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Health informatics — Interoperability of public health emergency preparedness and response information systems

Informatique de santé — Interopérabilité des systèmes d'information sur la préparation et la réponse aux urgences en matière de santé publique

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 215, *Health informatics*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The public health emergency preparedness and response operations are the critical component of the Global Health Security as well as the national multi-jurisdictional and multi-sectoral emergency response. All these operations rely on a unity of command approach, which FEMA defines as principles clarifying the reporting relationships and eliminating the confusion caused by multiple, conflicting directives. Another critical component of emergency response operations is implementing disaster management interoperability that supports the unity of command through equipping all responders with a clear understanding of their own responsibilities and functional interdependencies with other responders. From an information management perspective, it is important to note that the disaster management interoperability processes include development of communication channels that allow to share information via voice, data signals and electronic data developed on standardized terminology and vocabulary.

This document has been developed in response to the worldwide demand for strengthening PH EPR information systems, ensuring better preparedness at national and international levels, emerging pathogens, including COVID-19, chemical and nuclear accidents, environmental disasters and introduction of the threat of criminal acts and bioterrorism.

The document has been developed based on concepts and methodology described in:

— 2015 WHO Framework for a Public Health Emergency Operations Centre and supporting WHO Handbooks A and C[33];

— ISO/IEC 25012[34];

— ISO 30401[35];

— ISO 13054[36];

— ISO 22300[37];

— ISO 22320[19];

— ISO 1087[38].

Health informatics — Interoperability of public health emergency preparedness and response information systems

1 Scope

This document provides business rules for PH EPR information systems. It includes a description of the EPR information systems domain. It also includes an informative framework for mapping existing semantic interoperability standards for emergency preparedness and response to PH EPR information systems.

The primary target audience for this document is policy makers (governmental or organizational), regulators, project planners and management of PH EPR information systems, PH EPR data analysts and informaticians. The contents is also of interest to other stakeholders such as incident managers, PH educators, standards developers and academia.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
all-hazards approach
integrated approach to emergency preparedness planning that focuses on capacities and capabilities that are critical to preparedness for a full spectrum of emergencies or disasters, including internal emergencies and a man-made emergency (or both) or natural disaster

Note 1 to entry: The all-hazard approach acknowledges that, while hazards vary in source (natural, technological, societal), they often challenge health systems in similar ways. Risk reduction, emergency preparedness, response actions and community recovery activities are usually implemented along the same model, regardless of the cause.

3.1.2
case definition
<public health preparedness and surveillance> set of standard criteria for classifying whether a person has a particular disease, syndrome, or other health condition

Note 1 to entry: Use of an agreed-upon standard case definition ensures that every case is equivalent, regardless of when or where it occurred, or who identified it. Furthermore, the number of cases or rate of disease identified in one time or place can be compared with the number or rate from another time or place.

3.1.3
code set
<data> collections of codes or identifiers that are used to represent specific values within a value set

Note 1 to entry: These codes are often standardized and internationally recognized, such as ICD-10 codes for diseases or SNOMED CT codes for clinical terms.

3.1.4
common operating picture
COP
unified and shared understanding of a situation or scenario, that involves gathering and integrating data, information, and intelligence from various sources and presenting it in a comprehensive and accessible manner

Note 1 to entry: The COP aims to provide all stakeholders with a real-time, accurate, and synchronized view of the operational environment, enabling effective decision-making, coordination, and communication among the involved parties.

3.1.5
concept
<public health emergency preparedness and response data vocabulary > set of terms or concepts that have been agreed upon and adopted by a broader community or standard-setting organization in the context of public health emergency preparedness and response

Note 1 to entry: Public health emergency preparedness and response concepts are codified within the public health emergency preparedness and response data *vocabulary* (3.1.26). They designed in a way to ensure that data is collected and reported in a standardized and consistent manner, enabling effective communication and decision-making during emergency response.

3.1.6
critical information requirement
CIR
high-priority subset of *EEIs* (3.1.11) that triggers immediate or mandatory action

Note 1 to entry: These are elements of information specifically requested by incident leaders. These items are of such importance that leaders are notified immediately when the Planning Section receives updates on a CIR item.

3.1.7
data governance
process of overall management of the availability, usability, integrity, and security of the data employed in an enterprise assuring that the decision-making process prioritizes investments, allocates resources, and measures results

Note 1 to entry: Data governance is a component of the *information governance* (3.1.13).

3.1.8
disaster management interoperability
ability of systems, personnel, and equipment to provide and receive functionality, data, information and/or services to and from other systems, personnel, and equipment, between both public and private agencies, departments, and other organizations, in a manner enabling them to operate effectively together

Note 1 to entry: It allows emergency management/response personnel and their affiliated organizations to communicate within and across agencies and jurisdictions via voice, data, or video-on-demand, in real time, when needed, and when authorized.

3.1.9
domain
<information system> logical grouping of data pertaining to a common purpose, object, or concept

Note 1 to entry: The domain defines the context, requirements, and objectives that shape the design, functionality, and capabilities of the information system.

3.1.10
emergency operations centre
EOC
physical location at which the coordination of information and resources to support incident management (on-scene operations) activities normally takes place

Note 1 to entry: An EOC can be a temporary facility or located in a more central or permanently established facility, perhaps at a higher level of organization within a jurisdiction.

Note 2 to entry: EOCs can be organized by major functional disciplines (e.g., fire, law enforcement, medical services), by jurisdiction (e.g., Federal, State, regional, tribal, city, county), or by some combination thereof.

3.1.11
essential elements of information
EEIs
<emergency preparedness> crucial pieces of information necessary for effective planning, response, and coordination in the field of public health emergency preparedness and response

Note 1 to entry: EEIs encompass key data, indicators, and intelligence that are essential for public health agencies and organizations to assess, monitor, and respond to public health emergencies and disasters.

Note 2 to entry: EEIs are specifically tailored to the unique needs and requirements of public health preparedness, including vital information related to disease surveillance, epidemiological data, healthcare system capacity, medical resources availability, population demographics, risk assessments, and other factors influencing public health response efforts.

3.1.12
incident management system
IMS
comprehensive, interoperable organizational model for government, nongovernmental organizations, and the private sector to prevent, protect against, mitigate, respond to, and recover from incidents

Note 1 to entry: It provides stakeholders with a platform for sharing resources, coordinating and managing incidents, and communicating information through shared vocabulary, systems, and processes to successfully deliver the capabilities.

3.1.13
information governance
overall strategy that outlines the responsibility for ensuring appropriate behaviour when valuing, creating, storing, using, archiving, and deleting information for an enterprise

Note 1 to entry: It is a fundamental component of enterprise governance that includes processes, roles, policies, standards and metrics that help an organization achieve its goals.

3.1.14
information system
one or more computer systems and communication systems together with associated organizational resources such as human, technical, and financial resources that provide and distribute information

[SOURCE: ISO/IEC 25012:2008, 4.11]

3.1.15
interoperability
<IT> ability of different information systems, devices and applications (systems) to access, exchange, integrate and cooperatively use data in a coordinated manner, within and across organizational, regional and national boundaries, to provide timely and seamless portability of information

Note 1 to entry: IT interoperability is a component of disaster management interoperability.

Note 2 to entry: IT interoperability ensures that diverse technologies can understand, interpret, and utilize information exchanged between them without loss or distortion, allowing the smooth transfer of data, commands, and functionalities between different systems, enabling them to work together in a cohesive manner.

3.1.16
preparedness
<public health> ability to effectively anticipate, respond to, and recover from the impacts of likely, imminent, or current hazard events or conditions

Note 1 to entry: Public health preparedness encompasses the planning, organization, and coordination of resources and actions that is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response through to sustained recovery.

Note 2 to entry: Public health preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities.

3.1.17
population health
science of protecting and improving the health of people and their communities through promoting healthy lifestyles, researching disease and injury prevention, and detecting, preventing and responding to infectious diseases and other health threats

Note 1 to entry: The field of population health includes health outcomes, patterns of health determinants, and policies and interventions that link these two.

Note 2 to entry: Population health is a multidisciplinary approach that is based on a variety of disciplines, including epidemiology, biostatistics, social and behavioural sciences, emergency preparedness and response, health policy and management. It is focused on understanding and addressing the health needs of populations, with the goal of improving health outcomes and reducing health disparities.

3.1.18
public health
science and practice of protecting and improving the health of individuals, communities, and populations through the prevention of disease, injury, and other health-related issues

Note 1 to entry: Public health works to promote healthy behaviours and environments, identify and respond to health threats, and address health inequalities and disparities.

Note 2 to entry: Public health is a multidisciplinary field that draws on a variety of scientific and social science disciplines, including epidemiology, biostatistics, environmental health, social and behavioural sciences, and health policy and management. Public health professionals work in a range of settings, including public health departments, healthcare organizations, community-based organizations, academia, and government agencies.

3.1.19
public health and medical situational awareness
knowledge state that results from the process of active information gathering with appropriate analysis, integration, interpretation, validation and sharing of information related to health threats and the health of the human population, as well as health system and human services resources, health-related response assets, and other information that can impact the public's health to inform decision making and resource allocation

Note 1 to entry: Public health medical and situational awareness is critical in emergency response because it enables healthcare professionals to make informed decisions and take appropriate actions to mitigate the impact of the crisis. It allows them to identify potential risks and challenges, assess the capacity of the healthcare system, and develop effective strategies to manage the crisis.

Note 2 to entry: The public health medical and situational awareness plays a significant role in preventing public health emergencies and medical crises by enabling proactive risk assessment and mitigation. It involves identifying potential threats, developing early warning systems, and implementing appropriate preventive measures to prevent or mitigate a crisis.

3.1.20
public health emergency preparedness and response informatics
PH EPR informatics
interdisciplinary science, incorporating knowledge and techniques from multiple fields of research and practice, including epidemiology and surveillance, gathering and distributing information for situational awareness, IT technology and infrastructure development, incident management, and several other disciplines

Note 1 to entry: PH EPR informatics involves the strategic use of informatics tools, methods, and technologies to collect, analyse, exchange, and disseminate critical information and support decision-making processes during emergency situations.

Note 2 to entry: PH EPR informatics enhances the efficiency, accuracy, and effectiveness of emergency response efforts, enabling timely and informed decision-making, resource allocation, and coordination.

3.1.21
public health emergency preparedness and response information system
people, processes and technology involved in planning, acquiring, processing, managing and distributing PH EPR data and information in a coordinated manner, within and across organizational, regional, national and international boundaries to inform EPR decision making, resource allocation, community response and other actions necessary for PH EPR operations.

3.1.22
reference information model
single information model that covers the data domain of activity being addressed by a standards developing organization using this methodology

[SOURCE: ISO/TS 27790:2009, 3.62]

3.1.23
reference standard
single information model that covers the data domain of activity being addressed by a standards developing organization using this methodology

3.1.24
terminology
<public health emergency preparedness and response> specialized language used to describe the concepts, principles, and practices related to medical diseases and conditions, medical procedures and treatments, promoting and protecting populations' health, and preventing, responding and mitigating disasters

Note 1 to entry: Terminology is used to describe code sets, classifications, and vocabulary as a continuum.

Note 2 to entry: Public health terminology includes epidemiology (the study of the distribution and determinants of health and disease in populations), surveillance (the ongoing collection, analysis, and interpretation of health data), health promotion (activities aimed at improving health and preventing disease), and community health (the health status and needs of specific populations or communities).

3.1.25
value sets
<public health and public health preparedness> standardized codes and terms used to represent public health and public health concepts and their associated attributes, such as medical diseases and conditions, medical procedures and treatments, qualitative indicators for evaluation of health protection of populations, and disaster prevention, response and mitigation

Note 1 to entry: Value sets are commonly used in electronic information flows to enable exchanging public health, public health reporting and situational awareness information between all entities involved in public health emergency response.

Note 2 to entry: Standardized value sets are typically created and maintained by standard international public health organizations (i.e., WHO- International Classification of Diseases, ICD), standard development organizations (SDOs), i.e., IHTSDO (SNOMED CT codes), HL7, Regenstrief Institute (LOINC), which are widely adopted in public health.

3.1.26
vocabulary
<public health emergency preparedness and response data vocabulary> precise and standardized language and terminology for the public health emergency preparedness and response electronic data exchange to describe and respond to emergencies, disasters, and public health crises

Note 1 to entry: Public health emergency preparedness and response data vocabulary facilitates precise communication by minimizing or eliminating ambiguity (e.g., SNOMED CT, ICD-11).

Note 2 to entry: Public health emergency preparedness and response vocabulary includes terms related to emergency management, incident management, personal protective equipment, triage, mass casualty incidents, decontamination, and other concepts related to responding to emergencies and disasters that threaten public health.

Note 3 to entry: public health and public health preparedness data vocabulary very often use standardized *value sets* (3.1.25). For example, disability could be described by precise and standardized language, and it could be measured using such value sets as Disability status (a patient describes his/her own disability status), Disability type that described by a clinician (i.e., neurological disability, physical disability).

3.2 Abbreviated terms

CDC	Centres for Disease Control and Prevention
CIR	Critical Information Requirements
COVID-19	Coronavirus Disease 2019
DIS	Draft International Standard
EEI	Essential Elements Information
EOC	Emergency Operations Centre
EPR	Emergency Preparedness and Response
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HHS	Department of Health and Human Services
HIMSS	Healthcare Information and Management Systems Society
HL7	Health Level Seven
IDSR	Integrated Diseases Surveillance and Response
IEC	International Electrotechnical Commission, see ISO/IEC
IHR	International Health Regulations
IMS	Incident Management System
ISO	International Organization for Standardization
ISO/IEC	International Organization for Standardization/ International Electrotechnical Commission
IT	Information Technology
LOINC	Logical Observation Identifiers Names and Codes
PH	Public Health
PHE	Public Health Emergency (see ASPR)

PH EOC-NET	Public Health Emergency Operations Centre Network
PH EPR	Public Health Emergency Preparedness and Response
PHIN VADS	Public Health Information Network Vocabulary Access and Distribution System
SA	Situational Awareness
SNOMED-CT	Systemized Nomenclature of Medicine – Clinical Terms
SOP	Standard Operating Procedure
TC	Technical Committee
URL	Uniform Resource Locator
US	United States
VADS	See PHIN VADS
WHO	World Health Organization
WTO	World Trade Organization

4 Requirements for PH EPR information systems

4.1 Defining the PH EPR information system's domain

Information is the most critical asset during all phases of PH emergencies. It drives a decision-making process that enables situation assessment, risk analysis, resource allocation, response planning, public communication, and monitoring and evaluation.

The PH EPR information systems domain that manages PH EPR information encompasses people, processes and technology, and involves planning, acquiring, processing, managing and distributing PH EPR data and information in a coordinated manner, within and across organizational, regional, national and international boundaries to inform PH EPR decision making, resource allocation, community response and other actions necessary for PH EPR operations.

The PH EPR information systems domain typically includes the data management for the following data domains:

— Emergency preparedness: This domain encompasses data related to planning, training, and resource management in preparation for public health emergencies. It addresses information needs for developing response plans, conducting drills and exercises, establishing communication networks, and ensuring the availability of necessary resources and infrastructure.

— Surveillance and monitoring: This domain includes data to detect and track public health emergencies, such as data from surveillance systems for disease outbreaks, environmental monitoring, syndromic surveillance, and early warning systems. The domain also includes monitoring indicators such as case counts, hospitalizations, deaths, and other relevant data to inform decision-making.

— Risk assessment and modeling: This domain contains data for the evaluation and modeling of risks associated with public health emergencies, such as assessing the potential impact of emergencies, identifying vulnerable populations, estimating the spread of diseases, and predicting resource needs for response efforts. Risk assessment and modeling inform preparedness plans and resource allocation strategies.

— Communication and alerting: This data domain focuses on communication and information dissemination during emergencies, such as data for issuing alerts, warnings, and notifications to relevant stakeholders. Also, it includes data related to the development of communication channels, public messaging strategies, and the coordination of communication efforts across various entities involved in the response.

— Resource management: It focuses on data for the management of resources required for effective response during public health emergencies, tracking and inventorying medical supplies, vaccines, equipment, personnel, and other critical resources. Based on identified needs, this analysis ensures the availability, distribution, and utilization of resources.

— Incident reporting and documentation: This domain encompasses data from the documentation and reporting of incidents, response activities, and outcomes. It includes capturing and storing data on cases, interventions, epidemiological investigations, and outcomes. Incident reporting and documentation systems facilitate retrospective analysis, evaluation, and reporting to stakeholders, regulatory bodies, and the public.

— Collaboration and coordination: It focuses on data demonstrating the facilitation of collaboration and coordination among various stakeholders involved in PH EPR. Also, it contains indicators of coordinating efforts across different agencies, organizations, and jurisdictions to ensure a cohesive and synchronized response.

The PH EPR information systems play a critical role in fulfilling of the following major PH emergency response functions[31]:

— plans and procedures;

— physical infrastructure;

— information and communication technology (ICT) infrastructure;

— information systems and standards;

— human resources.

4.2 General principles of management and conformance

4.2.1 Conformance with general incident management principles

4.2.1.1 General requirements

The PH EPR information systems shall conform with general principles of incident management systems.

4.2.1.2 Utilization of common terminology, PH EPR vocabulary and concepts.

Incident management systems develop and utilize common EPR terminology that allows different organizations to fulfil assigned incident management functions, enhance IT interoperability and minimize confusion.

4.2.1.3 Modular organization

The incident management systems consist of building blocks that can be put in place as needed based on critical incident characteristics. These blocks include information on the incident's size, complexity and a type of hazards that caused the incident.

4.2.1.4 Managing by objectives

The incident commander establishes incident objectives that direct incident management operations. Managing by objectives require:

— Making specific, measurable objectives

— Developing executable strategies, tactics, tasks, and activities to fulfil the objectives

— Benchmarking, evaluating and documenting performance against objectives facilitate the initiation of corrective actions, and inform development of objectives for the next operational period.

4.2.1.5 Incident action planning

Development of coordinated incident action planning guides is crucial. Incident action plans (IAPs) outline incident objectives, tactics, and assignments for operational and support activities.

4.2.1.6 Manageable span of control

Span of control pertains to the number of individuals or resources that one supervisor can manage effectively during an emergency response. Effective spans of control enable supervisors to direct, communicate with and supervise subordinates. Incident management optimal control span is one supervisor to five subordinates. However, the 1:5 ratio is only a guideline. Effective incident management may call for different ratios, depending on the type of incident, purpose of tasks, existing hazards, distance between personnel and resources etc. In cases where a supervisor's control is insufficiently effective, they can assign subordinate supervisors or redistribute subordinates.

4.2.1.7 Organization of incident facilities and locations

Depending on the incident size, complexity and situation, the Incident Commander, Unified Command, and/or EOC director organize the necessary support facilities. Typical facilities include the Incident Command Post, incident base, staging areas, camps, mass casualty triage areas, points-of-distribution, and emergency shelters.

4.2.1.8 Comprehensive resource management

Comprehensive resource management serves as a systematic and coordinated approach for the development and maintenance of mechanisms to identify requirements, order and acquire, mobilize, track and report, demobilize, and reimburse and restock resources such as personnel, teams, facilities, equipment and supplies.

Key resource management activities include:

— resource identification and typing;

— qualification, certification and credentialing of personnel;

— planning for resources;

— acquiring, storing and inventorying resources.

4.2.1.9 Integrated communications

Integrated communications allow incident response teams from diverse organizations to achieve incident management interoperability, share information and achieve situational awareness.

Incident managers facilitate communications through the development and implementation of common communications plans, interoperable communications processes and systems.

Integrated communications are necessary to:

— maintain connectivity;

— achieve situational awareness;

— facilitate information sharing.

4.2.1.10 Establishment and transfer of command

The Incident Commander or Unified Command should clearly establish the command function at the beginning of an incident. The jurisdiction or organization with primary responsibility for the incident designates the individual at the scene responsible for establishing command and protocol for transferring command. When command transfers, the transfer process includes a briefing that captures essential information for continuing safe and effective operations, and notifying all personnel involved in the incident.

4.2.1.11 Unified Command

Unified Command may be established when an incident involves multiple jurisdictions, a single jurisdiction with multiagency involvement or multiple jurisdictions with multiagency involvement. The Unified Command establishes a common set of incident objectives and strategies that all can subscribe to. This is accomplished without losing or giving up agency authority, responsibility or accountability. Organizations participating in incident management share key features of Unified Command including a single, integrated incident organization, collocated (shared) facilities, a single planning process and Incident Action Plan, integrated staffing, a coordinated process for resource ordering.

4.2.1.12 Chain of command and unity of command

Chain of command refers to the orderly line of authority within the ranks of the incident management organization. Unity of command means that each individual only reports to one person. This eliminates the potential for individuals to receive conflicting orders from a variety of supervisors, thus increasing accountability, preventing freelancing, improving the flow of information, helping with coordination of operational efforts, and enhancing operational safety.

4.2.1.13 Personnel accountability

Personnel accountability in emergency response refers to effort to improve the safety of emergency responders by keeping track of their locations and assignments when operating at an incident site. Effective accountability for resources during an incident is essential. Incident personnel should adhere to accountability principles, including check-in/check-out, incident action planning, unity of command, personal responsibility, span of control, and resource tracking.

4.2.1.14 Dispatch/Deployment

Dispatch/deployment in emergency management refers to the resource management process that provides movement of personnel or/and other resources for emergency response. Resource management involves the coordination, oversight, and processes that ensure timely employment of resources during an incident. Ensuring that resource management systems and procedures are in place prior to an incident (or a planned event) is crucial to acquiring the resources necessary during an incident. Personnel or/and other resources should be deployed only when appropriate authorities request and dispatched through established resource management systems.

4.3 PH EPR data and information management (DIM) processes

4.3.1 Background

PH EPR data and information management (DIM) processes are crucial for effective decision-making, coordination, and communication among stakeholders involved in emergency preparedness and response efforts.

The PH EPR DIM shall conform to ISO/IEC 38500:2015, applying to PH EPR DIM the following principles for effective IT governance:

— responsibility;

— strategy;

— acquisition;

— performance;

— conformance;

— human behaviour.

The following are key DIM processes in PH EPR:

— data collection;

— data integration;

— data analysis;

— data visualization;

— data quality assurance;

— data sharing and exchange;

— deploying PH IMS;

— development of the public health and medical situational awareness and situational reporting;

— knowledge management;

— continuous improvement.

4.3.2 Establishing strategies and goals for the PH EPR DIM

4.3.2.1 Strategic planning

The PH EPR information systems shall develop a strategic planning process for DIM. The PH EPR DIM strategic planning process is a component of the overall incident strategic planning process and incident communication strategic planning. This process ensures that the incident information management system sustains and extends organizational strategies and helps to achieve organizational strategic goals and objectives. Also, it assures the interoperability of emergency management tasks at different jurisdictional, national and international levels. The strategic information management plan reflects the relevance of information management processes and products to each of the emergency response organization/entity strategic goals.

4.3.2.2 Aligning DIM strategies and objectives with the overarching PH EPR strategies and objectives

The overarching emergency response strategy is made up of high-level, multisectoral principles and policies and outlines the overall impact and needs arising from an emergency – including within the health sector – and the priorities for addressing these needs. At the national level, public health emergency preparedness entities work on achieving the following strategic objectives[28]:

a) Operational readiness to respond to emergencies: a high level of readiness that allows a timely, effective and efficient response. Achieving readiness is a continuous process of establishing, strengthening and maintaining a multisectoral response infrastructure that can be applied at all levels. This infrastructure follows an all-hazard approach and focuses on the highest priority risks. Operational readiness builds on existing capacities to design and set up specialized arrangements and services for emergency response. It requires political commitment, coordination, risk assessment, infrastructure, preparedness and response plans, financing, human resources, equipment, exercises, and knowledge.

b) Resiliency of health systems by strengthening essential public health functions and the capacities related societal systems.

c) Applying the One Health approach to the human-animal-environment interface. This approach ensures connectivity and coordination at the human-animal-environment interface, to facilitate and improve the effectiveness of emergency preparedness at all levels.

d) Applying a whole-of-government, whole-of-society approach by building integrated support for emergency preparedness across all sectors of government and society, including non-governmental and private sector organizations and essential services.

4.3.3 Defining goals for the PH EPR information system

Goals of an effective PH EPR information system is to support timely and informed decision-making, enhance coordination, and facilitate efficient communication among stakeholders involved in emergency preparedness and response efforts. The PH EPR information system provides a comprehensive and integrated platform for managing, analysing, and disseminating information related to emergencies, thereby improving overall response capacity and protecting public health.

Goals for the PH EPR information system support the following WHO[31] strategic PH EPR objectives:

— implementing emergency preparedness at all levels (national, sub-national, territorial levels);

— developing and implementing a strategic approach to emergency preparedness and response that assures achievement of the following 4 strategic outcomes:

  a) Operational readiness to respond to emergencies: a high level of readiness will allow a timely, effective and efficient response.

  b) Presence a resilient health system that fulfils essential public health functions and related societal systems' capacities, including:

    — Development, training and equipping of a health emergency workforce.

    — Maintenance of structurally and functionally safe hospitals and other health facilities.

    — A reliable supply of medicines. Disease surveillance systems and laboratory services.

    — Competent health service delivery for people directly affected by emergency and other important health conditions.

    — Financing for emergency risk management, including preparedness as an integral part of national health financing

    — Contingency funds for emergency situations

  c) Presence of the One Health at the human-animal-environment to assure connectivity and coordination at the human-animal-environment interface, to facilitate and improve the effectiveness of emergency preparedness at all levels.

  d) Operationalization of a whole-of-government, whole-of-society approach with the focus on building relationships between the health and non-health sectors, and on coordinating planning and implementation of emergency preparedness by implementing the following:

    — All-Hazards approach and addressing specific purposes of the PH incident (i.e., hurricane PH IMS, Ebola PH IMS, COVID-19 PH IMS)

    — Whole-of-Government Approach by emphasizing the involvement and collaboration of all government agencies and departments in emergency preparedness and response efforts

    — Whole-of-Society Approach by recognizing that emergency preparedness and response is not solely the responsibility of the government. It involves engaging and mobilizing all

sectors of society, including non-governmental organizations, community groups, private sector entities, and individuals, to actively participate in preparedness activities, share responsibilities, and contribute their resources and expertise

— Building strong relationships between the health and non-health sectors. These relationships foster cooperation, information sharing, and joint planning to address the diverse challenges and needs that arise during emergencies

— Coordinating planning and implementation of emergency preparedness through coordinated planning and implementation efforts across all sectors. It involves aligning strategies, policies, and actions to ensure a cohesive and integrated approach to emergency preparedness. This coordination encompasses activities such as risk assessment, resource planning, training and exercises, communication protocols, and response strategies.

4.4 Supporting PH EPR mission areas

The PH EPR information system shall support the following mission areas:

— Prevention: prevent, avoid or stop an imminent, threatened or actual act of terrorism.

— Protection: protect our citizens, residents, visitors and assets against the greatest threats and hazards in a manner that allows our interests, aspirations and way of life to thrive.

— Mitigation: reduce life and property loss by lessening future disaster impact.

— Response: respond quickly to save lives, protect property and the environment, and meet basic human needs in the aftermath of a catastrophic incident.

— Recovery: recover through a focus on the timely restoration, strengthening and revitalization of infrastructure, housing and a sustainable economy, as well as the health, social, cultural, historic and environmental fabric of communities affected by a catastrophic incident.

— Detection: identify, recognize, and promptly detect potential health threats, hazards, or emergencies that may impact public health. The detection mission focuses on implementing systems, processes, and surveillance methods to identify the early warning signs of emerging diseases, outbreaks, bioterrorism incidents, natural disasters, or other events that may pose risks to public health.

In many instances, the PH EPR information systems domain simultaneously supports more than one event. For example, a country could be in the middle of a pandemic response (i.e., COVID-19), and at the same time it could manage recovery operations related to a hurricane.

4.5 Establishing data and information governance

4.5.1 Data and information governance: Background and principles

4.5.5.1 The PH EPR data and information governance provide crucial support for enabling informed decision-making, enhancing situational awareness, promoting coordination and collaboration, facilitating resource management, ensuring privacy and security, and supporting learning and improvement.

The purpose of data and information governance in the PH EPR information system is to exercise authority and control by planning, monitoring and enforcing applicable laws, policies, and standard operating procedures (SOP) that pertain to data information management and overall, support incident strategies and objectives.

The PH EPR information systems shall develop and maintain data and information governance processes that support business needs for making informed disaster management decisions.

4.5.5.2 There are many benefits to implementing information and data governance processes in PH EPR information systems, including:

— overall, improvement in quality, timeliness of delivery and user satisfaction with information products;

— interoperability and improved coordination between existing and new data programmes;

— eliminating redundancy in some processes and data collection;

— additional consolidation information management processes and information flows;

— better compliance with existing regulations, policies and SOPs.

4.5.5.3 The following tasks are included in the PH EPR data and information governance processes:

— Develop a governance framework specific to PH EPR data and information governance. This includes defining the governance structure, roles, and responsibilities of stakeholders involved in data governance during emergency response.

— Conduct a comprehensive inventory and assessment of available data sources and systems relevant to PH EPR. Identify the types of data collected, their quality, accessibility, and potential gaps in data collection.

— Develop plans and protocols for data collection during emergencies. Define the data elements to be collected, establish data collection methods, and identify the responsible entities or individuals for data collection.

— Establish data standards and guidelines to ensure consistency, interoperability, and quality of data collected during PH EPR. Define data formats, coding schemes, and naming conventions to enable effective data sharing and analysis.

— Implement procedures to monitor and assure the quality of data collected during PH EPR. This includes data validation, verification, and cleansing activities to address errors, inconsistencies, and missing data.

— Establish mechanisms and protocols for data sharing and collaboration among relevant stakeholders involved in PH EPR. This includes developing data sharing agreements, ensuring data privacy and security, and facilitating interoperability between different information systems.

— Develop procedures and tools for data analysis and reporting during PH EPR. This involves employing appropriate data analysis techniques, generating timely and accurate reports, and disseminating information to support decision-making and response efforts.

— Implement measures to protect the privacy and security of sensitive data collected during PH EPR. This includes ensuring compliance with relevant data protection regulations, establishing data access controls, and implementing secure data storage and transmission practices.

— Provide training and awareness programmes to stakeholders involved in PH EPR data governance. This includes educating personnel on data governance policies and procedures, data privacy and security practices, and promoting data literacy and ethical data use.

— Establish mechanisms to monitor and evaluate the effectiveness of data governance processes during PH EPR. This includes conducting regular assessments, audits, and reviews to identify areas for improvement and ensure compliance with data governance standards.

— Maintain documentation of data governance processes, policies, and procedures specific to PH EPR. This includes maintaining records of data collection, data sharing agreements, data quality assessments, and any modifications or updates to governance frameworks.

— Continuously review and improve data governance processes based on lessons learned from emergency responses and evolving needs. This involves incorporating feedback from stakeholders,

identifying areas for enhancement, and implementing necessary adjustments to optimize data governance practices.

4.5.5.4 A process of developing and executing information governance plans shall be focused on addressing of the information management issues, including:

— identification and management of gaps in policies, standards and procedures for information management enterprise

— assessment of public health risks and capabilities

— identification and resolution of data quality issues:

  a) Integrating data flows across offices.

  b) Identifying critical information requirements and ways for improvement of actionable analytics.

— standardization approach to address key information management issues;

— prevention redundant data collection;

— maintenance 24x7 information security and accessibility.

4.5.5.5 The PH EPR information systems domain shall develop, maintain and govern information flows that support the following five PH EOC core functions[23],[19]:

a) Management – responsible for the overall operation of incidents or events (including coordinating risk communication and liaison with other agencies).

b) Operations – at the field level, this function provides direct response to the incident or event; at higher levels, it provides coordination and technical guidance.

c) Planning – collection of data, analysis, and planning of future actions based on the likely course of the incident and the resources available for the response.

d) Logistics – this function acquires, tracks, stores, stages, maintains, and disposes of material resources required for the response. It also provides services in support of the response, such as health services for responders.

e) Finance and administration – cash flow management; tracking of material and human resource costs; budget preparation and monitoring; and production and maintenance of administrative records.

4.5.5.6 The PH EPR information systems governance process shall include tasks on development and maintenance of interoperable communication terminology and data vocabulary standards, as well as referencing them through the metadata repository:

a) Continuous improvement of terminology and data vocabulary through standardization and harmonization. ISO 22300 provides definitions of generic and subject-specific terms related to security and resilience.

b) Establishing the roles, responsibilities, and decision-making processes for developing and implementing standardized vocabulary and terminology.

c) Defines the steps and procedures for developing and implementing standardized vocabulary and terminology.

d) Focusing on ensuring that standardized vocabulary and terminology are implemented correctly and consistently across data systems and platforms.

e) Adding to the metadata repository critical reference standards for the standards creation. This list includes standards and documents developed by ISO, WHO, LOINC, SNOMED, HL7 and national agencies. Table 1 provides the list of standards development organizations that work on terminology and standards for PH EPR information systems and typically included in the repository.

Table 1 — Examples of organizations developing vocabulary and terminology standards for PH EPR information systems

Organization	Organization's scope of responsibilities	Examples of reference standards relevant to development of vocabulary and data vocabulary
ISO TC 215 Health informatics	TC 215 works on standardization in the field of health informatics, to facilitate capture, interchange and use of health-related data, information, and knowledge to support and enable all aspects of the health system.	ISO 23903[39]
		ISO/TR 12309[40]
		ISO/TR 14292[41]
		ISO 13054[36]
ISO/TC 292 Security and resilience, Working Group 3 - Emergency management	This Working Group is responsible for drafting of standards in the field of emergency management.	ISO 22300[37]
ISO/TC 262 Risk Management Guidelines	TC 262 develops international standards in the field of risk management to support organizations in all their activities including making decisions to manage and minimize the effects of accidents, disasters and faults in technical systems as well as response and recovery from major disruptive risks.	ISO 31000[42]
WHO Public Health Emergency Operations Centre Network (EOC-NET)	The WHO EOC-NET is working to identify and promote best practices and standards for EOCs and provide support to EOC capacity building in Member States. WHO has been working with EOC-NET partners in developing evidence-based guidance for building, operating and improving public health EOCs.	Framework for a Public Health Emergency Operations Centre, 2015[43]
		Handbook for Developing a Public Health Emergency Operations Centre Part A: Policies, Plans and Procedures[44]
		Handbook for Developing a Public Health Emergency Operations Centre Part C: Training and Exercises[45]
WHO. Humanitarian health action	This WHO project develops terminology related to PH emergencies	WHO. Humanitarian health action. Definitions: Emergencies[46]
FEMA	Terms frequently used by FEMA for emergency preparedness and response	FEMA Glossary[47]
Canada. Public Works and Government Services Canada. Translation Bureau	This organization in 2012 published the Emergency management vocabulary that provides a bilingual (English and French) term for emergency management.	Emergency management vocabulary. Terminology bulletin; 281[48]
US CDC	US CDC works on data interoperability, including development and management standardized vocabulary sources for PH EPR.	CDC. PH Information Network (PHIN). Data Interchange Standards[49]
		CDC. Vocabulary Access and Distribution System (VADS), PH Emergency Preparedness (data vocabulary)[50]

Table 1 *(continued)*

Organization	Organization's scope of responsibilities	Examples of reference standards relevant to development of vocabulary and data vocabulary
LOINC (Logical Observation Identifiers Names and Codes)	LOINC the international Standards Development organization that develops a common language (set of identifiers, names, and codes) for identifying health measurements, observations, and documents. The LOINC scope includes development of standardized data dictionary for PH EPR.	LOINC 89724-9. Minimum Data Set (MDS) for Public Health Emergency Operations Centres (EOC) [CDC Emergency Operations Centres][51]
HL7 International. Emergency Care (EC) Work Group	The goal of the Emergency Care (EC) Work Group is to bring the unique understandings and perspectives of the emergency health care enterprise to the HL7 standards process.	HL7 Version 3 Specification: Data Elements for Emergency Department Systems (DEEDS), Release 1 - US Realm[52]
SNOMED (Systematized Nomenclature of Medicine) International	SNOMED International determines global standards for health terms, an essential part of improving the health of humankind. SNOMED International browser includes a clinical terminology that also used for reporting clinical problems caused by emergency situations and PH EPR (i.e., reporting COVID-19 cases).	SNOMED International CT browser[53]

4.5.2 Ongoing training

The PH EPR information systems domain shall support the development of knowledge, skills and abilities required to fulfil the core EPR functions, data and information governance.

The success of PH EPR information systems in the development of public health and medical situational awareness and other analytical products depends on a qualification of staff and understanding responsibilities. The WHO, describing training and exercises for personnel of the PH EOC, has provided a detailed list of skills and abilities related to fulfilment of core EPR functions, and they apply to any PH EOC position.

The role of the PH EPR informatician in PH emergency response is gathering, storing, interpreting, and managing data and information that supports incident management functions in all PH EPR disaster response mission areas (Prevention, Protection, Mitigation, Response, Recovery and Detection). The PH EPR informatician's competencies consist of general competencies required for all responders working in emergency response, as well as specific competencies.

The following core competencies are recommended for the PH EPR informatician:

— General competencies:

  a) Understand the purpose, functions, and tasks of the national, inter-jurisdictional, jurisdictional Incident Command System (ICS) and National Incident Management System (NIMS) and apply this knowledge to building PH EPR information systems.

  b) Demonstrate a leadership style, and ability to manage time and resources effectively.

— Competencies in the development and maintenance of PH EPR information systems

  — Demonstrate knowledge and skills in patient and population health data, informatics sciences, and development and maintenance of PH EPR systems.

  — Demonstrate knowledge of public health and emergency preparedness and response informatics and skills to provide effective support of emergency preparedness operations by utilizing

electronic communication, data exchange tools and applications, and developing actionable analytics and data visualization.

— Develop and maintain a public health and medical situational awareness.

Knowledge, Skills, and Attitudes (KSAs) and Competencies for Public Health Emergency Preparedness and Response Informatics Professionals are outlined in Annex B.

4.5.3 Defining Essential Elements of Information (EEIs) and Critical Information Requirements (CIRs)

The PH EPR information systems domain establishes a process for development, collection, and utilization Essential Elements of Information (EEIs) and Critical Information Requirements (CIRs).

Collection, analysis and dissemination of EEIs and CIRs are vital for facilitating public health and medical situational awareness and decision-making[14]. They ensure public health and medical SA, support decision-making, facilitate resource allocation and coordination, enable timely response, aid in risk assessment and mitigation, and contribute to evaluation and learning for future emergencies. By defining and focusing on critical information needs, these elements enhance emergency response effectiveness and efficiency.

While EEIs are normally defined during the Prevention and Preparedness mission areas, CIRs complement EEIs and developed during the Response, Recovery and Mitigation. For example, a state PH agency, while developing an annual All-Hazards Preparedness Plan, will specify tasks related to hurricane response and related EEIs. However, when a hurricane causes a flooding in a specific area, the PH EOC may create CIRs that reflect daily information reporting needs that were not included into the EEIs (i.e., reporting infrastructure damages, status of shelters).

The WHO Handbook[14] provides the following examples of EEIs:

— information to facilitate public health emergency preparedness and response activities;

— standardized data and information items for routine public health and medical situational awareness;

— context and contribute to data analysis;

— data and analytics for situation reports;

— comprehensive list of tasks for all notifiable diseases/conditions.

The WHO Handbook[14] provides examples of CIRs:

— all Public Health Emergencies (PHEs) of international concern in accordance with IHR requirements;

— an outbreak that exceeds the threshold defined in the Integrated Diseases Surveillance and Response (IDSR) and is being monitored by PH EOC;

— any acute PHE that requires assistance from WHO;

— media interest for any event;

— accidental death/injury of response personnel deployed in the field;

— any event affecting installation activities/operations;

— upward or downward change in grade of a current PHE;

— an incident that negatively impacts the facilities, activities, or operations of the PH EOC or Ministry of Health;

— an unusual or serious event reported from the sub-national level.

The following are examples of PH EPR information systems tasks related to EEIs and CIRs management:

— collecting existing EEIs and CIRs;

— providing gap analysis and facilitate development of additional EEIs and CIRs;

— establishing data flows, data analysis and developing public health and medical information products that address information needs defined in EEIs and CIRs;

— collecting standardized terminology and establishing the necessary standardized vocabulary to support EEIs and CIRs.

The following is a list of specific EEIs data and information requirements for many types of public health emergencies [22]:

— number of total medical facilities in the impact zone;

— name and location of medical facilities operating on generator power;

— name and location of medical facilities evacuated;

— number and location of medical needs shelters operating;

— name and location of closed medical facilities (unable to provide services);

— location of medical evacuation airports;

— number of medical evacuations;

— location of medical resources (personnel/teams and equipment);

— location of Incident Response Coordination Teams;

— location of national medical stations;

— number of patient encounters;

— number of State reported fatalities;

— location of temporary morgue facilities;

— limiting factors or shortfalls.

As presented in the above instances, EEIs can have different contextual formats, starting from elements that express almost at a precise level of data elements in a data dictionary (i.e., number of patient encounters, number of medical evacuations) up to a general description of the information flow that will require making a list of data elements (i.e., name and location of medical facilities evacuated).

4.5.4 Establishing a process for the collection, development, and utilization of standardized case definitions

The PH EPR data and information governance process domain shall define a process for collection, development, and utilization of case definitions for public health surveillance.

The development and implementation of case definitions require ongoing collaboration, communication, and flexibility to adapt to the evolving nature of the emergency and the emerging evidence related to the disease or condition. The following are key steps typically followed in the process of development and implementation of case definitions:

a) Define the Objective: Clearly define the objective of the case definition, which is usually to identify and classify cases of the specific disease or condition associated with the emergency. Determine the purpose of the case definition, such as surveillance, data collection, or diagnostic criteria.

b) Review Existing Evidence: Conduct a comprehensive review of the scientific literature, guidelines, and recommendations from relevant national and international health organizations. Identify existing case definitions for similar diseases or conditions and evaluate their applicability to the current emergency. Consider any specific characteristics or manifestations of the disease observed in the emergency.

c) Establish a Working Group: Form a multidisciplinary working group consisting of experts in the field, including clinicians, epidemiologists, laboratory specialists, and public health professionals. The working group should have diverse expertise and representation from relevant stakeholders to ensure comprehensive input and decision-making.

d) Determine Case Criteria: Define the clinical, laboratory, and epidemiological criteria used to identify and classify cases. Consider factors such as symptoms, signs, laboratory test results, exposure history, and temporal aspects of the disease. Discuss and determine the sensitivity and specificity of the criteria to ensure they are appropriate for an emergency situation.

e) Consultation and Validation: Seek external input and validation of the proposed case definition from relevant stakeholders, including other public health agencies, healthcare providers, and academic experts. Engage in discussions, conduct workshops, and solicit feedback to refine the case definition and address any potential concerns or challenges.

f) Pilot Testing: Implement a pilot testing phase to evaluate the feasibility and practicality of the case definition. Apply the defined criteria to a subset of cases and assess the ability to accurately identify and classify cases. Adjustments may be necessary based on feedback and experience gained during the pilot phase.

g) Finalize and Document: Incorporate the feedback received during the consultation and pilot testing phases to finalize the case definition. Prepare comprehensive documentation that includes clear definitions, inclusion and exclusion criteria, clinical and laboratory parameters, and guidance for data collection and reporting.

h) Dissemination and Training: Ensure widespread dissemination of the finalized case definition to relevant stakeholders, including healthcare providers, laboratories, and surveillance teams. Conduct training sessions and provide educational materials to facilitate understanding and consistent implementation of the case definition.

i) Implementation and Data Collection: Roll out the case definition across the healthcare system and surveillance networks. Monitor the implementation process and collect data according to the defined criteria. Continuously monitor and evaluate the case definition's performance and make adjustments if needed based on emerging evidence or changing circumstances.

j) Periodic Review and Update: Regularly review and update the case definition based on emerging scientific evidence, epidemiological trends, and lessons learned from the emergency response. Conduct post-emergency evaluations to assess the effectiveness and validity of the case definition and make necessary revisions for future emergency.

The WHO has proposed a standard that describes categories of information (sections) that should be addressed in case definitions[27]. It includes the following categories of information:

— rationale for surveillance;

— recommended case definition, including clinical case definition, laboratory criteria for diagnosis, case classification (suspected, probable and confirmed);

— recommended types of surveillance;

— recommended minimum data elements for case-based and aggregate reporting;

— recommended data analyses, presentation and reports;

— principal use of data for decision making (i.e., detecting outbreak, estimating the incidence and planning supplies);

— special aspects, including at least one reference laboratory in each country;

— contact information.

All the above categories of a case definition serve as information requirements for making PH EPR SOPs and planning information needs for PH emergencies.

Similar categories information have been included in the international and US CDC case definitions. For example, the US CDC COVID-19 case definition[1] and European Union CDC COVID-19 case definition[7] contain the following categories of information:

— background (similar to the WHO rationale for surveillance);

— clinical criteria;

— laboratory criteria;

— epidemiologic linkage;

— case classification.

4.6 Reporting — Data analytics and visualization

Data analytics and visualization facilitate data integration, public health and medical situational awareness, early warning systems, resource allocation, risk assessment, decision support, communication, and evaluation. By leveraging data-driven insights, public health authorities can enhance their ability to detect, respond to, and mitigate the impact of emergencies on public health.

The PH EPR information systems shall develop processes and procedures supporting data visualization and analytics.

The PH EPR information systems develop trusted, understandable, optimized for use and timely delivered DIM analytical and visualization products. For example, sophisticated DIM analytics and visualization tools were implemented during the COVID-19 pandemic. For instance, the Centre for Systems Science and Engineering at the John Hopkins University, relying on US state level COVID-19 analytics, as well as national summaries from different countries, has developed a dashboard that provides daily updated public health and medical situational awareness on US and international numbers of total COVID-19 cases, total death and total vaccine dose administered and other indicators that characterize the COVID-19 pandemic[21].

PH EPR data analysis and visualization products help in measuring and improving emergency operations that leads to shortening a recovery cycle and response times.

PH emergency management organizations utilize 4 common types of data analytics[20]:

— Descriptive analytics. This is a data and content examination that aims to answer the question "What happened?" (or "What is happening?"). Descriptive analytics is a component of the traditional business intelligence (BI) and visualizations such as pie charts, bar charts, line graphs, tables, or generated narratives[12].

— Diagnostic analytics. This analytics exams data or content for answering the following question: "Why did it happen?". Drill-down, data discovery, data mining and correlations[13] are examples of diagnostic analytics.

— Predictive analytics. This is a type of analytics that utilizes historical data, statistical algorithms and machine learning techniques to identify the likelihood of future outcomes. The goal of the predictive analytics is to go beyond knowing what has happened to provide a best assessment of what will happen in the future[21].

— Prescriptive analytics. This is a form of advanced analytics, which aims in data or content examination by answering the following question: "What should be done?" or "What can we do to

make _____ happen?" These analytical products aim to identify the best course of action when making complex decisions involving trade-offs between business goals and constrains[17].

The implementation of these four types of analytics depends on the type of emergency response organization, the skills of personnel with data analytics, and the technology available.

Data visualization products consists of common graphics, such as visual elements as charts, graphs, and maps. By using these products, incident responders will be able to fulfil their specific tasks and overall manage incidents in a more accurate manner. Besides emergency response, data visualization tools can also be used to assess community resilience and preparedness.

A Geographic Information System (GIS) is one of the most important tools for visualizing EPR data. GIS applications combine layers of data on critical infrastructure, natural hazards, and man-made threats, and on the community's demographics and social inequities to help in a distribution of resources. For example, FEMA provides interactive GIS-based data visualization tools for Hazard Mitigation Assistance (HMA) by state, county, grant programme, and project type, fire incidents by state and county, and disaster housing assistance[8]. Using GIS tools aim in quickly manoeuvring with resources, better understanding geographic distribution of threat and other tasks related to public health and medical situational awareness and operational picture. Also, during a recovery process, GIS tools help in quickly assessing damage, opening roadways, and removing debris, capturing where priorities are located, and demonstrating recovery progress.

5 Interoperability in PH EPR information systems

5.1 Background

The EPR incident management interoperability allows emergency management/response personnel and their affiliated organizations to share information via voice, data signals and electronic data developed on standardized terminology and vocabulary in real time, when needed, and when authorized.[9][25] By promoting collaboration, information sharing, standardized processes, training, compatible IT systems, effective governance, and continuous improvement, organizational interoperability strengthens the collective response to public health emergencies. It enables a coordinated, integrated, and efficient response across multiple organizations, resulting in better outcomes for emergency preparedness and response.

5.2 Aligning the PH EPR information systems interoperability with the organizational interoperability of the activated IMS and overall emergency response

The PH EPR information system is one of the critical PH incident response systems built on and supports organizational interoperability. This approach provides mechanisms to assure that the staff, infrastructure, and business processes within PH EPR information systems have data and information capabilities for supporting PH emergency response. Achieving organizational interoperability means that PH EPR information systems develop data and information governance, business requirements and SOPs that facilitate the secure, seamless and timely communication and use of data both within and between organizations, entities and individuals[16]. This also means that PH EPR information systems enable shared consent, trust and integrated end-user processes and workflows.

The IT interoperability of PH EPR information systems shall be aligned with the incident management of the activated IMS and overall emergency response.

The PH EPR information systems succeed in achieving a business purpose through the alignment of PH EPR information systems business requirements with emergency response entity's objectives and functions for all emergency management mission areas. This alignment includes analysis of requirements for people (Who? Stakeholders and PH EPR staff), processes (How? Analysis of system's capabilities), IT structure (Where? Resources analysis), and timing (When? Requirements analysis by emergency management mission areas: Prevention, Preparedness, Response, Recovery, Mitigation and Detection).

5.3 Facilitating the improvement of organizational interoperability through organizational emergency resilience

Emergency resilience is an integral and crucial component of the overall organizational business management strategy, as well as development of organizational interoperability. By using "resilience" in accordance with ISO 22316,[18] public health organizational emergency resilience could be defined as an emergency management capability for responding to emergency events timely, with efficient use of resources and minimum loss of performance capacities and bringing the system back to recovery and mitigation state. The purpose of public health organizational emergency resilience is to continuously improve emergency response capacities, including capacities to anticipate, prepare and respond to health threats.

Improvement of public health emergency response organizational interoperability through organizational emergency resilience can be achieved by implementing the following approaches:

a) Establish Clear Governance and Leadership: Develop clear governance structures and leadership roles that support both interoperability and resilience. Assign responsibilities for coordinating and overseeing interoperability efforts, and ensure that leadership promotes a culture of collaboration and resilience within the organization.

b) Conduct Interagency Training and Exercises: Organize joint training and exercises involving multiple agencies and organizations to enhance their interoperability skills and capabilities. These exercises should simulate emergency scenarios and encourage collaboration, communication, and information sharing across organizations.

c) Standardize Communication Protocols: Establish standardized communication protocols and procedures that ensure seamless information exchange during emergencies. Define common terminology, data formats, and communication channels to facilitate effective communication and interoperability between organizations.

d) Enhance Information Sharing Systems: Invest in information sharing systems and technologies that enable secure, real-time data exchange among different organizations. Implement interoperable systems that allow for seamless data integration and sharing , ensuring that critical information is readily available to all relevant stakeholders.

e) Develop Shared Appropriate and Interoperable Information and Knowledge: Foster a common understanding of the emergency situation among participating organizations. Implement systems and processes for sharing real-time PH and medical situational information, including data on resource availability, response activities, and emerging risks. This shared situational awareness helps organizations make informed decisions and coordinate their efforts effectively.

f) Foster Collaborative Relationships: Establish and nurture collaborative relationships among public health emergency response organizations. Encourage regular communication, information sharing, and joint planning to build trust and familiarity among organizations. Collaborative relationships enhance interoperability by facilitating seamless collaboration during emergency.

g) Align Plans and Procedures: Ensure that emergency response plans, procedures, and protocols across organizations are aligned and compatible. Coordinate the development and review of response plans to identify and address any gaps or inconsistencies in interoperability requirements.

h) Enhance Training and Education: Provide ongoing training and education to emergency response personnel on interoperability principles, procedures, and technologies. Develop training programmes that focus on building skills related to communication, collaboration, and the use of interoperable systems and tools.

i) Support Research and Innovation: Foster research and innovation in the field of emergency response interoperability. Support initiatives that explore new technologies, standards, and approaches to enhance interoperability. Encourage collaboration with academia, industry partners, and other relevant stakeholders to drive advancements in the field.

j) Learn from Past Experiences: Conduct thorough post-incident reviews and evaluations after each emergency response operation. Identify areas where interoperability challenges were encountered and develop strategies to address them. Incorporate lessons learned into future planning and preparedness efforts to continually improve interoperability and resilience.

5.4 Assuring the expandability of PH EPR information systems without compromising interoperability

The expandability of a PH EPR information system is a system's ability to increase information management capabilities (increased number of users, extending infrastructure and system's technical capacities) while retaining or increasing response time, throughput performance. Assuring expandability of PH EPR information systems without compromising of IT interoperability (at technical, structural, semantic and functional levels) includes implementation of the following strategies:

a) Scalable Architecture: Design information systems with a scalable architecture that can accommodate future expansion and growth. This involves considering factors such as the system's capacity, performance, and ability to handle increased data volumes and user demands. Use modular and flexible designs that allow for the addition of new functionalities or modules as needed without disrupting the overall system's interoperability.

b) Standards-Based Approach: Adopt and adhere to widely recognized data standards and interoperability frameworks. Standards provide a common language and structure for data exchange, ensuring compatibility and interoperability across different systems. By following established standards, new components modules can be seamlessly integrated into existing information systems without compromising interoperability.

c) Service-Oriented Architecture (SOA): Implement a service-oriented architecture where different system components are designed as independent services that can be combined and reused in various configurations. This approach promotes interoperability by allowing systems to communicate and exchange data through well-defined service interfaces. It also enables the addition of new services or functionalities without disrupting overall system's interoperability.

d) Application programming interfaces (APIs) and Integration Frameworks: Utilize application APIs and integration frameworks to facilitate interoperability and expandability. APIs allow different systems to communicate and share data in a controlled and standardized manner. Integration frameworks provide a unified platform for integrating new applications, modules, or services into existing information systems, ensuring compatibility and interoperability.

e) Future-Proof Planning: Conduct thorough analysis and planning to anticipate future needs and requirements. Consider factors such as evolving technologies, emerging data sources, and changing regulatory or reporting standards. Incorporate flexibility into the system's design to accommodate potential future expansion and modifications while maintaining interoperability.

f) Collaboration and Partnerships: Foster collaboration and partnerships with relevant stakeholders, including other public health organizations, government agencies, and technology providers. Engage in ongoing dialogue to understand emerging needs, share best practices, and leverage collective expertise. Collaborative efforts can help identify opportunities for system expansion and ensure interoperability considerations are taken into account during the planning and implementation phases.

g) Continuous Evaluation and Improvement: Regularly assess the performance and effectiveness of the information systems, considering factors such as system usage and user feedback. Identify areas for improvement and prioritize enhancements that support expandability and interoperability based on feedback and evaluation results.

h) Robust Change Management: Implement robust change management processes to ensure smooth transitions and minimize disruptions when expanding or modifying the information systems. Plan for adequate testing, training, and user support to facilitate seamless integration of new components while maintaining interoperability with existing systems.

The expansion of GIS support is an example of expandability for EPR information systems. During the planning process, a PH EPR information systems management defines areas of interest, maps tactical resource assignments, and defines tactical public health and medical situational awareness indicators that will be visualized and shared on maps during emergency response. As a situation evolves, the GIS team works on getting real-time updates, making updates and changes, and quickly informing teams. It also ensures to maintain communication between the field and command centre in disconnected, intermittent, or limited-bandwidth environments.

5.5 Usability

ISO 9241-11:1998 defines “usability” as the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use. Applying this definition to PH EPR information systems, their usability could be defined as the quality of a user's experience when interacting with EPR information and information delivery through the PH EPR information systems[24].

The following strategies enhance the usability of PH emergency preparedness and response information systems:

a) User-Centred Design: Adopt a user-centred design approach that places end-user needs and preferences at the forefront. Involve representatives from different user groups, such as emergency responders, public health officials, and healthcare providers, in the design and development process. Conduct user research, gather feedback, and incorporate user insights to create intuitive and user-friendly interfaces.

b) Streamlined Workflows: Analyse and streamline workflows associated with emergency preparedness and response processes. Identify bottlenecks, unnecessary steps, and areas where the system can automate or simplify tasks. Design the information system to align with the natural flow of work, minimizing cognitive load and maximizing efficiency.

c) Clear Navigation and Structure: Ensure the information system has clear and intuitive navigation. Use logical menus, breadcrumbs, and visual cues to guide users through the system. Organize information and functionalities in a structured manner, considering user roles and tasks. Provide search functionalities and filters to help users locate relevant information.

d) Responsive Design: Develop the information system with a responsive design that adapts to different devices and screen sizes. Ensure that the system is accessible and usable on desktops, laptops, tablets, and mobile devices. Responsive design enhances usability by accommodating diverse users' preferences and working conditions.

e) Training and Documentation: Provide comprehensive training and documentation to users. Offer user guides, video tutorials, and help documentation that explain system features, functionalities, and workflows. Conduct training sessions to familiarize users with the system's interface and capabilities. Ongoing support and assistance are essential to ensure users can effectively utilize the information system.

f) Iterative Testing and Feedback: Conduct iterative usability testing throughout the development process. Gather feedback from end-users and incorporate their suggestions for improvement. Identify usability issues, such as confusing interfaces, slow response times, or inefficient workflows, and address them promptly. Regularly test the system with representative users to validate its usability and make necessary adjustments.

g) Integration with Existing Systems: Integrate the emergency preparedness information system with existing systems and tools used by stakeholders. Avoid creating information silos and duplicate data entry. Ensure seamless data exchange and interoperability with other relevant systems, such as electronic health records, incident reporting systems, and communication platforms. Integration enhances usability by providing a unified and comprehensive view of information.

h) Continuous Improvement: Establish mechanisms for continuous improvement based on user feedback and evolving needs. Regularly evaluate the usability of the system and gather feedback

from users to identify areas for enhancement. Monitor system performance, analyse usage patterns, and incorporate user suggestions to refine and optimize the information system over time.

The PH EPR information systems staff evaluates information needs for different categories of users. Also, it works on usability assessment, making plans for improvement and assuring that improving usability will be achieved without compromising incident management interoperability. The following are examples of the usability assessment through the evaluation of the following tasks [24]:

1) integrity of information (accuracy, completeness, validity of EPR information);

2) how easy to learn (how fast an experienced and inexperienced user can accomplish basic tasks while using PH EPR Information systems);

3) efficiency of use and communication (how fast an experienced user can accomplish tasks);

4) error frequency and severity (how often users make errors accessing information through the system, how serious these errors are, and how users recover from the errors):

5) how different categories of PH EPR information systems users are satisfied with the system.

5.6 Adaptability

The adaptability of public health emergency preparedness and response information systems allows these systems to adjust and respond effectively to evolving public health threats, emergencies, and changing circumstances, adapting to frequent changes PH EPR information requirements, information volume, information quality, and delivery modes through changing the system's technical capabilities and assuring human readiness for adapting to evolving complex situations.

It involves designing and implementing information systems that can be easily modified, expanded, or reconfigured to meet the dynamic demands of public health emergency preparedness and response efforts.

An adaptable public health emergency preparedness and response information system can:

a) Handle various public health emergencies: The system should be capable of addressing a wide range of public health emergencies, such as infectious disease outbreaks, pandemics, natural disasters with health implications, bioterrorism events, and other public health threats. It should be flexible enough to accommodate the unique characteristics and requirements of each type of emergency.

b) Provide real-time data and situational awareness: The system should provide timely and accurate information about the ongoing public health emergency, including the spread of the disease, affected areas, population demographics, available healthcare resources, and intervention strategies. This allows public health officials, healthcare providers, and decision-makers to have up-to-date situational awareness and make informed decisions to control the outbreak and protect public health.

c) Support interoperability and data sharing: An adaptable system should facilitate seamless communication and data sharing among different stakeholders involved in public health emergency response, such as public health agencies, healthcare facilities, laboratories, emergency management organizations, and community organizations. It should enable the exchange of critical information, resources, and coordination of efforts to enhance response effectiveness.

d) Scale up or down as needed: The system should have the capacity to scale up or down based on the magnitude and severity of the public health emergency. It should be able to handle large-scale outbreaks or disasters that require extensive data management, surveillance, and response coordination, as well as smaller localized outbreaks or incidents. This scalability ensures that the system can effectively respond to emergencies of varying sizes and intensity.

e) Integrate technological advancements: An adaptable system should embrace technological advancements and innovations that can enhance public health emergency preparedness and response capabilities. This may include the integration of digital surveillance systems, data analytics

tools, mobile applications for contact tracing or symptom monitoring, telehealth platforms, and interoperable electronic health records. These technologies can improve data collection, analysis, communication, and decision-making processes during public health emergencies.

f) Learn from past experiences: The system should incorporate lessons learned from previous public health emergencies to continually improve its functionality and response effectiveness. It should allow for the collection, analysis, and dissemination of data and best practices from past outbreaks or emergencies. This will enable the implementation of evidence-based strategies and enhancements for future responses.

The adaptability approach is usually implemented through a design of PH EPR information systems by addressing information requirements described in the All-Hazards disaster management approach, EEIs and other business requirements for EPR systems.

5.7 Measure-driven capabilities for PH EPR information systems

Measurement-driven capabilities shall be developed in the PH EPR information systems.

For instance, the US CDC has developed a list of 15 PH emergency preparedness and response capabilities for state, local, tribal and territorial organizations[5]. A description of each of these capabilities includes a capability name, definition and tasks grouped by function.

Capability 6 of the CDC standard outlines functions, tasks and resource elements for Information Sharing. Capability 6 has been defined by US CDC as the ability to conduct multijurisdictional and multidisciplinary exchange of health-related information and public health and medical public health and medical situational awareness data. This capability consists of the ability to perform the following 3 functions:

— Identification of stakeholders to include in information flow and defining their information sharing needs.

— Development of guidance, standards, and systems for information exchange.

— Information exchange to determine a common operating picture.

6 Business requirements for collecting, developing and maintaining PH EPR terminology and data vocabulary

6.1 Background

Collecting, developing, and maintaining public health emergency preparedness and response terminology and data vocabulary plays a vital role in enhancing communication, data exchange, coordination, research, and preparedness efforts. Also, in a situation where an emergency response involves multiple jurisdictions and multiagency, the utilization of pre-coordinated incident actions plans, standardized PH EPR terminology and vocabulary, gathering public health and medical public health and medical situational awareness become conditions that assure mutual understanding, responsibility and accountability. Overall, it facilitates effective response to public health emergencies, improves decision-making, and ultimately helps protect and promote the health and well-being of populations.

The PH EPR data hierarchy can be presented as the following (see Figure 1).

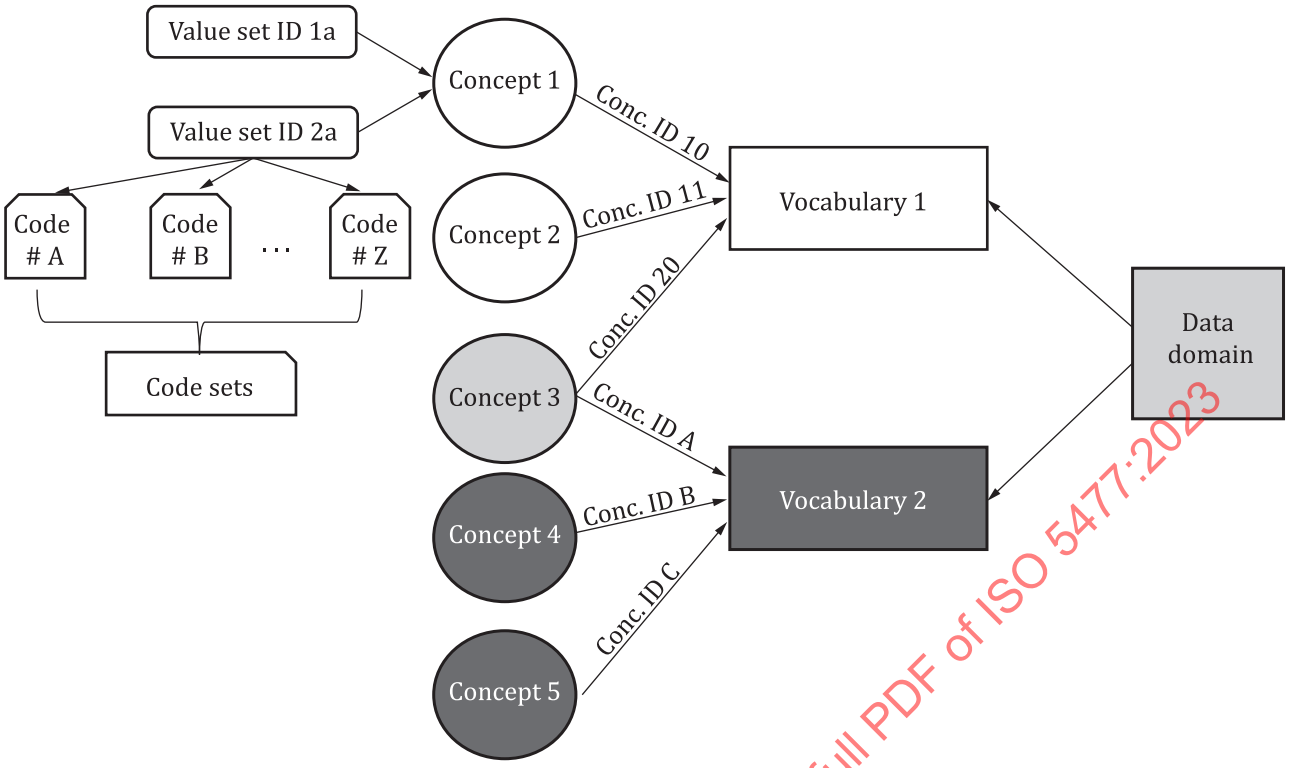

Figure 1 — PH EPR data hierarchy

This hierarchical structure ensures consistency, interoperability, and effective data management within the field of PH EPR. Also, it assists in defining clear business requirements for data collection, development, and maintenance. It helps identify the specific data domains, concepts, and value sets relevant to public health emergency preparedness. This clarity ensures that the business requirements are aligned with the needs and priorities of emergency response efforts, enabling efficient and effective data management.

PH EPR data terminology focuses on the specific language and definitions used to describe data-related concepts, while data concepts encompass the broader ideas and principles that guide the understanding and application of data. Examples of PH EPR terminology are definitions of incident rates, vital signs and emergency events.

6.2 Alignment of standardized PH EPR terminology and vocabulary with critical PH EPR functions

The alignment of standardized terminology and vocabulary in public health emergency preparedness (PH EPR) supports critical incident management functions and contributes to the effectiveness of incident PH EPR functions and overall emergency response.

The alignment of standardized public health emergency preparedness (PH EPR) terminology and vocabulary with critical PH EPR functions provides significant benefits for the following functions:

a) Effective Communication: Standardized terminology ensures common understanding among stakeholders involved in PH EPR. It enables clear and precise communication, reducing misinterpretation or confusion during emergency response efforts.

b) Interoperability and Data Exchange: Consistent terminology allows for seamless interoperability and data exchange between different systems and agencies involved in PH EPR. When everyone uses the same vocabulary, data can be shared, aggregated, and analysed more effectively, leading to improved situational awareness and informed decision-making.

c) Efficient Resource Management: Standardized terminology facilitates accurate tracking and management of resources during emergencies. When all stakeholders understand and use the same terminology, it becomes easier to identify and allocate resources based on their specific functions and needs.

d) Coordination and Collaboration: A shared vocabulary promotes effective coordination and collaboration among different agencies, organizations, and jurisdictions involved in PH EPR. It allows for smoother information sharing, joint planning, and integrated response efforts, resulting in a more efficient and coordinated emergency response.

e) Training and Preparedness: Standardized terminology simplifies training and preparedness activities. Training materials, exercises, and simulations can be developed using the established vocabulary, ensuring consistency and uniformity in understanding and practice. This facilitates better preparedness and readiness for PH EPR scenarios.

f) Evaluation and Lessons Learned: Consistent terminology enables accurate evaluation and analysis of PH EPR efforts. It allows for effective comparison of data across different incidents or geographical areas, leading to improved assessments of response effectiveness and the identification of best practices and areas for improvement.

The WHO Framework for the Public Health Emergency Operations Centre, EOC[31] demonstrates the alignment of PH EPR vocabulary and terminology with critical PH EPR functions. This Framework provides a conceptual model for alignment of PH EOC functional domains, supporting functions, minimum data sets (MDSs) and data elements that could be presented as the following (see Figure 2).

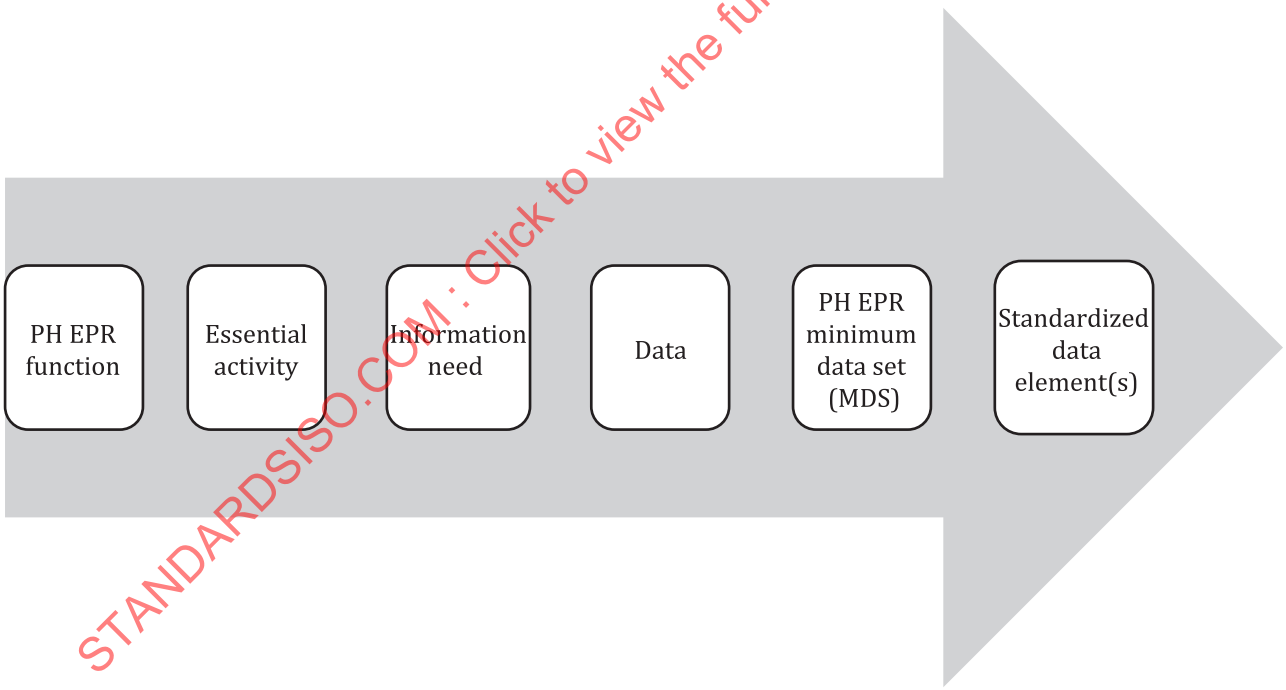

Figure 2 — Representation of a relationship between PH EPR Functions and Minimum Data Sets, MDS

The US CDC, in collaboration with WHO and LOINC, has developed a national extension of the 2015 WHO PH EOC Framework[31]. The US CDC standard reflects the WHO approach on the alignment of PH EPR data elements and functions. It includes a technical specification for functional alignment of the PH EPR standardized vocabulary (see Table 2).

Table 2 — Example of alignment EOC functions, essential activities, information needs and data elements through LOINC

Functions	Essential activities	Information need/ category	Data element name	LOINC code
2. Operating, LOINC 89726-4	2.2. Event investigation, LOINC 89751-2	2.2.5. Hospital or facility beds utilization panel [CDC Emergency Operations Centres], LOINC 95893-4	Date and time report was released	90089-4
			Organization name	76469-6
			Organization NPI	76468-8
			Date data collected for Report	95884-3
			Inpatient beds [#]	95885-0
			Inpatient beds occupied [#]	95886-8
			Inpatient beds occupied/ Inpatient beds	95887-6
			Inpatient beds occupied by patients with disease of interest [#]	95888-4
			Inpatient beds occupied by patients with disease of interest/ Inpatient beds occupied ICU beds [#]	95889-2
			Intensive care unit beds occupied [#]	95890-0
			Intensive care unit beds occupied/ ICU beds	95891-8

Table 2 shows an example of alignment for the PH EPR critical function, Operating (LOINC code 89726-4), with dependent essential activity, event investigation (LOINC code 89751-2), dependent information category, hospital or facility beds utilization (LOINC 95893-4) and precoordinated data elements. It is important that the US CDC standard re-uses already existing codified data elements (i.e., in Table 2, the Date and time report was released, LOINC 90089-4) and makes new codified data elements as needed (i.e., LOINC 95879-3, 95905-6).

Another example of such alignment process is a collaboration between LOINC, US Department of Health and Human Services (HHS), and US CDC in the development and maintenance of the national Interoperability Standards Advisory, ISA[15]. The US HHS ISA repository provides a standardized vocabulary and implementation specifications for patient level healthcare data (i.e., clinical notes, family health history) and population level data. For example, the ISA PH EPR Representing Healthcare Personnel vocabulary and public health emergency preparedness and response value sets have been initially developed by US CDC through the PH EOC MDS[6], then standardized through the LOINC panel 95892-6, Representing Healthcare Personnel Status[28], and finally added to the ISA.

6.3 Applying standardized terminology and vocabulary to emergency response to standard operations procedures (SOPs) and disaster planning

6.3.1 General

Standard Operating Procedures (SOPs) are formal, written guidelines or instructions for disaster planning and emergency response that typically have both operational and technical components. SOPs describe who, what, where, when and how to operate during a response.

PH EPR organizations establish and maintain Standard Operations Procedures (SOPs) that guide the development, maintenance and implementation of standard terminology and data vocabulary, and their use in disaster planning documents.

These SOPs outline the following tasks:

— Electronic communication procedures that require implementation of semantic interoperability, including standardized terminology and public health emergency preparedness and response vocabulary.

— Roles and responsibilities of staff involved in development and maintenance terminology and data vocabulary.

— Development of technical specifications that align standardized terminology and vocabulary with PH EPR functions and information flows.

It is common practice to include standardized terminology and vocabulary in incident management documents. The WHO has developed the Glossary of Health Emergency and Disaster Risk Management Terminology[26]. It is designed for policymakers, practitioners, and other stakeholders to reduce health risks and consequences of emergencies and disasters. It is also helpful in the development of national and regional PH EPR OSPs.

The WHO has developed the SOP for Coordinating Public Health Event Preparedness and Response in the WHO African Region[32], which is an example of PH EPR SOPs. In this procedure, the Event Management Team is assigned the responsibility of managing data and information. Collecting and utilizing existing standardized classifications and nomenclatures

6.3.2 Utilising event grading and classifications of emergencies

The PH EPR emergency communication and data exchange flows shall utilize existing emergency classifications.

PH EPR classifications are a valuable source of standardized terminology and data categorization that apply to international and national events' grading and categorization.

For instance, the WHO has developed a grading classification for single or multiple countries' involvement in emergency events[29]. This WHO grading classification is based on a scale of events, urgency, complexity, capacity and reputational risk. It has been developed for the following purposes:

— informing emergency response organizations of the extent, complexity and duration of the emergency response;

— prompting all WHO offices at all levels to be ready to repurpose resources;

— ensuring that the emergency response organizations act with appropriate urgency and mobilize the appropriate resources in support to the response of the affected Member State, partners and the WHO country office;

— triggering WHO's Emergency Response Procedures and emergency policies;

— reminding the Head of the WHO country office (HWCO) to apply WHO's Standard Operating Procedures (SOPs) as per the Director General's memorandum of 15 January 2008;

— expediting clearance and dissemination of internal and external communications.

The WHO classification of hazards[29] divides emergencies into the following two categories:

— natural emergencies;

— man-made emergencies.

Figure 3 shows the subcategorization of these emergencies according to WHO classification of hazards.

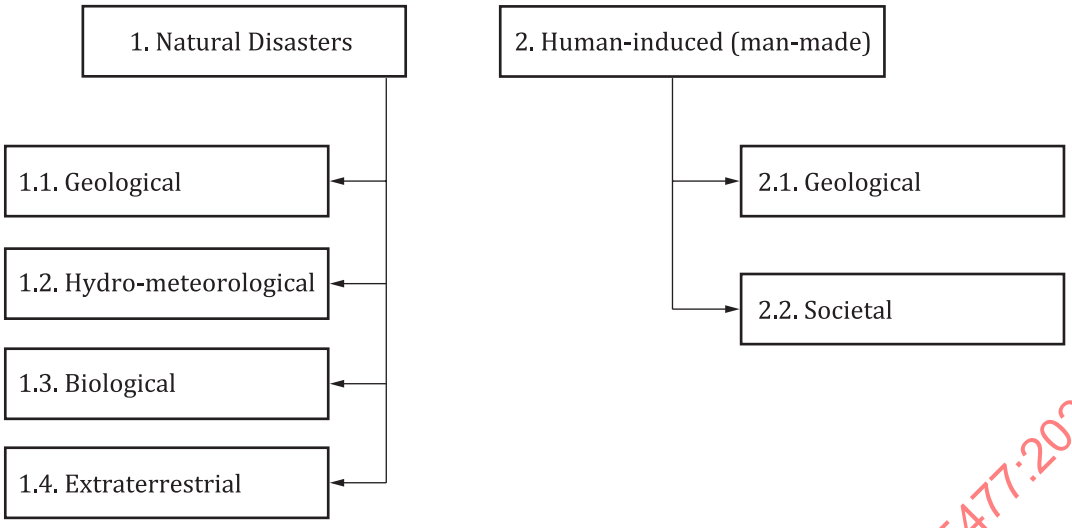

Figure 3 — WHO classification of hazards (adopted from Reference [31])

National PH agencies, collaborating with WHO, develop terminology and case definitions for specific events. For example, the US CDC maintains the Emergency Preparedness and Response web portal[2], which includes six categories of emergencies:

— outbreaks

— severe weather

— radiation emergencies

— bioterrorism

— pandemic influenza

— chemical emergencies

This portal also provides a description and terminology of bioterrorism agents, specific chemical hazards and case definitions.

6.3.3 Using the WHO International Classification of Diseases (ICD)

WHO develops and maintains the ICD[30]. ICD plays a vital role in supporting public health emergency preparedness data management by providing a standardized coding system for diseases and health conditions. It provides the following benefits for PH EPR information systems:

a) Enabling effective disease surveillance and monitoring during public health emergencies.

   By assigning specific codes to diseases and health conditions, the ICD facilitates case identification, tracking, and reporting. It supports the timely detection, analysis, and response to outbreaks. This helps public health authorities understand the scope and impact of emergencies and inform appropriate interventions.

b) Streamlining epidemiological analysis.

   The use of ICD codes in public health emergency data management allows for epidemiological analysis and research. By analysing the patterns and trends of specific diseases or conditions, public health professionals can gain insights into transmission dynamics, risk factors, and impacts of emergencies. This information is crucial for guiding prevention and control strategies, resource allocation, and public health policy decisions.

c) Serving as a common language for data exchange and collaboration among different countries and healthcare systems.

It enables the sharing of public health emergency data across borders, facilitating global surveillance, early warning systems, and international collaboration in responding to health emergencies. Consistent use of ICD coding enhances the interoperability and comparability of data, promoting effective data exchange and sharing of best practices.

d) Supporting public health policy development and planning related to emergency preparedness.

By providing standardized codes and classifications for diseases and health conditions, the ICD enables the identification of priority areas for intervention, resource allocation, and evidence-based policies. It facilitates the assessment of burden of disease during emergencies, informing public health strategies and interventions.

e) Promoting consistency, comparability, and interoperability of data, facilitating effective surveillance, analysis, response coordination, research, and policy development during public health emergencies.

The ICD-10-CM extension has been developed in the United States[4] for the purpose of ascertaining and reporting national clinical cases. Several ICD-10-CM codes can also be combined to provide detailed codification of symptoms and syndromes. For example, a manifestation of bronchitis caused by COVID-19[3] can be coded as U07.1 (COVID-19 infection) combined with J20.8 (Acute bronchitis due to other specified organisms) and J40 (Bronchitis, not specified as acute or chronic).

6.4 Assuring relevance and coverage

Public health emergency preparedness and response vocabulary should encompass a comprehensive range of data elements and terms, including diseases, conditions, interventions, resources, and outcomes. It should address the specific needs and requirements of public health agencies, emergency management organizations, healthcare providers, and other stakeholders involved in preparedness and response efforts.

PH agencies and organizations can ensure that their PH EPR vocabulary and terminology remain relevant, comprehensive, and aligned with the needs of stakeholders and the evolving landscape of public health emergencies by implementing the following tasks:

a) Needs Assessment: Conduct a comprehensive needs assessment to identify the specific data elements, terms, and concepts required to support public health emergency preparedness and response activities. This involves engaging stakeholders, including public health professionals, emergency management organizations, healthcare providers, and subject matter experts, to gather their input and understand their information needs.

b) Review Existing Standards: Evaluate existing standards, guidelines, and vocabulary related to public health emergency preparedness and response, such as the World Health Organization (WHO) International Health Regulations (IHR) and the Centres for Disease Control and Prevention (CDC) frameworks. Identify relevant terms, classifications, and coding systems that can be utilized or adapted to ensure compatibility and consistency with established standards.

c) Gap Analysis: Perform a gap analysis to identify any missing or insufficient terminology and concepts within the existing vocabulary. Compare the identified needs from the needs assessment with the available vocabulary, and determine areas where additional terms, definitions, or classifications are required to enhance coverage and relevance.

d) Stakeholder Engagement: Engage stakeholders through workshops, focus groups, or expert consultations to validate and refine the identified gaps and requirements. Seek their input on the relevance, applicability, and importance of potential additions or modifications to the vocabulary and terminology. Encourage discussions and collaboration to ensure shared understanding and ownership of vocabulary.

e) Terminology Development: Develop new terms, definitions, and concepts to address the identified gaps in public health emergency preparedness and response vocabulary. Ensure that the new additions are consistent with existing standards, guidelines, and terminology frameworks. Use an iterative approach by involving stakeholders in the review and validation of the proposed additions to ensure accuracy and relevance.

f) Harmonization and Alignment: Align the developed terminology with existing public health and emergency response frameworks, guidelines, and vocabulary. Ensure compatibility and interoperability with relevant international, national, and regional standards. This includes aligning with coding systems such as the International Classification of Diseases (ICD) and other relevant classification systems.

g) Documentation and Dissemination: Document the finalized vocabulary and terminology, including definitions, usage guidelines, and any supporting reference materials. Create a comprehensive reference document or database that is easily accessible to stakeholders. Develop training materials and communication resources to disseminate the vocabulary and promote its understanding and usage among relevant stakeholders.

h) Review and Revision: Establish a process for ongoing review and revision of the public health emergency preparedness and response vocabulary. Monitor emerging trends, technological advancements, and lessons learned from real-world emergency events. Encourage feedback from users and stakeholders to identify areas for improvement, expansion, or refinement of the vocabulary over time.

i) Collaboration and Networking: Foster collaboration and networking opportunities with other public health agencies, organizations, and international bodies involved in emergency preparedness and response. Engage in knowledge sharing and exchange of best practices to continuously enhance the relevance and coverage of the vocabulary considering evolving public health challenges.

6.5 Role of stakeholders' involvement in collecting, developing, and maintaining a public health preparedness and response data vocabulary

Stakeholders, including public health professionals, subject matter experts, data managers, and end-users, should be actively engaged in the development and maintenance of the vocabulary. Their input and feedback are crucial for ensuring that the vocabulary meets their needs, is practical to implement, and aligns with real-world scenarios.

While engaging stakeholders in the development of business requirements for public health emergency preparedness data vocabulary and data terminology, the following requirements should be considered:

a) Representation: Ensure diverse and inclusive stakeholder representation, including public health professionals, emergency management organizations, healthcare providers, subject matter experts, data managers, policymakers, and end-users. Aim for balanced representation across different disciplines, geographical regions, and organizational levels to capture a broad range of perspectives and expertise.

b) Collaboration: Foster a collaborative environment that encourages active participation and engagement from stakeholders. Provide opportunities for open dialogue, knowledge sharing, and constructive feedback throughout the process. Encourage stakeholders to contribute their insights, experiences, and suggestions to shape the development of business requirements.

c) Clear Communication: Clearly communicate the purpose, scope, and expected outcomes of the engagement process. Explain the importance of stakeholder input and how it will inform the development of business requirements for the vocabulary and terminology. Use plain language and avoid jargon to ensure understanding among all stakeholders.

d) Stakeholder Needs Assessment: Conduct a thorough needs assessment to understand the specific requirements, challenges, and priorities of different stakeholder groups. Gather information on their data needs, data collection and reporting processes, existing vocabulary usage, and any gaps

or issues they have encountered. This assessment will help tailor the business requirements to address the specific needs of stakeholders.

e) Regular Updates and Feedback Sessions: Organize regular update sessions or feedback opportunities to keep stakeholders informed about the progress of the development process. Share draft versions of the business requirements, vocabulary, and terminology for review and solicit feedback. Incorporate stakeholder input into subsequent iterations to ensure their perspectives are considered and valued.

f) Training and Capacity Building: Offer training and capacity-building activities to enhance stakeholders' understanding of the importance and usage of the public health emergency preparedness data vocabulary and terminology. Provide guidance on how the vocabulary will be integrated into their existing workflows and systems. Support stakeholders in implementing the vocabulary effectively through training materials, workshops, or webinars.

g) Governance and Decision-Making: Establish a governance structure that includes stakeholder representation to oversee the development and implementation of the vocabulary and terminology. Ensure transparency in decision-making processes and provide opportunities for stakeholders to contribute to the decision-making discussions. This will help foster ownership and a sense of shared responsibility among stakeholders.

h) Documentation and Accessibility: Document the engagement process, including meeting minutes, summaries of discussions, and decisions made. Make these documents accessible to all stakeholders, ensuring transparency and accountability. Provide a centralized platform or repository where stakeholders can access relevant resources, updates, and documentation related to the vocabulary and terminology.

i) Evaluation and Continuous Improvement: Regularly evaluate the effectiveness and impact of stakeholder engagement efforts. Seek feedback from stakeholders on their satisfaction with the process and outcomes. Use the insights gained to make necessary adjustments, improvements, and refinements to the engagement strategies, ensuring that stakeholder engagement remains an iterative and ongoing process.

By addressing these requirements, organizations can effectively engage stakeholders and harness their collective expertise to develop robust business requirements for public health emergency preparedness data vocabulary and data terminology. This collaborative approach will ensure that the resulting vocabulary and terminology meet the needs and expectations of all stakeholders involved.

6.6 Assuring flexibility and scalability of PH EPR vocabulary

The PH EPR vocabulary should be flexible and scalable to accommodate emerging public health threats, evolving terminology, and changing data requirements. It should be designed in a way that allows for future updates, additions, and modifications to support the evolving landscape of public health emergencies.

To assure the flexibility and scalability of a PH EPR vocabulary, the following tasks can be undertaken:

a) Requirements Gathering: Conduct a comprehensive assessment of the current and future needs of stakeholders involved in PH EPR. Identify their requirements for flexibility and scalability in terms of accommodating new terms, emerging threats, evolving terminology, and changing data needs.

b) Review Existing Standards: Evaluate existing standards, frameworks, and classifications related to PH EPR. Identify those that offer flexibility and scalability features, such as the ability to incorporate new codes or adapt existing codes to accommodate emerging concepts and evolving needs.

c) Conceptual Design: Develop a conceptual design for the PH EPR vocabulary that allows for future growth and expansion. Consider factors such as hierarchical structures, code ranges, and relationships between codes to ensure flexibility and scalability as new terms and concepts are added.

d) Version Control: Implement a version control mechanism for the PH EPR vocabulary. This allows for the management and tracking of different versions of the vocabulary as it evolves over time. Maintain a clear documentation of changes made in each version to ensure transparency and facilitate future updates.

e) Reference Information Model: Implement a reference information model that provides a standardized framework for organizing and structuring information, facilitating interoperability, data sharing, and consistent understanding across different systems and stakeholders.

f) Extensibility Framework: Implement an extensibility framework that enables the addition of new terms and concepts to the PH EPR vocabulary without disrupting existing codes and structures. This framework should define rules and guidelines for the introduction of new codes and ensure their compatibility with the existing vocabulary.

g) Maintenance Process: Establish a process for ongoing maintenance and updates of the PH EPR vocabulary. This includes mechanisms to review and incorporate new terms, retire obsolete terms, and address gaps or inconsistencies. Regularly engage stakeholders in the maintenance process to ensure their input is considered.

h) Documentation and Guidelines: Develop comprehensive documentation and guidelines that outline the procedures for extending and modifying the PH EPR vocabulary. Provide clear instructions on how to add new terms, update existing terms, and maintain backward compatibility to preserve data integrity and consistency.

i) Stakeholder Engagement: Engage stakeholders throughout the process to gather feedback and insights on the flexibility and scalability needs of the PH EPR vocabulary. Involve them in decision-making processes related to extensions, modifications, and updates to ensure their requirements are considered.

j) Testing and Validation: Conduct thorough testing and validation of the PH EPR vocabulary to ensure its flexibility and scalability. Test the vocabulary against various scenarios, including the addition of new terms, expansion of code sets, and compatibility with different information systems. Validate the functionality and performance of the vocabulary in real-world use cases.

k) Continuous Improvement: Establish a feedback loop to continuously assess the effectiveness of the PH EPR vocabulary in meeting flexibility and scalability requirements. Seek input from stakeholders on their experiences and challenges encountered during its usage. Use this feedback to identify areas for improvement and implement necessary adjustments.

By following these tasks, organizations can ensure that the PH EPR vocabulary is designed and maintained with flexibility and scalability in mind. This enables the vocabulary to adapt to emerging needs, accommodate new terms and concepts, and support the evolving landscape of public health emergencies.

6.7 Supporting tasks for PH EPR vocabulary quality and integrity

The PH EPR vocabulary and terminology should support data quality initiatives by promoting accurate and consistent data capture, validation, and documentation. It should include guidelines and standards for data entry, data validation, and error handling to ensure the integrity and reliability of the collected data. Specifically, it should include the following tasks:

a) Definition and Standardization: Clearly define the purpose, scope, and structure of the PH EPR data vocabulary. Establish standardized guidelines and rules for terminology, definitions, and classifications to ensure consistency and interoperability.

b) Data Governance: Establish a data governance framework that outlines roles, responsibilities, and processes for managing and maintaining the PH EPR data vocabulary. This includes assigning data stewards or responsible individuals who oversee the vocabulary's quality and integrity.

c) Data Validation: Implement mechanisms for data validation within the PH EPR data vocabulary. This involves conducting regular checks to ensure the accuracy, completeness, and adherence to defined standards. Identify and resolve any discrepancies or inconsistencies identified during the validation process.

d) Version Control: Establish a version control system for the PH EPR data vocabulary. Maintain a record of changes made, including additions, modifications, and retirements of terms or codes. Ensure proper documentation and communication of version updates to stakeholders.

e) Documentation and Metadata: Develop comprehensive documentation that provides clear definitions, usage guidelines, and metadata for each term or code in the PH EPR data vocabulary. Document the source, rationale, and any relevant mappings or relationships with other vocabularies or standards.

f) Training and Education: Provide training and educational resources to stakeholders who will use the PH EPR data vocabulary. Ensure they understand the correct usage, data entry conventions, and quality requirements to maintain the integrity of the vocabulary.

g) Continuous Improvement: Establish a process for continuous improvement of the PH EPR data vocabulary. Encourage feedback from stakeholders, data users, and subject matter experts to identify areas for enhancement or correction. Regularly review and update the vocabulary based on emerging needs and best practices.

h) Data Quality Assurance: Implement data quality assurance measures within the PH EPR data vocabulary management. This may include data profiling, data cleansing, and data monitoring activities to identify and address data quality issues that arise.

i) Collaboration and Feedback: Foster collaboration among stakeholders to gather their input and feedback on the quality and integrity of the PH EPR data vocabulary. Engage in discussions and seek consensus on improvements or changes needed to enhance the vocabulary's reliability and usefulness.

j) Regular Audits: Conduct regular audits to evaluate the overall quality and integrity of the PH EPR data vocabulary. This includes reviewing the adherence to established standards, identifying areas of improvement, and ensuring compliance with regulatory requirements.

By incorporating these tasks into the framework for the PHEPR data vocabulary, organizations can establish robust mechanisms to ensure the quality, accuracy, and integrity of the vocabulary. This, in turn, supports the reliability and effectiveness of data collection, analysis, and decision-making in public health emergency preparedness and response efforts.

6.8 Ongoing maintenance and updates

The PH EPR vocabulary and terminology should have a process in place for regular maintenance, updates, and version control. This includes mechanisms to incorporate new terms, address gaps or inconsistencies, and incorporate feedback and lessons learned from real-world experiences. Specifically, this process includes the following tasks:

Stakeholder Engagement: Continuously engage stakeholders involved in PH EPR, such as public health professionals, emergency management organizations, and subject matter experts. Seek their input, feedback, and suggestions for improving the vocabulary and addressing emerging needs.

a) Monitoring and Evaluation: Regularly monitor and evaluate the effectiveness and relevance of the PH EPR vocabulary and terminology. Assess its usage, identify areas of improvement, and gather feedback from users to ensure it meets evolving requirements and remains up-to-date.

b) Gap Analysis: Conduct periodic gap analyses to identify any new terms or concepts that need to be added to the vocabulary. Analyse emerging public health threats, technological advancements, and changes in best practices to ensure the vocabulary covers all necessary domains.

c) Standards Alignment: Align the PH EPR vocabulary and terminology with relevant international, national, and regional standards. Ensure compatibility and interoperability with established frameworks, classifications, and coding systems, such as the WHO International Health Regulations (IHR) or the Centres for Disease Control and Prevention (CDC) guidelines.

d) Version Control: Maintain a version control system for the PH EPR vocabulary and terminology to track changes and updates. Document and communicate changes made in each version, including additions, modifications, and retirements of terms or codes.

e) Reference Information Model: Conduct regular reviews of the reference information model and the public health emergency preparedness and response vocabulary to ensure their relevance and accuracy. This includes identifying gaps, inconsistencies, or emerging needs that require updates or revisions. Engage stakeholders in the review process to gather feedback, validate changes, and ensure broad acceptance and adoption.

f) Documentation and Communication: Continuously update the documentation and reference materials related to the PH EPR vocabulary and terminology. Ensure that the documentation reflects the latest changes and provides clear definitions, usage guidelines, and any relevant mappings or relationships with other vocabularies.

g) Collaborative Review Process: Establish a collaborative review process involving stakeholders and subject matter experts. Periodically review the vocabulary and terminology to identify areas for improvement, address inconsistencies, and ensure accuracy and completeness.

h) Training and Support: Provide ongoing training and support to users of the PH EPR vocabulary and terminology. Offer guidance on proper usage, data entry conventions, and any updates or changes made to the vocabulary. Address user inquiries and provide assistance as needed.

i) Regular Maintenance Cycles: Establish regular maintenance cycles to review and update the PH EPR vocabulary and terminology. Determine the frequency of updates based on the pace of change in the field of public health emergency preparedness and response.

j) Governance and Oversight: Establish a governance structure and assign responsibilities for the ongoing maintenance and updates of the PH EPR vocabulary and terminology. Define the roles and responsibilities of data stewards or a dedicated team responsible for managing the vocabulary's maintenance process.

By incorporating these major tasks into the ongoing maintenance and updates of the PH EPR vocabulary, organizations can ensure that the vocabulary remains relevant, accurate, and aligned with evolving needs and standards in public health emergency preparedness and response.

6.9 Assuring compliance and fulfilment of regulatory requirements

Assuring regulatory compliance and fulfilling regulatory requirements for PH EPR data vocabulary and terminology is essential to ensure legal compliance, maintain data integrity, enhance interoperability, foster public trust, improve decision-making, and protect privacy and security.

To assure regulatory compliance and fulfil regulatory requirements for PH EPR data vocabulary and terminology, the following steps can be followed:

a) Identify Applicable Regulations: Identify the relevant regulatory frameworks, guidelines, and standards that govern public health emergency preparedness and response data management and public health emergency preparedness and response terminology. This may include national, regional, or international regulations specific to public health, emergency preparedness, and data privacy.

b) Regulatory Analysis: Conduct a comprehensive analysis of the identified regulations to understand their requirements, obligations, and implications for PH EPR data vocabulary and terminology. Identify specific provisions or clauses that directly relate to data management, terminologies, and compliance.

c) Gap Assessment: Perform a gap assessment to compare the existing PH EPR data vocabulary and terminology against the identified regulatory requirements. Identify any gaps or areas where the vocabulary and terminology need to be enhanced or modified to ensure compliance.

d) Update and Enhance Vocabulary and Terminology: Based on the gap assessment findings, update and enhance the PH EPR data vocabulary and terminology to align with regulatory requirements. Incorporate specific terms, classifications, or coding structures mandated by the regulations, ensuring accuracy and consistency.

e) Documentation and Compliance Framework: Develop a documentation framework that outlines how the PH EPR data vocabulary and terminology fulfil regulatory compliance. Document the alignment between the vocabulary/terminology and specific regulatory provisions. Maintain comprehensive records of updates, changes, and compliance-related activities.

f) Internal Policies and Procedures: Establish internal policies and procedures that reflect regulatory compliance requirements related to PH EPR data vocabulary and terminology. These policies should provide guidance on data collection, management, sharing, and reporting, ensuring adherence to regulatory obligations.

g) Training and Awareness: Conduct training sessions and awareness programmes for relevant stakeholders on regulatory compliance related to PH EPR data vocabulary and terminology. Ensure that employees, data managers, and other users understand their roles and responsibilities in maintaining compliance.

h) Periodic Audits and Reviews: Perform regular audits and reviews to assess compliance with regulatory requirements. Evaluate the effectiveness and appropriateness of the PH EPR data vocabulary and terminology in meeting regulatory obligations. Identify areas for improvement and address any compliance gaps or issues.

i) External Compliance Validation: Engage external experts or consultants to validate the compliance of the PH EPR data vocabulary and terminology with relevant regulations. Seek their input and recommendations to ensure comprehensive compliance and address any identified shortcomings.

j) Ongoing Monitoring and Updates: Continuously monitor changes in regulatory requirements related to PH EPR data management and terminology. Stay informed about any updates or amendments to regulations and promptly update the vocabulary and terminology to maintain compliance.

6.10 Providing adequate training and support

By investing in training and support for the development and implementation of public health emergency preparedness terminology and vocabulary, organizations can enhance data quality, promote consistency, improve communication, comply with standards, enable effective decision-making, and adapt to changing needs in public health emergency preparedness and response. Providing adequate training and support for the development and implementation of public health emergency preparedness and response (PH EPR) data terminology and vocabulary involves several important steps, including the following:

a) Assess Training Needs: Identify the target audience and assess their training needs. Determine the level of familiarity with PH EPR terminology and data vocabulary, their roles and responsibilities, and any specific areas where additional knowledge or skills are required.

b) Develop Training Materials: Create comprehensive training materials that cover the key concepts, definitions, and usage guidelines of the PH EPR data vocabulary and terminology. Include practical examples, case studies, and exercises to facilitate understanding and application.

c) Customize Training Content: Tailor the training content to the specific needs and context of the organization or individuals being trained. Consider their existing knowledge base, work processes, and data management requirements to make the training relevant and practical. For instance, Annex A provides recommendations on required knowledge, skills and abilities for the fulfilment

of essential PH EOC functions. Similar recommendations should be developed for other PH EPR entities and serve as foundational documents for training.

d) Establish Training Delivery Methods: Determine the most effective delivery methods for the training. This could include in-person workshops, online courses, webinars, video tutorials, or a combination of different approaches. Consider the availability and preferences of the target audience.

e) Conduct Training Sessions: Deliver the training sessions using the chosen methods. Ensure that the training is interactive, engaging, and allows for questions and discussions. Encourage active participation to promote understanding and knowledge retention.

f) Provide Hands-on Practice: Offer opportunities for participants to practice using the PH EPR data vocabulary and terminology in real-world scenarios. This could involve exercises, simulations, or practical assignments that allow individuals to apply what they have learned.

g) Address Frequently Asked Questions: Dedicate a section or session to address common questions, challenges, and misconceptions related to the PH EPR data vocabulary and terminology. Provide clear explanations and practical solutions to help participants overcome any difficulties they may encounter.

h) Offer Ongoing Support: Provide ongoing support to participants even after training sessions. This can include access to resources, job aids, and a point of contact for follow-up questions or assistance. Consider establishing a dedicated support channel or community where participants can engage with experts and peers.

i) Seek Feedback and Evaluation: Collect feedback from participants to assess the effectiveness of the training programme. Use surveys, assessments, or interviews to gather their insights and suggestions for improvement. Evaluate the impact of the training on participants' knowledge, skills, and confidence in using the PH EPR data vocabulary and terminology.

j) Update and Refine Training Materials: Continuously update and refine the training materials based on feedback, emerging needs, and evolving best practices. Ensure that the training programme remains current, relevant, and aligned with any updates or changes in the PH EPR data vocabulary and terminology.

Annex A
(informative)

Criteria to take into account on knowledge, skills and abilities for the fulfilment of essential PH EOC functions

A.1 Being aware of legal requirements for public health emergencies

A.1.1 Knowledge

— Being aware of relevant to emergency preparedness legal requirements and policies on local, national, and international levels.

— Knowledge of the legal frameworks for public health surveillance, data sharing, and privacy.

— Understanding of legal authorities and the powers of public health agencies during emergencies.

— Knowledge of legal and ethical considerations regarding the use and disclosure of health information during emergencies.

— Awareness of liability issues and legal protections for responders and organizations involved in emergency response.

— Understanding of legal frameworks for resource allocation and management during emergencies.

— Familiarity with legal requirements for mass vaccinations, quarantine, isolation, and other public health interventions.

— Knowledge of legal frameworks for coordinating and collaborating with other agencies and jurisdictions during emergencies.

— Understanding of legal and policy considerations related to public health communication and public information dissemination during emergencies.

A.1.2 Skills

— Analytical skills to interpret and analyse relevant legal requirements.

— Ability to apply legal and policy frameworks to guide decision-making in emergency response.

— Skill in assessing the legal implications and potential risks of proposed actions and interventions.

— Effective communication skills to convey legal and policy requirements to stakeholders and decision-makers.

— Skill in drafting and reviewing emergency response plans, policies, and procedures from a legal perspective.

— Ability to navigate and comply with legal and regulatory requirements for data collection, sharing, and protection.

— Skill in conducting legal research and staying updated on emerging legal issues in public health emergencies.

— Negotiation and advocacy skills to collaborate with legal and policy stakeholders and advocate for necessary changes.

— Skill in analysing and advising on legal issues related to resource allocation, procurement, and logistics in emergencies.

— Ability to provide legal guidance and support to incident management teams and other emergency response personnel.

A.1.3 Abilities

— Ability to apply legal frameworks and policies in a dynamic and rapidly evolving emergency environment.

— Capacity to analyse complex legal and policy issues and provide practical and actionable recommendations.

— Ability to collaborate and build partnerships with legal and policy stakeholders at different levels (local, regional, national).

— Skill in navigating the intersection of public health, emergency management, and legal and policy considerations.

— Effective decision-making abilities based on legal requirements, public health objectives, and ethical considerations.

— Capacity to assess and manage legal risks and liabilities associated with emergency response activities.

— Ability to provide clear and concise legal guidance to incident management teams and emergency responders.

— Capacity to balance public health objectives with legal and privacy concerns in data management and information sharing.

— Ability to advocate for changes in legal and policy frameworks to enhance public health emergency preparedness and response.

— Capacity to educate and train emergency response personnel on legal and policy requirements and considerations.

A.2 Planning

A.2.1 Knowledge

— Understanding of emergency management principles, frameworks, and best practices.

— Knowledge of public health emergency planning concepts, methodologies, and approaches.

— Familiarity with risk assessment and hazard analysis techniques.

— Knowledge of public health response strategies and interventions for various types of emergencies.

— Understanding of incident command systems and emergency operations centre structures.

— Knowledge of resource management and logistics in emergency response planning.

— Awareness of public health information systems and tools for planning and coordination.

— Understanding of community engagement and communication strategies in emergency planning.

— Knowledge of legal and regulatory requirements relevant to emergency planning.

— Familiarity with national and international public health emergency planning guidelines and frameworks.

A.2.2 Skills

— Strong analytical and problem-solving skills for assessing risks, identifying gaps, and developing effective response plans.

— Excellent organizational and time management skills to develop and implement comprehensive emergency plans.

— Effective communication skills to collaborate with internal and external stakeholders in the planning process.

— Skill in conducting situational analyses and using data to inform planning decisions.

— Ability to develop and execute multi-agency coordination plans and standard operating procedures.

— Proficiency in using planning tools and software for data analysis, resource allocation, and plan development.

— Skill in conducting exercises and drills to test and improve emergency plans.

— Ability to adapt plans to dynamic and evolving situations, considering lessons learned from previous emergencies.

— Capacity to integrate public health principles and interventions into broader emergency management plans.

— Skill in coordinating with community partners, agencies, and organizations for collaborative planning efforts.

A.2.3 Abilities

— Ability to think critically and strategically to anticipate and plan for potential emergency scenarios.

— Capacity to assess complex information and make informed decisions to develop effective emergency response plans.

— Strong leadership abilities to guide and coordinate the planning process within the PH EOC.

— Ability to work collaboratively with diverse stakeholders and build consensus during the planning process.

— Capacity to effectively manage resources, including personnel, equipment, and supplies, in the planning phase.

— Ability to identify and prioritize the needs of vulnerable populations and incorporate equity considerations in planning.

— Skill in fostering a culture of preparedness and engaging individuals and communities in emergency planning efforts.

— Capacity to evaluate and adapt emergency plans based on lessons learned and feedback from exercises and real-world events.

— Ability to navigate political, organizational, and logistical challenges to ensure effective planning and preparedness.

— Capacity to effectively communicate and present complex planning information to decision-makers and stakeholders.

A.3 Commanding

A.3.1 Knowledge

— Understanding of incident command systems (ICS) and emergency management principles.

— Knowledge of public health emergency response frameworks, protocols, and best practices.

— Familiarity with the roles and responsibilities of different agencies and stakeholders involved in emergency response.

— Understanding of public health surveillance and epidemiology principles.

— Knowledge of relevant public health laws, regulations, and policies.

— Awareness of resource management and logistics in emergency response operations.

— Understanding of risk assessment and risk management methodologies.

— Knowledge of communication and information management systems in emergency operations.

— Familiarity with incident documentation and reporting procedures.

— Knowledge of health and safety protocols for responders and the public during emergencies.

A.3.2 Skills

— Skills in establishing a clear chain of command and organizational structure within the PH EOC.

— Proficiency in setting response objectives and priorities based on the situation and available resources.

— Decision making skills related to resource allocation, response strategies, and incident management.

— Proficiency in coordinating with external partners, agencies, and stakeholders to ensure a unified response.

— Skills in providing guidance and direction to response personnel.

— Progress monitoring skills for response activities and adjusting strategies as needed.

— Proficiency in maintaining situational awareness and staying informed about the evolving situation.

— Skills in communicating and collaborating with other key incident commanders and decision-makers.

— Skills in ensuring compliance with relevant protocols, regulations, and policies.

— Proficiency in assessing the effectiveness of response efforts and identifying areas for improvement.

A.3.3 Abilities

— Ability to remain calm and composed under stressful conditions and provide effective leadership.

— Capacity to analyse complex information and make sound decisions in a timely manner.

— Strong problem-solving abilities to address challenges and adapt response strategies as needed.

— Ability to build and maintain effective working relationships with response partners and stakeholders.

— Capacity to foster a culture of collaboration and teamwork within the PH EOC.

— Effective coordination and delegation abilities to ensure efficient and coordinated response operations.

— Skill in leveraging available resources and assets to maximize response efforts.

— Ability to communicate effectively with diverse audiences, including responders, the public, and decision-makers.

— Capacity to establish and maintain clear lines of communication and information flow within the PH EOC.

— Adaptability and flexibility to adjust response strategies based on changing circumstances and evolving needs.

A.4 Operating

A.4.1 Knowledge

— Understanding the principles and structure of Incident Command Systems (ICS).

— Familiarity with emergency management principles, frameworks, and best practices is crucial.

— Knowledge of public health emergency response strategies, protocols, and interventions.

— Understanding the structure and functioning of PH systems.

— Familiarity with the operations and functions of an EOC.

— Knowledge of health and safety protocols and guidelines is essential to ensure the well-being of responders and the public during emergencies.

— Understanding the management and utilization of data and information systems within the PH EOC.

— Understanding effective communication strategies and techniques.

— Staying updated with the latest developments, best practices, and lessons learned in PH EPR.

A.4.2 Skills

— Proficiency in carrying out specific response tasks and activities as directed by commanders.

— Skills in coordinating with internal teams and external partners to implement response actions.

— Resources management skills, including personnel, equipment, and supplies, to support response operations.

— Skills in data collection and analysis to inform decision-making and improve situational awareness.

— Effective communication and information sharing skills within the PH EOC and with external stakeholders.

— Skills in monitoring and reporting on the status of response activities.

— Skills in ensuring adherence to established protocols, procedures, and safety guidelines.

— Skills in documentation management and reporting.

— Proficiency in collaborating with other functional areas within the PH EOC, such as planning, logistics, and public information.

— Time management skills, including setting priorities, organizing workflows, and managing multiple responsibilities simultaneously.

A.4.3 Abilities

— The ability to maintain a clear understanding of the current situation, including the status of the emergency, available resources, and response activities. This involves gathering and analysing information, monitoring developments, and staying updated on the evolving circumstances.

— The ability to pay close attention to details, accurately recording and documenting information, ensuring data integrity, and maintaining thorough and precise records of activities, decisions, and communications.

— The ability to adapt to changing circumstances and adjust plans accordingly, including to be open to new information, embracing innovation, and quickly adapting to unexpected developments.

— The ability to work collaboratively within multidisciplinary teams, actively participating in team discussions, contributing expertise, and respecting diverse perspectives to achieve common goals.

— The ability to analyse problems, identify viable solutions, and make informed decisions, applying critical thinking skills, evaluating options, and implementing effective strategies to address challenges and overcome obstacles.

— The ability to manage stress and remain composed in high-pressure situations, practicing self-care, and maintaining a positive and resilient mindset.

— The ability to make ethical decisions and upholding professional standards.

— The ability to engage in ongoing learning and professional development, staying updated on best practices, emerging trends, and new technologies relevant to public health emergency response.

A.5 Communicating

A.5.1 Knowledge

— Understanding the established communication protocols and procedures within the PH EOC.

— Familiarity with the information management systems and tools used within the PH EOC, including knowledge of data collection, storage, and sharing platforms.

— Understanding the various stakeholders involved in the emergency response, including internal teams, external agencies, and community partners.

— Knowledge of crisis communication principles and strategies, including understanding the importance of timely, accurate, and consistent messaging during emergency situations.

— Awareness of cultural diversity and sensitivity to different cultural norms and communication styles.

A.5.2 Skills

— The ability to actively listen and comprehend information from different sources.

— The skill to convey information clearly and concisely, including the ability to articulate complex concepts in a simplified manner to ensure understanding among diverse audiences.

— Proficiency in written communication.

— The skills to build positive and effective relationships through interpersonal communication.

A.5.3 Abilities

— The ability to adapt communication styles and approaches to different situations and stakeholders.