and to assess how implementation of the AAR action plan contributes to the improvement of emergency preparedness and response capacities.

Part 2. Considerations for IARs/AARs focused on COVID-19

The four key phases of conducting IARs and AARs set out in Part 1 of this document are generally applicable when reviewing the response to any event of public health concern, including the present COVID-19 pandemic. In addition to the list of trigger questions provided in Annex 3 to facilitate the design of AARs or IARs focussing on the public health response to COVID-19, there are several specific factors that can be considered in relation to COVID-19.

In-action reviews during the response to COVID-19

In-action reviews for COVID-19 may be productively applied in both national and sub-national settings. The scale, impact, duration and different phases of the COVID-19 pandemic point to the necessity of conducting IARs focused on specific aspects of the public health response (i.e. specific response areas). Due to time constraints of public health staff during the response to COVID-19, it is advised that countries consider organising a focused half-day debriefing workshop or 'facilitated look-back' session with relevant stakeholders to focus on identifying key strategic issues; good practices that could be reinforced; challenges that need to be overcome, and immediate solutions that could be readily implemented. Consideration may be given to conducting multiple in-action reviews, each focusing on specific response areas, but if doing so, some attention should be paid to the coordination between response areas.

This approach might be productively combined with a 'forward-look', assessing strategic options for the next phase of the response by considering scenarios of how the covid-19 pandemic might unfold in the coming months.

The 'during the response' trigger questions listed in Annex 3 would be the most appropriate focus point for discussion. For IAR implementation, it is strongly recommended that a neutral meeting facilitator/moderator is appointed who has a good understanding of the local public health response to COVID-19. A rapporteur should also be identified.

After-action reviews of the response to COVID-19

The magnitude of the scale and impact of the COVID-19 pandemic globally means that all countries should plan to conduct thorough AARs of the public health response, when appropriate. Due to the scope of the COVID-19 pandemic, mixed-method AAR approaches would be the most suitable. Very careful attention will need to be paid to the desired scale of the AAR. It is suggested to conduct AARs that cover the full response to COVID-19. An overview of relevant response areas in the context of COVID-19 is given in Table 2.

Table 2. Response areas relevant to the public health response to COVID-19

Response area
Emergency preparedness planning and national coordination
International coordination and collaboration
Cross-sectoral coordination and collaboration
Strategic national stockpiles
Incident management
Situational awareness
Surveillance
Laboratory systems and testing strategies
Case investigation and management
Healthcare and long-term care facilities
Non-pharmaceutical interventions
Risk and crisis communication
Research and development

Where AARs seek to address specific aspects of the response, a modular approach may be preferable through which specific response areas (see Table 2) and/or specific phases of the pandemic are reviewed separately or in parallel. However, in this case careful attention should be paid to matters of coordination between different response areas.

For AARs focused on COVID-19, it is suggested that there should be interactive sessions to encourage frank but productive discussion. One approach that has been successful in the past has been 'event-storming' workshops where participants collectively identify and prioritise key challenges, good practices and changes to be implemented. This approach results in a matrix of prioritised shorter- and longer-term actions to enhance public health preparedness, and is advocated in the context of COVID-19 AARs.

The scale of the COVID-19 pandemic will necessitate a substantial amount of preparatory desk-work in the preparatory phase of the AAR. This will include background information, a detailed stakeholder analysis (see Annex 1 for an example), assembling timelines of key decision points and response measures alongside the trajectory of the outbreak and selecting or refining discussion questionnaires which may be based upon the trigger questions presented in Annex 3.

Box 4. Types of background information and documents relevant for supporting an AAR on COVID-19

- National pandemic preparedness, response and contingency plans;
- Incidence management structure;
- Past evaluations of public health preparedness and surveillance systems, including results from any completed Joint External Evaluation (JEE);
- Previous reports from AARs or any evaluations to past events including influenza pandemics and, if applicable, the health response to SARS and/or MERS-CoV;
- Details of the COVID-19 pandemic, a timeline of response measures and the trajectory of the outbreak (timelines can be made available by ECDC);
- COVID-19 Risk assessments and situational assessments;
- Relevant media reporting on the response to COVID-19.

Information package for external AAR team members

If international experts are involved in the AAR, the AAR host country team can provide background information and English translated versions of:

- Country epidemiological profile;
- National health system;
- Surveillance system;
- Public health response system.

Official COVID-19 information resources

- ECDC: https://www.ecdc.europa.eu/en/covid-19-pandemic
- European Commission: https://ec.europa.eu/info/live-work-travel-eu/health/coronavirus-response_en
- WHO: https://www.who.int/emergencies/diseases/novel-coronavirus-2019
- WHO COVID-19 information sessions: https://apps.who.int/gb/COVID-19/

For an AAR, the trigger questions for each dimension of a preparedness and response system can be divided according to three points in time:

- What was in place prior to the response to COVID-19?
- What happened during the response to COVID-19?
- After the response to COVID-19: what good practices were there, and what lessons can be learned from COVID-19?
- What lessons can be generalised?

This breakdown corresponds to the phases of an AAR suggested by WHO: document, identify and analyse, and improve. The context for developing these questions is national-level responses by European countries, but the questions may be applicable to wider settings. The trigger questions presented here are by no means exhaustive as they principally aim to facilitate discussion during plenary workshops and interviews. Due to the magnitude of the public health response to COVID-19 and depending on national settings, many stakeholders could potentially be involved in the AAR. If an AAR is focused on the full-scale response, it may be necessary to initially deploy broader, less-detailed questions for each response area. However, if the scope of the AAR is focused on one or two specific response areas, then it may be helpful to ask more detailed questions.

An IAR may also benefit from the trigger questions identified in Annex 3, but the most useful questions for an IAR should focus on identifying actionable improvements to an ongoing response.

To facilitate this work it is advisable to consider compiling lists of key events, challenges and good practices from the response to COVID-19 and, if possible, this should be done during the response phase. It is possible to add to these lists later but it would help to ensure that pertinent issues are captured at the time and receive adequate focus during the AAR, without being influenced by hindsight bias.

A COVID-19 AAR project team will require, at the least, a strong moderator/facilitator for interview and workshop discussions, a rapporteur, and the engagement and accessibility of key personnel within the lead agency (probably the technical public health agency of a jurisdiction). Sufficient effort should be made to carefully and adequately document the findings in order to ensure that all stakeholders have the opportunity to comment and to develop action plans that are implemented.

For both AARs and IARs focused on COVID-19, extraordinary circumstances could make it necessary to organise the reviews on a virtual basis, either fully or partially – e.g. via video- or teleconferences, webinars, phone interviews or online surveys.

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Annex 1. Example of a stakeholder matrix

This matrix was used as the basis for identifying stakeholders to contribute to AARs of West Nile virus case detection and control in Europe [17].

	Human health	Entomology	Animal health	Substances of human origin - Safety
Surveillance and early warning	People engaged in surveillance of human cases (West Nile Virus (WNV), fever, blood donors)	People engaged in mosquito surveillance	People engaged in surveillance of equids, target/other bird species	
Policy	People engaged in human health policy (e.g. Ministry of Health)		People engaged in animal health policy (e.g. Ministry of Agriculture, immunisation policies in horses	People engaged in substances of human origin (SoHO) safety policy (if different from actors already engaged)
Laboratory	People engaged in laboratory testing and confirmation of WNV in humans	People engaged in laboratory testing and confirmation of WNV in mosquito pools (if different from actors already engaged)	People engaged in laboratory testing and confirmation of WNV in animals	
Clinical care	People engaged in patient care (e.g. hospitals)			
Vector control	People engaged in vector control related activities and management of alerts	People engaged in vector control related activities and management of alerts	People engaged in vector control related activities and management of alerts	
Substances of human origin safety measures				People engaged in guiding and implementing SoHO safety measures (screening/deferrals/follow-ups for transplants).
Communication	People engaged in communicating with healthcare providers/general public	People engaged in communicating with general public	People engaged in communicating with veterinarians/general public	People engaged in communicating with medical specialists/general public.

Annex 2. Eleven validity-boosting considerations for improving after-action review methods and reporting

	Consideration	Recommendation
1	Prolonged engagement	AARs should spend adequate time observing the setting and incident documentation and speaking with a range of people to build a deep understanding of the after-action and its context. Prolonged and repeated engagement with the people and processes involved in the after-action over time offers a greater chance of uncovering deeper and more valid insight than brief and sporadic engagement with the study subject.
2	Use of theory	After-action reviews may benefit from being more closely aligned with after action review theoretical frameworks – such as the after-action technique – to ensure PHEP improvement plans from AARs address root causes. Furthermore, AARs should consider applying basic qualitative methods validity checks as a standard – such as those in the 11-item validity tool – to boost the validity of the insights gained. This - and additional concepts such as data saturation - could also help improve efficiency where an 'ask everyone, gather everything' approach is not pragmatic.
3	Data selection	Study sample rationales should be clearly described in all AARs to allow readers to easily understand how data informing the review, for example, participants in interviews, were targeted and selected. This is important to enable assessment of potential selection bias.
4	Information sampling	Study samples should be clearly described in all AARs to allow readers to understand which individuals, groups or data were used to inform the review. For example, documenting the number of people interviewed, their job titles and their role in the after action. Without this, readers do not know whether important views, reports or data were excluded, so are less able to evaluate the review for selection bias.
5	Multiple data sources	AARs should use multiple approaches for data collection to ensure a variety of information is considered, reducing the risk that one potentially biased data source dominates, and increasing the likelihood that root causes and relevant contributory factors will be appropriately uncovered. It is common for the most comprehensive AARs to include a combination of personal testimony (through different types of interviews, questionnaires etc.), document review (PHEP protocols, guidelines, relevant reports on the incident, safety reports before the incident etc.), and where relevant, one or more site visits.
6	Triangulation	Triangulation can help uncover perception bias and ensure insights are more roundly developed. It is recommended that multiple analysts, observers or reviewers be used to check interpretation of data; specifically looking at consistencies and divergence among different, but also within similar, data sources.
7	Negative case analysis	AARs should clearly report how discordant evidence (from personal testimony, reports, site visits or in forming improvement plans) has been reconciled. AARs should discuss any evidence that contradicts initial findings, explanations and developing theories alongside the consensual views. This encourages open and critical assessment of emergent themes and conclusions when forming the AAR, and may discourage seeking only harmonious views as part of the AAR sample.
8	Peer debriefing and support	Sharing preliminary or draft findings of the AAR with PHEP experts outside of the event for critical comment may increase the validity by introducing a fresh and independent perspective on the findings of an AAR, as well as pointing out any gaps in the review or analysis. This may also serve to facilitate learning across different sectors and geographies, increase awareness and build and expand professional networks.
9	Respondent validation	Initial insight and findings should be checked by those who contributed to the review (respondent validation) to ensure the accuracy and relevance of the AAR findings. This technique increases the likelihood that the AAR accurately represents the views of those contributing to it.
10	Audit trail	As a minimum standard, after-action reviews should report the methods they have used to gather information, analyse it, and clearly report how these led to the recommendations made. To aid readability, these can be in an appendix, but should be easily available for those wanting to evaluate the validity of the AAR. The development of evidence-based minimum reporting standard for after-action reviews, similar to the CONSORT statement for randomised control trials[3], may facilitate this process and comparisons between AARs.
11	Depth and insight	AARs should seek to uncover and report active and latent failures, contributory factors and root causes of the after-actions and make specific recommendations to improve PHEP as a result of significant depth and insight into the issues at hand. They should be explicit in their methods of doing so in terms of data collection and analysis. AARs should be explicit in stating how they interpreted data to gain the insights they have into improvement processes, including any attempts to increase the validity of their insights – e.g. independent interpretive checks through peer review.

Source: European Centre for Disease Prevention and Control (ECDC). Best practice recommendations for conducting after-action reviews to enhance public health preparedness. Stockholm: ECDC; 2018. Available from: https://www.ecdc.europa.eu/en/publications-data/best-practice-recommendations-public-health-preparedness [12]

Annex 3. Trigger questions to guide AARs/IARs focused on the public health response to COVID-19 in European settings

Trigger questions are used to guide discussions during an AAR or IAR. Trigger questions are designed to be open-ended as their primary aim is to generate discussion. Very few AARs or IARs would address all of the response areas noted below and it is suggested instead that the most appropriate response areas and trigger questions should be selected.

The trigger questions are informed by multiple sources, including ECDC Rapid Risk Assessments for COVID-19, ECDC Technical Guidance on COVID-19, WHO Guidance for After Action Review and its associated database of trigger questions [5], lessons learned from three European case studies of preparedness planning for MERS-CoV [6], options for public health response as identified and available during the outbreak [7], WHO's Joint External Evaluation Tool [8], the joint ECDC/WHO Guide to revision of national pandemic influenza preparedness plans, lessons learned from the 2009 A(H1N1) pandemic [9] and WHO's Interim Guidance on Strengthening preparedness for COVID-19 in cities and other urban settings [10].

Response area		Questions
Overall		• Overall, what were the major perceived successes during the emergency response? What went well and why did it go well? • What were some of the main challenges of the response? Why were they a challenge? • Where do you think improvements are still needed? What would be needed to make these improvements happen? • What lessons did you learn during the COVID-19 pandemic that would be applicable in future emergencies? • What are the specific actions to be taken now in order to improve future response capacity?
Emergency preparedness planning and national coordination	**Preparedness planning**	**Prior to the response** • Were pandemic preparedness plans/emergency preparedness and response plans developed and regularly and systematically tested within the health sector and across other sectors? • Had preparedness plans incorporated lessons learned from recent relevant outbreaks? If so, had the lessons learned been communicated to relevant stakeholders? • When was the last time the plan had been updated and/or tested? • Did an emergency preparedness and response plan for responding to a novel viral respiratory threat exist? If yes, was it flexible enough to be applied during the COVID-19 pandemic? • Was hospital preparedness a main component of the emergency preparedness and response plan? Were health system contingency plans reviewed and updated in accordance with risk assessments for COVID-19? Were there plans to ensure the continuity of essential medical services (incl. emergency medical and surgical services and vaccinations)? • Were there plans for communicating and coordinating with other sectors? Were there lists of contacts for all relevant sectors in the country to identify actions and decision-making authorities and to ensure effective coordination and information exchange? • Were business continuity plans developed for non-healthcare settings? • Did emergency preparedness and response plans account for the phasing of public health strategies during a pandemic, such as threat containment and threat mitigation?

		During the response • If there was a plan, was it followed in the response to COVID-19? Why or why not? • Which were the most critical elements of the plan to guide response measures? • Which elements of the plan had to be modified and which were applied as planned? If response measures diverged from the plan, how was this justified? • Was the plan effective in ensuring a coordinated national response to COVID-19? **Learning from the response** • What do you see as your main institutional strength in terms of preparedness for a respiratory virus pandemic? • Which elements of preparedness were the main enablers of the response? • What could be done to improve emergency preparedness planning in the future? • Did the response to COVID-19 expose any good practices or gaps in the preparedness process and existing plans?
	Legislation and policy	**Prior to the response** • Was a national/subnational legal framework available and sufficient to enforce measures decided at national committee level? • What national/subnational legislation and policies exist for enabling the response to COVID-19? Did they enable effective threat detection, assessment and response? **During the response** • What was the process for sharing scientific data and recommendations with policy makers and national leaders? • Were new laws and policies adopted during the response? If yes, please describe the decision-making process (e.g. evidence and rationale, timing, influencing factors, etc.)? **Learning from the response** • How did the existing and/or newly adopted legislation and policies enable the response? • If applicable, what were the mechanisms for policy monitoring and evaluation? How did this knowledge improve policy efficiency and effectiveness? • Did the pandemic lead to long-term changes in legal frameworks and policies, if yes, how?
	National coordination	**Prior to the response** • Was there a national planning committee or structure within the Ministry of Health or under another authority (such as Ministry of Interior, Civil Protection) that has a coordinating role for respiratory virus preparedness and response? Details? – Was there regional or district planning for pandemic preparedness? Were the plans intersectoral? Which institutions were involved? – To what extent is there national involvement in sub-national planning and coordination? – How was coordination managed at local and regional level and between local, regional and national level and how well did it work? Was two-way communication between local/regional and national authorities established and tested? – Were the lines of command and control for the COVID-19 response established and communicated to all relevant stakeholders? – Was the readiness and capacity of the public health and healthcare systems to implement response measures for COVID-19 assessed and monitored? Were the resources (human, financial and material) sufficient to adequately coordinate the response operations at each level?

		During the response • Was a national crisis team and/or emergency coordination mechanism (e.g. emergency operations centre, task force) for responding to COVID-19 established or activated and did it include public health authorities? • If so, when was it activated and on what basis? Was the team intersectoral/multi-disciplinary? Was there a coordinating role for preparedness/surveillance/response? Please provide details (e.g. lead institution, contributing institutions, means of communication, frequency of meetings, reasons for meetings). • How was subnational collaboration ensured throughout the response? • How were emergency response activities managed at subnational level? **Learning from the response** • If there was a coordination mechanism, was it effective? Why or why not? • Did the established coordination mechanism enable rapid information exchange between the national crisis team and stakeholders/sectors, and decision-makers? If not, what were the main challenges? • How could national coordination be improved?
International coordination and collaboration		**Prior to the response** • Were any plans in place for communicating and coordinating with neighbouring, EU, and other countries in the event of a pandemic or a Public Health Event of International Concern? Please provide details. • Had any joint work, training, or simulation exercises been conducted related to pandemic preparedness or respiratory viruses with neighbouring, EU, or other countries? • Did the Ministry of Foreign Affairs or Ministry of Health have a dedicated focal point for communicating and/or coordinating with neighbouring, EU or other countries during a pandemic or Public Health Event of International Concern? • To what extent had the Ministry of Foreign Affairs been involved in pandemic preparedness simulation exercises or training events with neighbouring, EU or other countries? • Were memorandums of understanding or other agreements in place between your national public health agency and other national public health agencies globally to exchange information during a health crisis? **During the response** • What international partners (e.g. WHO, ECDC, neighbouring, EU, other countries) did you coordinate with during the outbreak? On what topics? • How were the information flows and collaboration (both formal - e.g. IHR and EWRS, and informal) with international partners? – What epidemiological information was available from international partners? – Was information about potential response measures shared with neighbouring countries? – Were any arrangements in place in relation to issues such as enhancing or pooling the availability of laboratory support, hospital surge capacity and clinical case management, protective equipment? **Learning from the response** • How effective was the coordination between the Ministry of Health, Public Health Agency, and the Ministry of Foreign Affairs? • Was information sharing with international partners effective? Was information timely and relevant?

		• What dimensions in international coordination went well, and what could be improved?
Cross-sectoral coordination and collaboration		**Prior to the response** • Were there pre-existing cross-sectoral arrangements in place relevant to pandemic preparedness, respiratory viruses, and/or Public Health Emergencies of International Concern? • Were there national coordinating structures within government for the maintenance of non-health-related essential services in the event of a severe pandemic (e.g. power supply, transport, civil protection, food distribution, tourism industry, education)? • Had designated points of entry and the transportation sector participated in pandemic preparedness planning, training, or simulation exercises where issues such as entry screening were discussed? **During the response** • Which sectors did the public health sector collaborate with in the response to COVID-19? On what topics? • Were any decisions taken to implement entry/exit screening measures, quarantine individuals, or close transportation links to certain countries? How were these decisions made and implemented? • Were any actions taken to ensure business continuity across sectors? How were these actions decided upon and implemented? • Were lines of responsibility clear in instances of cross-sectoral decision-making? **Learning from the response** • Are there any examples of effective cross-sectoral action taken in the response to COVID-19? • Are there any examples of sub-optimal cross-sectoral action in the response to COVID-19? • What can be improved upon?
Strategic national stockpiles		**Prior to the response** • Was there a national inventory and mapping of the available resources for emergency response? Did this mapping address resources and capacities relevant to the response to COVID-19, including expertise, staff, logistics, medical equipment, finance, and facilities? • When was the last mapping of resources conducted? Which sectors participated? • What was the status of stockpiling with respect to pharmaceuticals, protective equipment and other equipment prior to COVID-19? • What provisions were made with respect to stocks of vaccinations, pre-ordering/licencing/import of drugs and vaccines and protective equipment? **During the response** • How were national stockpiles assessed, monitored and reported on during the COVID-19 pandemic? How was this assessed at subnational level? Who was in charge of assessments and who were shortages reported to? • How were shortages addressed and communicated to those affected (e.g. healthcare workers)? How was the availability of medical equipment (e.g. ICU equipment, personal protective equipment (PPE), vaccines and therapeutics, laboratory supplies) ensured during the pandemic? • Which procurement mechanisms and agreements (e.g. EU Joint Procurement Agreement, rescEU stockpile, existing bilateral and regional agreements) were used? How were resources distributed in the country?

		Learning from the response • What were the main challenges related to national stockpiles? Which were the most critical shortages and how did they affect the response to COVID-19? • Which were the most critical steps before or during the response to ensure the availability of strategic national stockpiles? • What could be improved?
Incident management	**Emergency Operations Centres**	**Prior to the response** • Was there an incident management system in the health sector at the national and subnational level? • Had a national emergency operations centre or equivalent structure been established? If yes, had emergency operations centre plans, activation and functions at the national level been tested and updated in the past two years? Were emergency operations centres available at the subnational level with plans and standard operating procedures (SOPs), resources and staff trained in emergency operations centre SOPs? • Were exercises (e.g. table top exercises) conducted at least annually to test emergency response capabilities at all levels? If yes, were corrective actions to update plans and strengthen capacities developed and implemented following the exercises? • Was there a dedicated coordination mechanism under the national health emergency operations centre for activation and coordination of emergency medical teams (EMTs) (such as an EMT Coordination Cell)? **During the response** • How long after the receipt of an early warning or information of an emergency did it take for the emergency operations centre to be activated? Was it activated within 120 minutes? • Were emergency operations centre operations sustained for the duration of the COVID-19 pandemic? • Describe scenarios or triggers for activation of emergency response. Are there multiple levels of emergency response activation? • What was the procedure for decision-making in the emergency operations centre? • Was the organisation able to convene participants from ministries and agencies of all relevant sectors and other national and multinational partners as appropriate? **Learning from the response** • What were the main challenges for the emergency operations centre during the response? What worked well? • Were the available resources (equipment, trained staff) sufficient to ensure effective and efficient management of emergency response operations during the COVID-19 pandemic?
Situational awareness	**Epidemic intelligence, early warning and epidemiologic modelling**	**Prior to the response** • Do you have a regular early detection activity at regional national and international level? • Who was responsible for early warning of emerging pathogens? • How is information from early warning and epidemic intelligence routinely disseminated and analysed? • Was there an epidemic intelligence system in place to detect potential threats? • What agreements were in place for exchanging early warning alerts and epidemic intelligence data with WHO, ECDC, neighbouring, EU and other countries? • Does your country have access to EWRS?

		• When did you first learn of cluster of atypical pneumonia in China and COVID-19? How? • In previous years, have you monitored an emerging disease at regional national and international level (e.g. Zika, Ebola)? • Was epidemiologic modelling capacity planned to be available during a pandemic? **During the response** • How was epidemic intelligence organised and conducted through the course of the pandemic? • How was epidemic intelligence supporting the collection and analyse of data during the epidemic? • Was epidemic intelligence information fed into the decision-making process of the response on a routine and timely basis? • Were early warning messages from neighbouring countries received and assessed? • What were your main sources of data at regional, national and international level? • Were epidemiological models of potential transmission scenarios available to decision-makers in a timely manner during the response to guide decision-making? **Learning from the response** • What were the main challenges for epidemic intelligence and early warning during the responses? What worked well? • Were resources sufficient to ensure continued epidemic intelligence activity throughout the pandemic? • Was early warning exchange with neighbouring and partner countries timely and useful? • Were some epidemic intelligence activities dropped or not implemented during the response?
Surveillance		**Prior to the response** • Were there general surveillance plans for emerging infectious diseases in place? Was there a plan to estimate the disease prevalence during all phases? • Were influenza surveillance plans and systems in place? • Was there a strategy to monitor mortality due to the new diseases (incl. subnational level/in specific population groups)? • Was there a strategy to monitor hospital beds and ICU beds and easily share such information? **During the response** • If there were any suspected or confirmed cases in your country, how were they detected? • Was an ad-hoc surveillance system (or multiple systems) for SARS-CoV-2/ COVID-19 established? – If so, how was it organised? What was the flow of epidemiological information? Was a database established? – Were surveillance objectives clearly defined to ensure that the system was fit-for-purpose? – Was guidance on case detection including sampling/testing policy provided? Did it evolve with time? – How was information provided to healthcare professionals for reporting cases? – What was the median time between detection and reporting of cases to public health authorities and, in the case of an EU Member State, to ECDC? – For EU Member States, what information was reported to TESSy? – What was the percentage of completeness for key variables related to COVID-19 surveillance?

		– Was regular analysis conducted of surveillance data/surveillance outputs related to COVID-19? – How was sentinel syndromic and virological surveillance for COVID-19 affected by lockdown measures and other recommendations which limited contact with general practitioners? – Were alternative sources of data (e.g. telephone helplines, centralised testing facilities etc.) included in surveillance? – Did you include sites with potentially high mortality rates (e.g. long-term care facilities (LTCF)) in surveillance? – How was surveillance for other priority diseases affected by the shift in focus to COVID? – How representative was surveillance for COVID? – Was it possible to obtain a sub-national view of the situation? – How was epidemiological data analysed and used to enable the response? – How was data collected (e.g. via paper, fax, email, surveillance software application) and shared (e.g. timeliness, automation, data protection)? – Did COVID-19 have an impact on other areas of public health (e.g. vaccination programmes, STI services, non-communicable diseases, including access to services)? How was this monitored? – How did the surveillance system detect the end of the COVID-19 outbreak? **Learning from the response** • Were there any challenges in analysing or gaps in receiving epidemiological or early warning data that would have enabled a better response during the initial response phase? • Were there any significant delays in detection/confirmation of suspect or confirmed cases that hindered the public health response? • What challenges were there in establishing a surveillance system for COVID-19? • What worked well? Which actions taken enabled an efficient and timely detection of the event?
Laboratory systems and testing strategies		**Prior to the response** • How is the national laboratory system linked to public health epidemiology? • What processes were in place for the transport of samples to national reference laboratories? • What laboratory capacity was in place in your country to work with high-consequence respiratory viruses such as SARS and MERS-CoV? • Was there pre-existing guidance on testing strategies during pandemic situations? **During the response** • What role did national laboratories play in the establishment of a diagnostic (and eventually serologic) test for SARS-CoV-2? • Were assay validation tests performed? • How was testing capacity expanded(i.e. scaled-up)? • What guidance on testing strategies for COVID-19 was available and followed? Was the overall laboratory system able to conduct laboratory testing for SARS-CoV-2? – If so, when? – If so, what was the process for laboratory confirmation? – If so, was the laboratory system able to handle the volume of requests (sufficient financial and human resources)?

		• If no laboratory test for SARS-CoV-2 was developed in the country, was an effective test obtained from a partner country? • Did you achieve timeliness of results throughout the pandemic wave? • Where there any shortages of reagents? If so, what solutions were found? • How was the protection of laboratory staff ensured - i.e. access to appropriate PPE? • How was the supply of laboratory consumables secured and coordinated? • How was information on case confirmation shared with national public health authorities? • What networking activities took place with other EU/EEA countries, and did these assist with capacity building and strengthening? **Learning from the response** • How did the capacity to test effect the overall response to the pandemic? • What worked well in establishing a system for laboratory confirmation of SARS-CoV-2? • Was scaling-up of testing for SARS-CoV-2 effective? What were the challenges and good practices that emerged through scaling-up? • What could be improved upon?
Case investigation and management	**Contact tracing**	**Prior to the response** • What operational guidelines, resources, and arrangements were in place for contact tracing prior to the outbreak of COVID-19? • Were agreements in place with airlines, cruise ships, train operators, for obtaining public health passenger locator cards as needed? • Were arrangements in place with other countries to enable multi-country case investigation and contact tracing? **During the response** • How were COVID-19 contacts defined? Did this definition change with time? How? • Was an algorithm for managing contacts of probable or confirmed cases developed or followed? • Were any apps or other technology used for digital contact tracing? • Were volunteers form the community (e.g. retirees, final year medical students) engaged to support contact tracing if resources were scarce for implementing contact tracing? • How many contacts were followed during the response? • What information was provided to contacts about quarantine and. self-isolation? • How was the follow-up of contacts managed? • Was information about data for passengers who may have been on a flight with a confirmed COVID-19 case available from travel services? **Learning from the response** • How effective and efficient was contact tracing/management? If new technologies or volunteers were used/engaged, what were the best practices or challenges? • What was the maximum number of confirmed cases for which contact tracing has been performed? Was the capacity to conduct contact tracing an issue during the response? • What could have been done better?
	Patient referral and transfer	**Prior to the response** • What procedures were in place for patient referral and transport for high consequence infectious disease (HCID)?

		• What surge capacity existed in designated hospitals for pandemic scenarios? • Did protocols exist to ensure potentially infected patients did not present to standard emergency rooms or other healthcare settings? **During the response** • How were suspect COVID-19 patients routed or transferred to designated healthcare facilities? Were there transfer arrangements between overburdened hospitals (including within cities, within a country or internationally)? • What guidance was provided to the general population in terms of accessing healthcare? • What protocols were established to direct suspect patients to appropriate healthcare facilities? **Learning from the response** • What best practices for patient referral and transfer were practiced/developed? • What were the main challenges?
Healthcare and long-term care facilities	**Infection prevention and control (IPC) in healthcare settings**	**Prior to the response** • What IPC guidance was available for high-consequence infectious disease? • Was there a national emergency stockpile supply of PPE (e.g. FFP respirators) and disinfectants? • Did a strategy exist for minimising infection risk among staff and citizens in healthcare facilities and long-term care facilities? **During the response** • Were IPC measures for COVID-19 implemented in designated hospitals? What were these measures? • Were the necessary personal protective measures and equipment, and human resources available for appropriate IPC and protection of healthcare workers? • Were there any documented instances of nosocomial SARS-CoV-2 transmission? If so, have the causes been investigated? **Learning from the response** • What best practices for IPC for COVID-19 were practiced/developed? • What were the challenges in implementing IPC measures in healthcare settings? • What challenges were there for IPC in healthcare settings during the COVID-19 pandemic?
	Intensive care unit (ICU) capacity and crisis standards of care (CSC)	**Prior to the response** • Was comprehensive mapping of Intensive Care Unit (ICU) capacity available for the whole country? • Were plans in place for the pooling of hospital beds and for optimising ICU capacity usage across national sub-regions? • Were crisis standards of care (CSC) for pandemic situations available to guide clinical practice and the allocation of scarce resources (including ventilators)? • Were ethical guidelines established in relation to triage of medical care during a pandemic? • Were there plans and materials in place to establish a medical surge capacity? **During the response** • Were mechanisms identified to optimise the national usage of ICU capacity? How was surge capacity established and managed? • Were CSC for COVID-19 implemented in hospitals? How? • Was timely and accurate data available on ICU capacity during the COVID-19 pandemic? • Was ICU capacity data used to inform decision-making on societal-level control measures?

		• Was there a period where ICU beds and/or ventilators needed to be allocated through a triage algorithm? How long was this period, and was triage based upon pre-existing guidelines? **Learning from the response** • Was it feasible or productive to pool medical resources and ICU capacity? • Were CSC effectively implemented for COVID-19? • Were ethical guidelines able to provide clinicians with adequate support for making triage decisions? • How effective was national data on ICU capacity for informing decision-making? What worked well, and what did not, in terms of optimising ICU capacity usage throughout the COVID-19 pandemic? • What can be improved when it comes to optimising ICU capacity during public health emergencies?
Non-pharmaceutical interventions	**Quarantine and physical distancing**	**Prior to the response** • Were any national guidelines and/or regulations in place concerning quarantine during major infectious disease outbreaks? • Were any national guidelines and/or regulations in place concerning physical distancing measures, such as school or workplace closures, limits to gathering sizes, or otherwise? **During the response** • Was quarantine implemented for COVID-19? How? Why? Who was responsible for implementation? • Was a cordon sanitaire implemented for COVID-19? How? Why? Who was responsible for implementation? • Was self-isolation for suspected or confirmed COVID-19 cases implemented? Who was responsible for implementation and follow-up of cases? • Were physical distancing measures (e.g. school closures) implemented? How? Why? Who was responsible for implementation? • Which factors had an impact on the specific timing of the implementation of physical distancing measures? • Was a mechanism for assessing efficacy of physical distancing measures assessed during the response? • What triggered the relaxation or removal of physical distancing measures? **Learning from the response** • Were physical distancing measures effective in helping containment and/or mitigation strategies? • Did any legal issues arise in relation to implementing quarantine and/or physical distancing measures? • What challenges existed to implement quarantine and/or physical distancing measures? What good practices can be built upon going forward?
	Points of entry (PoE)	**Prior to the response** • Was there a designated Point of Entry (PoE) according to the International Health Regulations (IHR) in advance of the COVID-19 pandemic? • Was the PoE integrated into national emergency preparedness plans? Had PoE preparedness measures been tested? • Did the designated PoE have patient isolation facilities and arrangements for the safe transfer of patients to designated hospitals? • If your country is a Schengen country, what additional measures or agreements were in place to prevent the spread of high-risk infectious disease across borders?

		During the response • What role, if any, did a designated PoE play in the response to COVID-19? • Was the PoE resourced with appropriate staff and facilities to respond to COVID-19? – Did the PoE coordinate medical triage and management of suspected COVID-19 cases arriving at the PoE? – Did the PoE have a system and facilities in place for the safe transport of confirmed or suspect COVID-19 travellers? – Did the PoE carry out entry screening or public health messaging related to COVID-19? **Learning from the response** • How effective was coordination between the PoE and national public health authorities? What went well? What could be improved? • How effective was the PoE in the response to COVID-19? Were there any capacity gaps, and what could be improved?
	Entry screening	**Prior to the response** • Was a protocol established for dealing with an ongoing, large-scale respiratory disease outbreak abroad that could lead to entry screening or even closing the border? • What guidelines existed for conducting entry screening at PoEs? **During the response** • Was entry screening implemented? How and why? • Was information available about flights/travellers entering from COVID-19 affected areas? • Were specific control measures, such as entry screening, information to passengers, or thermal screening implemented at airports as part of the response to COVID-19? **Learning from the response** • Did entry screening measures implemented fulfil their objectives? Why or why not?
Risk and crisis communication	**Communication to healthcare workers**	**Prior to the response** • How should communication to healthcare workers be organised? • Was any pre-existing material related to pandemic influenza, or MERS-CoV available? **During the response** • What processes were in place for disseminating messages to healthcare workers? How was communication to healthcare workers implemented during the COVID-19 pandemic? **Learning from the response** • Was communication to healthcare workers timely and effective in ensuring they had a common and consistent approach to the response to COVID-19? • What challenges were there in communication to healthcare workers? What were good practices?
	Communication to the public and community engagement	**Prior to the response** • Which is the lead authority for risk and crisis communication to the public during a health emergency? • Has a national risk communication strategy for pandemics been developed? Did it target different audiences? • Have health promotion materials already been developed? • Has a community engagement strategy been developed? How were vulnerable and at-risk populations identified

		and targeted in the response and risk communication strategies? • Were sufficient resources available to conduct risk communication and community engagement? Are responsibilities for health communication to the public clearly delineated for pandemic situations? • Has public communication from recent infectious disease outbreaks or other health emergencies been evaluated and improved upon? • Was there a monitoring system to observe public perceptions and opinions of both the outbreak, and the response to the outbreak? • Was there a strategy for tackling misinformation/disinformation (e.g. from online sources)? **During the response** • How was public communication coordinated during the response to COVID-19? Who was leading the risk communication strategy? • What was the process for the clearance of communication outputs? • How were communication outputs coordinated with other sectors within the country, and with neighbouring countries and partner institutions (e.g. WHO and ECDC)? • How was influential media (e.g. traditional media, bloggers, and influencers) identified and engaged with? • What were the main communication channels with the public? Which communication tools and technologies were used (e.g. new apps, social media, national television, dedicated websites)? • How was risk communication implemented at community level and how were communities engaged and mobilised? Were existing community networks engaged in response measures? • Were public perceptions monitored during the outbreak? If yes, how did this information affect the response? Was public communication consistent and transparent? • How was misinformation/disinformation dealt with and how did it impact the response? Were proactive steps taken to correct misinformation/disinformation? **Learning from the response** • Was public communication effective in conveying public health messages and establishing public trust? If so, how has this been assessed? • What challenges were there in public communication? What were good practices from the outbreak of COVID-19?
Research and development		**Prior to the response** • What arrangements were in place for the rapid development of vaccines during pandemics or public health events of international concern? • What vaccine and antiviral manufacturing capacity exists in your country that could be formally leveraged during a pandemic? • What international research and development agreements or partnerships did your country belong to? **During the response** • Was your country involved in efforts to develop a vaccine against SARS-CoV-2? If so, in what ways? • Was your country involved in any clinical trials for the safety or efficacy of a vaccine against SARS-CoV-2? • Did your country participate in clinical trials of pharmaceuticals for the treatment of COVID-19 cases?

		• While vaccines against SARS-CoV-2 were in development, did you develop a plan for its eventual distribution? • Did you participate in any public health research initiatives related to COVID-19, such as on the efficacy of various physical distancing measures? **Learning from the response** • What challenges existed in launching work to develop and/or procure a vaccine against SARS-CoV-2? • What worked, and what needs to be improved for a future pandemic?