Introduction

The European Centre for Disease Prevention and Control (ECDC), in order to fulfill its mandate under Decision No. 1082/2013/EU, seeks to identify both the strengths and the areas for improvement of public health emergency preparedness (PHEP) in the European Union (EU) Member States. With the eventual goal of developing competency-based training programs intended to help with these improvements, one aspect of this work began with our earlier discussion paper developed ECDC public health emergency preparedness logic model that focuses particularly on cross-border threats to health in the European context.¹ This discussion paper aims to take this work a step further by translating the capabilities in the ECDC logic model – which apply at the system level – into competencies for individuals who work in the public health emergency preparedness system. Phase 3, to be completed in 2017-2018, involves the development and pilot testing of competency-based curricula.

We begin this discussion paper by describing the goals of the ECDC competency-based training project and the target audiences. We then summarize the role of logic models in the development of

¹ Stoto MA, Nelson C, Savoia E, Towards a ECDC Public Health Preparedness Logic Model. Draft discussion paper. Available at: [Add link to something on ECDC or Harvard website]
measurement and assessment systems, particularly in distinguishing between capabilities and capacities, as well as the logic model proposed in the previous paper. Following a summary of the methods used in the current paper, we present for discussion a set of competencies for different types of individuals in the EU Member States, focusing on the members of national preparedness committees. The final sections of the paper discuss approaches for developing competency-based trainings for public health staff, which incorporate the KSAs aligned with the ECDC’s logic model, as well as the strengths and weaknesses of various approaches for assessing countries’ capabilities and capacities.

Project goals

The ECDC has initiated a medium-term project aimed at designing competency-based training curricula for experts working in preparedness at national level in the Member States. “Competency-based” means that training participants acquire knowledge and skills based on defined set of core competencies they need to best fulfil their job responsibilities. The competency-based approach enhances harmonisation and helps to ensure similar levels of competency throughout the EU, regardless of the background of those working in the field.

The target audience for these competencies is experts working in preparedness at the national level such a national preparedness committee members or their equivalent. We recognize that the preparedness and emergency response structures of EU member countries vary. In general, however, public health preparedness is included in the general emergency management structures in a country, which are usually led by interior affairs or civil protection staff. When an emergency is of a health nature, then health typically takes the lead.

Regardless of the structure, some of the individuals who work in them have a health or more explicitly public health background: epidemiologists, microbiologists, veterinarians, health communication experts, other public health experts and managers), and so on. Others may have backgrounds in civil protection, finance, local administration, transportation, environmental science, and other fields. See Box 2 below for our working list of Generic preparedness and emergency response workforce categories.

Measuring and Assessing Public Health Emergency Preparedness Capabilities

Assessing public health system preparedness is challenging for several reasons: serious public health emergencies are both rare and specific to the context in which they unfold, so there are few opportunities to assess outcomes by direct observation; an effective public health emergency response
is broad, complex and multifaceted so it can be difficult to determine what the best response to a specific situation might have been; and public health systems are multi-jurisdictional and multidisciplinary, so system-level preparedness is not necessarily just the sum of the parts.²

In order to address these challenges, we suggest using a logic model to identify factors that are considered to contribute positively to response outcomes. Logic models specify the goals and objectives of public health preparedness, as well as the response capabilities and preparedness capacities needed to achieve those goals and objectives.³ A logic model is not a measurement tool per se, but rather a theoretical framework for identifying what to measure. As is discussed below, capacity inventories, exercises, critical incident analyses, and other approaches describe how to measure both capacities and capabilities, and all of these methods can be implemented either with or without external peer review. Agreeing on a common set of capacities and capabilities to measure allows for making comparisons both over time and between Member States, which is important for enhancing learning and sharing results from all of these approaches.⁴

Our proposed logic model (Figure 1) incorporates a fundamental distinction between capacities and capabilities that is implicit in Nelson and colleague's definition of PHEP.⁵ Capacities represent the resources—infrastructure, policies and procedures, knowledgeable and trained personnel—that a public health system has to draw upon. Much of what public health preparedness organizations do on a day-to-day basis—planning, training, and acquiring equipment and supplies—is intended to build capacity for future emergencies.Capabilities, on the other hand, describe the actions a public health system is capable of taking to effectively identify, characterise, and respond to emergencies. For example, in the case of communicable diseases, having strong laboratories and skilled laboratorians may be insufficient if they cannot be mobilized in a timely manner, and/or if lab results cannot be shared with and acted upon by decision-makers. Similarly, having stockpiles of vaccines and other countermeasures is of limited utility if a community lacks the ability to transport and deliver them to the right people in a timely manner.

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Capacities typically refer to components of a PHEP system, whereas capabilities usually describe the entire system's performance in putting those capacities to work. Indeed, the failure to effectively deploy a capability during an event could reflect capacity gaps, such as the lack of laboratory equipment or inadequately trained staff. Budget constraints or inaction by political actors during a crisis can also prevent effective actions by an otherwise well-prepared system. Capabilities describe what a system should be able to do; why it did or did not perform as expected is an appropriate topic for a critical incident analysis.

Box 1 summarizes the capabilities in the ECDC logic model. The first three categories – (1) assessment, (2) policy development and implementation, and (3) prevention and treatment in the health sector – correspond to the core functions of public health (IOM, 1988) and represent what the public health system must accomplish to respond effectively. The fourth and fifth categories represent a series of interrelated functions needed to ensure that the system fulfills its assessment, policy development and prevention and treatment roles. (4) Coordination and communication regards information sharing within the public health system, incident management and leadership. (5) Emergency risk communication focuses on communication with the public.

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Box 1 (part 1 of 2). Proposed ECDC public health preparedness capabilities

**Assessment**
- **Incident recognition.** Identifying that a cross-border threat to health has arisen, either in one or more of the member states, or elsewhere in the world that could affect Europe
- **Risk characterisation.** For communicable diseases, identifying the (possibly novel) pathogen and its epidemiologic characteristics such as modes of transmission, risk of infection, virulence (e.g. case-fatality rate), intergenerational time, control strategies that are available, and so on. For other health risks, characterising the current and potential human health consequences in directly affected and other member states
- **Epidemiological investigation.** Developing case definitions, conducting outbreak investigations and case-control studies to validate and analyse case reports, identify pathogens and sources of exposure, and to aid in risk characterisation
- **Surveillance and epidemiological monitoring.** Indicator- and event-based surveillance, including case reporting, and active surveillance, to identify outbreaks, characterise affected population groups, monitor disease trends and the impact of control strategies
- **Laboratory analysis.** Technical ability to identify (possibly novel) pathogens, monitor antimicrobial resistance, and to handle large numbers of samples submitted for diagnostic purposes
- **Environmental monitoring.** Ability to monitor chemical, biological (including animal), and other contaminants in air, soil, and water

**Policy development, adaptation, and implementation**
- **Policy development and adaptation for infection control and treatment guidance.** Policies must be flexible and adaptable to accommodate for an evolving infection and/or emergency. Effective treatment and mitigation of an emergency can begin with clear policy directives and informed policy making
- **Policy development and adaptation for population-based disease control.** Authority and practical ability to adapt existing policies and guidance (or develop new if necessary) to prevent spread of communicable diseases, including personal hygiene, social distancing, and border controls
- **Policy implementation: communicating between national and subnational authorities and enforcing laws and regulations.** Ability to enforce laws and regulations required for disease control and prevention including the IHR, EU regulations, and member states’ laws and regulations

**Health care services**
- **Preventive services.** Ability of member states to mitigate a potential event and pre-empt the potential spread of disease through strategies including vaccination, personal protective actions, and medication distribution.
- **Medical surge.** Ability to provide adequate medical evaluation and care during events that exceed the limits of the normal medical infrastructure of an affected area during an infectious disease or other public health incident
- **Management of medical countermeasures, supplies and equipment.** Ability to procure, distribute, and manage counter measures, supplies and equipment, including personal protective equipment (PPE), during an incident.
- **Care for health care workers and emergency responders.** Ability to provide preventive and medical services to address the physical and mental health needs of health care workers and emergency responders
Box 1 (part 2 of 2). Proposed ECDC public health preparedness capabilities

Coordination and communication (within the public health emergency preparedness system)

- **Crisis management.** Employing a systematic approach to organise and manage resources and responsibilities for addressing all aspects of emergencies, including continuity of operations
- **Communication with healthcare providers.** Communication between public health agencies and healthcare providers, especially regarding surveillance protocols, prevention and treatment guidance, and other matters to ensure coordination of prevention and treatment efforts
- **Communication with emergency management, public safety, and other sectors.** Communication between public health and other sectors to ensure coordination of prevention and treatment efforts
- **Communication with other public health agencies at the global, European, national, and subnational levels.** Communication between public health agencies at all levels to ensure coordination of prevention and treatment efforts.

Emergency risk communication (with the public)

- **Address communication inequalities.** Ability to address differences across population groups on how the message is received, processed and acted upon due to the socio-economic and cultural characteristics of the population affected by the emergency – PROMOTE ACTION & SHOW RESPECT.
- **Generate dynamic listening and manage rumours.** Ability to disseminate messages that are clear and collaborate with other organizations, including health professionals and local leaders to disseminate the message using appropriate channels and messengers – BE CREDIBLE
- **Communicate risk in an accurate and timely manner and manage rumours.** Ability to provide information to the public in a timely manner taking into account the measurement of actual risk and populations’ risk perceptions – BE FIRST & BE RIGHT
- **Maintain transparency and trust.** Ability to deliver message that are generate trust in the way the emergency is handled by government officials. – BE CREDIBLE, EXPRESS EMPATHY, REMAIN HONEST AND OPEN
Development of workforce-specific PHEP competencies

During the past decade, there has been a growing interest across various areas of education, training, and professional development, including in public health emergency preparedness, in competency-based systems. Competency-based education initiatives have been implemented in a number of health care and health management professions. There is no single, authoritative definition of “competency-based education,” but it is generally distinguished from other educational approaches by the following key features. First, all learning outcomes—the required competencies—are precisely defined, so as to be measurable. Second, the aim of competency-based education is general preparation for specific jobs or professional roles, from which the competencies are derived. Third, trainings are typically implemented in a modular format based on level of difficulty and/or specificity.

In PHEP, similar to other fields, training budgets, time, and personnel backfill resources are all limited. Thus, public health officials need an efficient and highly practical educational approach that effectively addresses core readiness competencies for all public health workers. The creation of a competency-based model may facilitate the standardization of preparedness education across various public health systems and assists in determining priorities for the allocation of training funds, while being flexible enough to accommodate the unique response demands, infrastructural levels and vulnerabilities of specific public health systems and threats, and tailored specifically to an individual’s developmental trajectory.

**Competencies** are the set of key knowledge, skills and abilities (that individuals working in a certain area should have to best fulfil their job. Preparedness is multi-disciplinary, and people who work in public health preparedness in the EU member states have varied backgrounds. To be assessed as competent, a person must demonstrate the ability to perform a job’s specific tasks and meet acceptable standards. Formal education doesn’t necessarily equip employees with the appropriate skills to thrive in the workplace and the use of a competency-based model helps define what the specific requirements are, in term of knowledge, skills and abilities, that employees of an organisation and/or system need to have for the organisation/system to achieve specific capabilities. For this reason, in order to develop a competency-based model, we need to start by defining what capabilities an organization/system is expected to achieve.

Competencies are characteristics of individuals who work in the PHEP system, whereas the capacities and capabilities in the ECDC PHEP logic model are system level characteristics. There is an intuitive link between these elements: systems are made of individuals and the resources available to them, and the
“workforce” can be seen as the “smallest element,” and probably the most “central” element, of a system. Competencies are further described in terms of individuals’ knowledge, skills, and abilities (KSAs), which in turn form the basis of a competency-based curriculum. Specifically, we use the following definitions:

- **Knowledge:** a body of information applied directly to the performance of a function
- **Skill:** an observable competence to perform a learned psychomotor act
- **Ability:** the competence to perform an observable behavior or a behavior that results in an observable product.

As the second phase in a medium term ECDC project aimed at developing competency-based training programs, this discussion paper focuses on translating the capacities and capabilities in the ECDC logic model into competencies for individuals who work in the public health emergency preparedness system.

The focus of this work is the members of national preparedness committees in EU Member States, but as noted above the PHEP systems vary markedly among the Member States. This reflects, among other factors, different governmental structures, resources, and histories. The participants in an emergency response will also depend, to some extent, on the nature of the event – a nuclear or natural disaster requires different response elements than a pandemic or other biological event.

It should be noted that the individuals with primary responsibility for the functional areas vary across Member States. In some countries different functions might be combined in a single agency, with one responsible official, whereas other functional areas might not be explicitly represented at all in some countries.
Box 2. Generic preparedness and emergency response workforce categories

- Ministerial-level health officials
- National “public health institute” leadership
- Primary liaison with local public health agencies
- National focal point (NFP) for preparedness

- Public health epidemiologists
- Public health microbiologists
- Health care infection control experts
- Environmental scientists
- Public health veterinarians

- Officials responsible for
  - the public healthcare delivery system (including surge issues)
  - procurement and management of medical products, vaccines and technology
  - liaison with non-governmental hospitals and health professionals
- Public health legal advisors

- Public health emergency response managers
- Public health emergency preparedness planners

- Risk communicators
- National focal point (NFP) for communication

- Civil protection
- Regulatory agency leadership

We also recognize that the expectations placed on public health workers in each category will vary. Public health epidemiologists and microbiologists, for instance, will need to be able to conduct outbreak investigations and help to characterize the risk, whereas others will only have to know about the importance of these activities and how to interpret the results. The goal at this stage will be to develop the competencies and KSAs that apply to all members of national preparedness committees in EU Member States. Identifying the proper level of expertise – being able to do, vs. know about – will be addressed in the development of training programs for particular categories of workers. Furthermore, each Member State needs a team or committee of experts to ensure that all of the PHEP capabilities are
met. In this respect, the competencies can be used to review the composition of national preparedness committees.

A few of these workforce categories require some explanation. We assume that Member States have some equivalent of a national public health institute parallel to Public Health England or the Robert Koch Institute in Germany. In some countries the equivalent of this institute may be the ministry of health itself. The NFP for preparedness is likely to be the national public health institute, the ministry of health, or a unit in one of these organizations.

The second cluster of categories in Box 2 represents workers with scientific and technical expertise relevant for public health emergency preparedness. The ECDC has developed competencies for public health epidemiologists and microbiologists. We have drawn on these in the preparation of this report. ECDC has also developed a set of competencies for health care infection control experts. The infection control competencies relate more to infection control practitioners in healthcare facilities rather than at the country level, but we have drawn on them as well as appropriate. We are not aware of any existing competencies for public health environmental scientists, but regard them as the analogous to microbiologists who instead have expertise in chemical & radiological issues.

The next cluster of workforce categories describes governmental officials who either directly oversee public sector healthcare delivery organizations or who develop policy for or liaise with private-sector hospitals, physicians and other providers, and other elements of a country’s health care delivery sector. Because the organization of the health sector varies markedly among, and sometimes within, Member States, the specific officials in each of these workforce categories will also vary. Generically, we consider three categories of governmental officials who are responsible for: (a) directly overseeing the public healthcare delivery system (including dealing with surge issues), (b) procurement and management of medical products, vaccines and technology, and (c) liaison with non-governmental hospitals and health professionals.

The categories distinguish between those who are responsible for managing a public health emergency response and those who have responsibility for planning to improve preparedness for future public

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health emergencies. We recognize that in some Member States the same individuals will be responsible for both functions.

We use the term “risk communicators” to describe the public officials who have the responsibility for communicating with the public during health emergencies. In a high-profile event this might be the minister of health or even a president or prime minister. In other events, it could be the public health institute or some other agency. Whatever the level of the spokesperson, though, there are risk communication competencies expected of the staff that support them, including the NFP for communication.

The next step was to draft a list of the competencies expected of the PHEP workforce. The Appendix presents a draft list of competencies organized by capability from the ECDC logic model and workforce category. We drew on three sources of information to prepare the preliminary list of PHEP competencies that appears in the Appendix. First, the capabilities in the ECDC logic model were developed by reviewing a series of public health emergencies and identifying the PHEP system capabilities that were called upon. In some cases these same incidents yielded suggestions about competencies expected of different elements of the PHEP work force. Second, we considered existing competency statements especially those developed by ECDC for public health epidemiologists, microbiologists, and health care infection control experts. Third, we reviewed the scientific literature about public health emergency preparedness and guidance such as the Toolkit for assessing health-system capacity for crisis management developed by the Regional Office for Europe of the World Health Organization and the World Health Organization’s (WHO) Joint External Evaluation Tool: International Health Regulations (2005).

The next step in this work involves consultation with the ECDC national focal points for preparedness, communication, and training, external organisations, such as WHO, ASPHER, IANPHI, and other experts...
in public health emergency preparedness and related fields as relevant. Following these consultations, a final draft set of competencies will be produced in early 2017.

**Assessment of training needs: mapping system capabilities to competency-based education**

Building on our work in developing the Public Health Preparedness and Response Competency Model in collaboration with the U.S. Centers for Disease Control and Prevention (CDC) and the Association of Schools & Programs of Public Health (ASPPH)\(^\text{15}\), and on subsequent projects conducted with WHO on emergency risk communications during the Ebola crisis, we here present a six-step approach for the development and validation of a competency model in PHEP (See Figure 2). This section uses examples related to Emergency Risk Communication to illustrate this approach. The next section of this paper – “Approaches for Assessing Member State’s Capacities and Capabilities” – describes a systematic ongoing approach to assessing and improving system-level capabilities.

1. **Capability gap analysis**

   Competency standards for PHEP workers must be grounded in the capabilities the system has to possess in order to achieve an effective response to a threat. This approach to competency development is the result of our experience in developing and implementing training activities for the US public health workforce and WHO staff. During that process, we realised the importance of listening to practitioners who were responding to the Ebola crisis, and understanding what gaps in knowledge and competency they were experiencing in practice and what resources were available to them. This is necessary so that competencies could be built based on the actual environment in which they were working. Thus, we propose that the first step to conducting a capability gap analysis is to identify the capabilities that need to be enhanced. The ECDC Logic Model described above and depicted in Figure 1 provides a language for describing these capabilities. As a starting point, retrospective analyses of responses to real incidents can identify the specific response challenges that are experienced by a public health system during an actual event.\(^\text{16}\)

   System capabilities are achieved by organisations and, ultimately, by the individuals that operate within the resources of a specific system. Because Member States’ public health emergency preparedness


systems are organised in markedly different ways, each country must define which elements of their workforce is responsible for each of the capabilities.

Figure 2. Six-step approach to the development of a competency model

2. Define target workforce

Once the capability gaps are identified, the next step is to identify the organisations and related components of the public health workforce – the target audience for the training – that are engaged in achieving those capabilities, and the infrastructure and resources available to them. For example, defining the target audience of a training requires asking which unit is designated for emergency risk communication and what are the typical educational backgrounds and professional experiences (e.g. years in public health) of the workers in that agency. Regarding infrastructure, policies, procedures, and resources, critical questions include: Is there a designated spokesperson, and back-up spokesperson, identified for communication during an emergency? Is there a written regulation, policy or guideline on the accurate and timely release of information during a public health emergency? Is there a process in place for expediting approvals for information release?
3. **Define capability-specific competencies**

The next step is to develop practice-driven challenges that are aligned with the achievement of the capabilities identified in step 1. Practitioners representing the target audience can help identify these factors based on their experience with response challenges in previous emergencies. For example, some of the common emergency risk communication challenges that have been observed are delays in issuing messages due to (a) a lack of understanding of the risk assessment process, (b) concerns about how best to communicate uncertainty, or (c) complex official processes in place to approve information releases.

4. **Identify competencies and related KSAs**

Once the required competencies of the agencies have been identified, the next step is to identify the competencies that are relevant across types of incidents and independent of systems’ characteristics, and the related knowledge, skills, and abilities (KSAs) for workers in those agencies, and combine them into a competency model. This process can be completed by conducting a review of existing core competency models and implementing a Delphi method to achieve consensus on what competencies and KSAs to include in the model. For example, in emergency risk communication, a competency is the ability to communicate to the public the nature and magnitude of risk. This involves understanding the risk and risk assessment process (knowledge), using online resources to identify relevant information (skill), and accessing relevant emergency situational information coming into the agency (ability).

5. **Cross-walk capabilities and competencies**

The next step is to create a cross-walk between specific capabilities, functions within each capability, practice questions, and competencies. Table 1 illustrates this process in the context of emergency risk communication. In the first column we list specific response challenges derived from our experiences listening to practitioners responding to an emergency, overarching themes that are aligned with the system capabilities. In the second column, we describe the response challenge in terms of practice questions, as observed by the practitioners. In the third column, we list competencies that are required to address the specific practice question. In the fourth column, we describe the knowledge, skills and abilities (KSAs) that are required to perform a job and are demonstrated through qualifying service, education, or training. **Knowledge** is a body of information applied directly to the performance of a function. A **skill** is an observable competence to perform a learned psychomotor act. **Ability** is the competence to perform an observable behaviour or a behaviour that results in an observable product.
Table 1. Cross-walk between specific capabilities, functions, practice questions, and competencies for emergency risk communication.

<table>
<thead>
<tr>
<th>Response challenge:</th>
<th>Practice questions – factors observed by practitioners that are associated with the response challenge</th>
<th>Competency</th>
<th>KSAs</th>
</tr>
</thead>
</table>
| Communicate to the public in a timely fashion | a) Communication is frequently delayed due to lack of understanding of the risk assessment process | Be able to communicate to the public the nature and magnitude of risk in a timely manner | Knowledge: Understand risk and risk assessment process  
Skill: Use online tools to access information  
Ability: Assess relevant emergency situational information coming into the agency. |
| | b) Communication is frequently delayed due to lack of understanding of how to best communicate uncertainty | | Knowledge: Understanding of the impact of uncertainty on behaviours  
Ability: Develop messages that acknowledge what is known and what is unknown |
| | c) Communication is frequently delayed due to complex processes in place to approve information release | | Factor non modifiable by training |

To illustrate this process, consider the challenge of communicating with the public in a timely fashion during an emergency. Practitioners note that in practice communications are frequently delayed. One reason for this is the existence of complex information release approval processes; training cannot address this factor. The other two common reasons for delays – public health officials not being familiar with the risk assessment process, and not understanding how to communicate uncertainty – both fall under the same core competency: the ability to communicate to the public the nature and magnitude of risk in a timely manner. To address this response challenge, training programs are needed to address public health officials’ knowledge, skills, and abilities (KSAs), as discussed above.
6. Develop and test core competency training model

The final step consists of the following: a) developing and implementing trainings based on the core competency model, competency levels and standards to be achieved by the organisation and individuals, and workforce training needs identified by a training needs assessment and b) identifying opportunities for assessing the impact of the training on the ability of the workforce in responding to an emergency – measured by either an exercise or by documenting and assessing the response to a real event – at the individual, organisational and system levels.

Approaches for Assessing Member State’s Capacities and Capabilities

The previous section (“Assessing training needs”) notes that individual-level competencies should be linked to system-level capabilities, and that competencies are among the factors (along with sound structures) that enable systems to work effectively. The approach offered in that section provides a “quick-start” for identifying gaps that can be executed over a relatively short period of time. Given the importance of ensuring that individual-level competencies are firmly rooted in a clear understanding of systems, in the long run it is wise to develop a more multi-faceted and systematic approach when conducting an ongoing assessment of system-level capabilities. Such an approach can help ensure the following:

- Competencies are constructed with a sound understanding of how individual-level contributions combine with structures and processes to produce system-level outcomes.
- Individual-level competencies are updated over time, as conditions change (e.g., new threats, changes in technology, governance, etc.).
- Individual contributions can be combined and integrated at the system level. System-level assessments not only help capture and represent preparedness, but, by providing feedback on how the system works as a whole, provide a tool for improving it. Providing individual training is, by itself, unlikely to lead to strong steady-state capabilities unless accompanied by regular assessments.
Specific process for developing assessments will need to be customized to specific measures. But in our experience developing good assessments involves a number of common steps. Below we describe each step and how it could be applied in this context.

The overall goal is to develop an EU-wide “kit” of assessments that can be selected, combined, and adapted by Member States in a way that complements their own assessment efforts and promote stronger dialogue about preparedness, response, and recover across Member States. As such, development of these assessments could support ongoing efforts to upgrade WHO’s systems for monitoring and evaluating capacity to implement the International Health Regulations (IHR).

**Convene a measurement workgroup/reference group**

Designing – and even more so – implementing assessments and collecting data on a large scale (such as the EU) requires the joint effort of a large number of stakeholders from various response disciplines and countries. Their active engagement in key aspects of the assessment development is therefore essential to long-term success, not only to ensure the assessments are appropriate to the variety of member country contexts involved, but also because in our experience a participatory process for measure development can help foster and sustain open dialogue and trust. This is important in gaining access to information needed for the measures and to increase the odds that lessons from the assessments are incorporated into budgetary, policy, and management decisions – what WHO’s concept note on monitoring and evaluation characterizes as “transparent reporting and building trust through dialogue.”

Specifically, we propose convening a reference group at the beginning of the process.

Given breadth of capacity and capabilities involved in infectious disease response (the initial focus of this work), it may be necessary to use a “subcommittee” structure. Examples of subcommittees may include: epidemiology/surveillance, laboratories, environmental and animal monitoring, crisis and risk communication, vaccines and other medical and nonmedical countermeasures, incident management.

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While potentially complex, our experience in the U.S. suggests that such as structure can work, provided there is an oversight committee/work group responsible for integrating the efforts of each subcommittee.20

Such working groups will provide important input on issues such as:

- Prioritizing and selecting among specific constructs to measure within each capacity and capability area
- Striking the right balance between identifying a common “core” of assessments that apply across Member States and ensuring that assessments can be customized to match unique aspects of each MS’s systems and culture
- Helping to identify feasible and sustainable data sources
- Providing formative feedback on draft assessments and helping to recruit pilot sites
- Helping to ensure the utility of the assessments to end-users and key stakeholders.

**Identify candidate measurement constructs through more detailed system mapping**

The capacities and capabilities described above are broad. Developing assessments will require identifying specific, observable inputs, processes, and outputs that are related to downstream health outcomes. These, in turn, will become the focal points of assessment and data collection tools (see below). The approach described in the section on “assessing training needs” will generate lists of system-level gaps that can provide an initial list of points of measurement for assessments. However, we recommend using a more multi-faceted approach over time. This approach includes:

**More detailed logic models and process maps.** The preparedness logic model described above provides a high-level picture of preparedness. We will begin by developing more detailed logic models, in order to identify a longer list of candidate measurement constructs. Where more granular mappings of time-dependencies and parallel/sequential processing is useful, we may wish to use process maps/precedence diagrams (from industrial engineering) or causal loop diagrams instead of process maps. Draft models and maps should be vetted by key members of the Working Group to ensure accuracy and utility.

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**Review of research literature and incident reports.** Reviews of academic literature and research reports are important in assessing the strength of evidence behind various aspects of logic models and specific process maps, particularly of the assumed causal connections between the “boxes.” Generally, the stronger the causal linkage between an “upstream” construct and downstream health outcomes, the more valid the former is as a measure of preparedness. While the research literature on preparedness has grown considerably in recent years it is still limited, and no set of assessments can be completely “evidence-based” in the academic sense. Thus, the logic models and process maps will rely heavily on reviews of actual incidents (selected in consultation with the Work Group, and in coordination with incidents examined as part of the work on competencies), building on the analysis conducted for this paper.

**Mathematical models.** In some instances, understandings of key response processes can be represented mathematically and simulated through Monte Carlo and other computer models. For instance, examination of existing models of disease spread may help identify key response pathways. We can also draw upon findings from tabletops and other types of discussion-oriented simulations. Where possible, we will leverage pre-existing models and findings, but may need to consider running new ones where critical information gaps exist. Once again, we anticipate that Workgroup members and other stakeholders may be helpful for identifying previous work.

**Select specific measurements constructs according to explicit criteria**

Having identified candidate measurement constructs, the next step is to identify the constructs most worth covering in assessment instruments. Selection of constructs helps decide which specific aspects of each capacity and capability are most important. Focusing on aspects that are not clearly linked to outcomes may lead to wasted resources and effort. Specific criteria will be developed in consultation with the Workgroup. In the past, we have found the following criteria useful:

- **Critical to the success of the system or process.** Failure to execute this step or process could jeopardise the success of the response.

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• **Most vulnerable to failure.** The step or process is difficult in some way and is prone to break-down

• **Observable.** There are behaviours, decisions, or processes that can be observed to generate qualitative or quantitative data.

• **Relevant across a wide range of threat scenarios and communities.** This can be a challenge given the diversity among public health systems in Member States. It is not practical to identify a customised set of measures for each Member State for a EU-level measurement system (though member states could use these identify state-specific measures). Thus, we will give higher priority to constructs that are relevant across a wide range of community contexts and threat scenarios. In past work, we’ve been able to use process maps from multiple capabilities to identify “cross-cutting” or “common-mode” components that appear across a wide range of maps.\(^{23}\)

For the purposes of assessment at the system level, we remain indifferent to which actors or entities have authority or control over response processes. However, as noted in the previous section, the process for developing competencies includes identifying organisations and the related composition of the public health workforce (target audience of the training) who are engaged in the achievement of the capability/ies.

**Operationalizing the constructs in assessment tools**

The next step is to identify and design practical assessment tools that, taken together, provide data that represents all of the constructs selected in the previous step.

**Establish key definitions, categories, and scales.** First, each construct must be described in terms of observable quantities or qualities. This may include, but is not limited to, speed, timeliness, the extent to which activities adhere to standards/protocols, proportion of relevant population covered, variability across locations, etc. This will help articulate in clear terms what a “good” response would look like – a process that will be informed by consultations with the Workgroup. Where appropriate, we will also define specific scales (for quantitative constructs) or categories (for qualitative constructs). Another important task is to identify the appropriate unit of measurement for the construct – i.e., the member state, municipality, etc. This might also include identifying opportunities to “roll up” measures into higher aggregates, thus creating the opportunity to measure one and the same construct at more than one level.

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**Identify and (if needed) designing data sources.** In order to move to empirical observation, we will next identify feasible strategies for eliciting data. As noted above, a key challenge in conceptualising and assessing preparedness is the rarity of large-scale incidents. Thus, data sources may need to include a combination of naturalistic observation and simulations. Different types of assessment tools are better suited to capacities vs. capabilities.

- **Surveys and inventories.** In the U.S., a number of such assessments have been developed over the years to gauge the presence of plans, protocols, equipment, staff, and exercising programs needed to sustain preparedness. Some involve surveys of key individuals who report on behalf of their hospital, health department, or other entity [references, examples]. Other assessments seek to validate responses through on-site visits. More recently, assessments implemented in the EU have used visits by peer assessors to assess progress in implementing priorities called out in the Global Health Security Agenda. These assessments can be relatively low-cost and can be designed to produce readily-analysed quantitative responses (i.e., on scales). However, these assessments generally do a poor job of assessing how well individuals, organisations and states can use their plans, personnel and materials (i.e., capabilities) in responses.

1. **Drills and simulation exercises.** Drills and exercises can provide a more realistic assessment of organisations’ operational capability. These can range from discussion-based (i.e., “table-top”) exercises that involve no kinetic activity, to small-scale kinetic tests (i.e., “skill drills”) of specific response components (e.g., staff mobilization) to large-scale tests that involve the simultaneous execution of a combination of discussion-based and kinetic tasks (e.g., a full-scale hospital MCI exercise). The challenge with assessment via exercises, however, is that they are often less amenable to standardised measurement and require more time and effort to analyse. One way to manage the burden, provide an added degree of objectivity, and promote sharing across Member States is to use external peer assessors. This is one of the principles set out in WHO’s recent Concept Paper on Monitoring and Evaluating capacity for the IHR.

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26 For instance, a research team at RAND recently developed a peer assessment-based hospital response tool. The tool can has been distributed by the U.S. Department of Health and Human Services Hospital Preparedness
(2) **Critical incident analysis.** Systematic analysis of responses to real incidents provided an integrated view of capacities and capabilities working together in real operational contexts, and can provide a mechanism for continual validation of survey/inventories and drills/exercises.

Fields such as aviation, rail transportation, and medicine have had considerable success using critical incidents to identify lessons for improving complex systems. In the context of public health, a critical incident can take a number of forms. Some incidents will be critical (i.e., meaningful) because they cause high morbidity or mortality, require that public health agencies engage in non-routine practices with different partners, occur on a larger or new scale, have substantial communitywide non-health impacts, significantly alter the system’s behaviours or beliefs, or help identify best practices to address a common problem. Finally, some incidents may be meaningful simply because they capture the public health community’s attention.\(^{28}\) Most often, these reviews are conducted after an incident. But during longer incidents (e.g., Ebola) they could be conducted during the incident, thus improving the response as well as harvesting lessons learned for later use. Like exercises, they can be evaluated by outside peer assessors, as well as by staff within each Member State.

Past experience suggests, however, that special attention must be paid to identifying root causes of strengths and weaknesses in incident responses,\(^{29}\) and to learning from comparisons among responses.\(^{30}\) In order to facilitate learning across incidents (which are often unique), it is necessary to develop a template that affords a balance between standardisation (i.e., common topics) and flexibility (i.e., to allow representation of unique elements of each incident). A successful registry also requires the willingness of an organisation (e.g., ECDC) to “host” the data, ensure adherence to agreed-upon standards for data de-identification, and systematic analysis of patterns and trends across cases. Finally, a registry would need to be accompanied by explicit incentives for reporting, to overcome intrinsic disincentives.

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Legal Measures
- Accountability
- Organisational structures
- Policy Development
- Delegation of authority
- Administrative preparedness

Economic Measures
- Financing
- Workforce development
- Facilities
- Infrastructure

Operational Measures
- Capacity assessment and planning
- Drills and exercises
- After Action reports and post-event evaluation

Policy development, adaptation, and implementation
- For infection control and treatment guidance
- For population-based disease control
- Policy implementation: communicating between national and subnational authorities and enforcing laws and regulations

Health care services
- Preventive services
- Medical surge
- Management of medical countermeasures, supplies and equipment
- Care for health care workers and emergency responders

Coordination and communication (within the public health emergency preparedness system)
- Crisis management
- Communication with healthcare providers
- Communication with emergency management, public safety, and other sectors
- Communication with other public health agencies at the global, European, national, and subnational levels

Social Capital: partnerships between public health and
- Health care providers
- Emergency responders
- Law enforcement
- Community organisations

Assessment
- Incident recognition
- Risk characterization
- Epidemiological investigation
- Surveillance and epidemiological monitoring
- Laboratory analysis
- Environmental monitoring

Emergency risk communication (with the public)
- Address communication inequalities
- Communicate risk in an accurate and timely manner
- Generate dynamic listening and manage rumours
- Maintain transparency and trust

Objectives
- Earliest possible identification of event
- Early and effective response
  - Minimising morbidity and mortality
  - Limiting spread of disease
  - Minimising social disruption
  - Minimising infrastructure and environmental damage
- Earliest possible recovery and return to normal

Figure 1. Proposed ECDC Logic Model for PHEP