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TECHNICAL REPORT

Core competencies in applied infectious disease epidemiology in Europe

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Authors (in alphabetical order)

Name	Affiliation	Contribution
Julia Barry	University College Dublin, Ireland	Research assistance/scientific coordination project support
Adrian Boncan	European Centre for Disease Prevention and Control (ECDC)	Construction of self-assessment tools data visualisation
Arnoldus Bosman	Transmissible BV	Expert content input and peer review
Mary Codd	University College Dublin, Ireland	Project scientific leadership and coordination. Expert content input and peer review
Karl F Conyard	University College Dublin, Ireland	Research assistance/scientific coordination project support
Katarzyna Czabanowska	Maastricht University, The Netherlands	Expert content input and peer review
Nadav Davidovitch	Ben Gurion University of the Negev, Israel	Expert content input and peer review
Rodrigo Filipe	European Centre for Disease Prevention and Control (ECDC)	Expert content input and peer review
Lorena Gonzalez	European Centre for Disease Prevention and Control (ECDC)	Expert content input and peer review
Lore Leighton	The Association of Schools of Public Health in the European Region (ASPHER)	Project reporting and communication, project coordination support
Michael Ndirangu	European Centre for Disease Prevention and Control (ECDC)	Expert content input and peer review
John Middleton	The Association of Schools of Public Health in the European Region (ASPHER)	Expert content input and peer review
Amelie Plymoth	European Centre for Disease Prevention and Control (ECDC)	Expert content input and peer review
Jeanine Pommier	European Centre for Disease Prevention and Control (ECDC)	Concept, expert content input and peer review
John Reid	University of Chester, United Kingdom	Expert content input and peer review
Ralf Reintjes	Hamburg University of Applied Sciences, Germany and Tampere University, Finland	Expert content input and peer review
Darren Shickle	University of Leeds, United Kingdom	Expert content input and peer review
Shiraz Syed	University College Dublin, Ireland	Research assistance
Carmen Varela Santos	European Centre for Disease Prevention and Control (ECDC)	Concept, expert content input and peer review
Patrick Wall	University College Dublin, Ireland	Expert content input and peer review

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The following experts participated to the Advisory group (alphabetical order):

- László Balkányi , Medical Informatics R&D Center (MIRDC), Pannon University, Veszprém, Hungary
- Fortunato 'Paolo' D'Ancona, Istituto Superiore di Sanità (ISS), Italy
- Lisa Jensen, Training and Development Unit, Public Health Agency of Canada, Canada
- Kristina Lindvall, Department of Epidemiology and Global Health, Umeå University (Dept. of EpiGH, UMU), Sweden
- Jose M Martin-Moreno, Department of Preventive Medicine & Public Health, Medical School and INCLIVA, University of Valencia, Spain
- Boris Igor Pavlin, World Health Organization (WHO), Switzerland
- Julio Pinto, Animal Production and Health Division (NSA), Food and Agriculture Organization of the United Nations (FAO)
- César Velasco Muñoz, Instituto de Salud Global de Barcelona (ISGLOBAL), Spain.

The following experts reviewed and provided feedback on drafts of the framework:

- Ettore Severi, European Centre for Disease Prevention and Control (ECDC)
- Lara Payne, European Centre for Disease Prevention and Control (ECDC)
- Kostas Danis, European Centre for Disease Prevention and Control (ECDC)
- Liese Van Gompel, European Centre for Disease Prevention and Control (ECDC).

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Abbreviations

AMR	Antimicrobial resistance
ASPHER	Association of Schools of Public Health in the European Region
ECDC	European Centre for Disease Prevention and Control
EU	European Union
IPC	Infection prevention and control
OI	Outbreak investigation
PPE	Personal protective equipment
R	R (programming language)
RCT	Randomised controlled trial
SAS	Statistical analysis system
SPSS	Statistical package for the social sciences
STATA	Statistics and data software

Glossary

Competence(s): the actual knowledge, skills and abilities that an individual person has to perform a certain task or tasks successfully.

Competency(ies): refers to performance and focuses on the person's behaviour or action, when they put their competence into practice.

Context-specific: refers to the geographical, political and epidemiological contexts in which the professional is engaged in performing activities relating to applied infectious disease epidemiology.

Domain: within each subject area, there are specific domains that provide more detail about the substantive activities of that area.

Infodemiology: refers to the science of distribution and determinants of information in an electronic medium (Internet) or population, with the ultimate aim of informing public health and public policy.

Knowledge: the outcome of assimilating information through learning. Knowledge is the body of facts, principles, theories and practices related to a field of work or study.

Skill: the ability to apply knowledge and use know-how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive, and creative thinking) or practical (involving the use of methods, materials, tools, and instruments).

Subject area: a broad term representing the body of competence, expertise and work relevant to applied infectious disease epidemiology.

Executive summary

The European Centre for Disease Prevention and Control (ECDC) supports the European Union (EU) Member States and the European Commission in their efforts to ensure that Europe has a competent public health workforce. The aim of this project was to review and update the core competencies in applied infectious disease epidemiology for mid-career applied epidemiologists, based on previous ECDC work in this area.

A mixed-methods approach was applied to bring together different European partners from the policy, practice and academic sectors. This involved a literature review, as well as a qualitative and quantitative data collection and validation process.

The result of this process was the production of a framework, listing 157 competencies grouped into six subject areas:

- Essential methods for applied infectious diseases epidemiology (28 competencies)
- Preparedness, surveillance and response to infectious disease outbreaks (29 competencies)
- Communication and advocacy (25 competencies)
- Practice of infectious disease epidemiology (34 competencies)
- Contextual influences on infectious disease management (21 competencies)
- Leadership and management (20 competencies).

This competency framework can potentially be used for training needs assessments in public health institutions; individual assessments; writing vacancy notices and professional development planning. The harmonisation of competencies used in applied epidemiology will facilitate collaboration and the use of a common language among professionals tackling cross-border health threats in Europe.

Background

In 2009, ECDC published its report 'Core competencies for EU public health epidemiologists in communicable disease surveillance and response' [1]. As over ten years have now passed, it was important to update the core competencies in applied infectious disease epidemiology to reflect new approaches to public health practice and education, and to integrate the latest requirements, highlighted in the literature [2-27]. In the light of recent and current infectious disease epidemics and pandemics [28-31], it is critical to have a competent workforce with the necessary knowledge, skills and abilities to translate policy, theory and research into effective action.

This framework aims to update competencies in applied infectious disease epidemiology to reflect the needs of public health systems in Europe, while recognising that such competencies are dynamic and continuously evolving.

The framework focuses on mid-career professionals, defined as having approximately five years of experience in areas of professional practice relevant to applied infectious diseases epidemiology, and an advanced degree, such as a masters, higher degree or diploma with a specialisation in public health, epidemiology, or other related fields (e.g. immunology, microbiology, parasitology, vector control, environmental health, one health). This may include job titles such as field epidemiologist, infectious diseases epidemiologist or public health specialist focusing on infectious disease investigation and management. The titles given to such professionals may differ across countries.

In the context of capacity building and workforce development, the identification of competencies is a way of developing a shared vision of the specific knowledge and skills required for effective practice. Identifying and agreeing on the core competencies for effective practice, education and training is an essential component for developing and strengthening workforce capacity to improve global health in the twenty-first century. This is in line with the World Health Organization (WHO) 10 Essential Public Health Operations (EPHO), in particular EPHO7: 'assuring a sufficient and competent public health workforce. Investment in and development of a public health workforce is an essential prerequisite for adequate delivery and implementation of public health services and activities' [32].

The framework builds on the existing European competency framework developed by ECDC and other public health competency frameworks recently published and developed by our network partners [1,33-37]. The updated framework will serve as a reference for the following intended users: employers, professionals, trainees and trainers in the area of public health.

New and emerging areas of expertise have been included in this work, such as infodemiology, the impact of climate change and the increasingly important development of 'One-Health' approaches to accommodate the interactions of the human and animal worlds. As competencies are continuously evolving, the framework presented here will be regularly monitored and updated by ECDC so that it can be exploited to increase the skill and competency of professionals in applied infectious disease epidemiology and related disciplines. Moreover, new challenges will continue to present themselves, requiring updated knowledge and skills. We believe this competency framework provides a thorough picture of what is required of professionals working in applied field epidemiology today and what will be required in the near future. However, the list will periodically be subject to further scrutiny and review by ECDC to respond to new challenges faced by field epidemiologists in the years to come.

Intended uses

- Assessment and self-assessment of the skills of applied infectious disease epidemiologists.
- Training needs assessments.
- Workforce planning and development.
- Development of job descriptions underpinning recruitment strategies.
- Updating the curriculum of existing training programmes for postgraduate studies, targeting specialties in infectious disease field epidemiology.
- Development of training programmes for junior infectious disease epidemiologists or for in-service continuous professional development.
- Accreditation of training programmes.

Methods

Broad agreement on competencies can only emerge through the exchange of ideas since competencies evolve continuously as the knowledge base expands and as we learn from practice. For this reason, a specific methodological approach was developed to tackle this work, bringing together different European partners from the policy, practice and academic sectors.

An international advisory group of experts, with experience in epidemiology and competency development, supported the update of the framework. A mixed methods approach was used, including: i) a literature review on relevant core competencies and competency frameworks to identify new subject areas; ii) a qualitative approach where data was collected through interviews with 40 key stakeholders at national and sub-national level across Europe, to inform the content and structure of the competency framework; iii) online meetings with the technical advisory group, where the results of the qualitative survey were discussed, focusing on the content and presentation of the competency framework, and iv) a quantitative approach was adopted, in the form of an online survey to obtain feedback on the final draft of the framework [38].

Data protection notification (ID: 292 and 339) was submitted and granted by ECDC for the qualitative and quantitative data collection as part of the competency project. ECDC processes personal data in accordance with Regulation (EC) 45/20011.

Results

The main result of the methodological process was the production of the competency framework, comprising 157 competencies.

Structure of this competency framework

The competencies which align with each other are grouped into subject areas. Within each of the six subject areas, domains have been defined in which specific competencies are listed. The six subject areas are listed below and the number of competencies listed in each area is shown below in parentheses.

Subject area A: Essential methods for applied infectious diseases epidemiology (28)

Subject area B: Preparedness, surveillance and response to infectious disease outbreaks (29)

Subject area C: Communication and advocacy (25)

Subject area D: Practice of infectious disease epidemiology (34)

Subject area E: Contextual influences on infectious disease management (21)

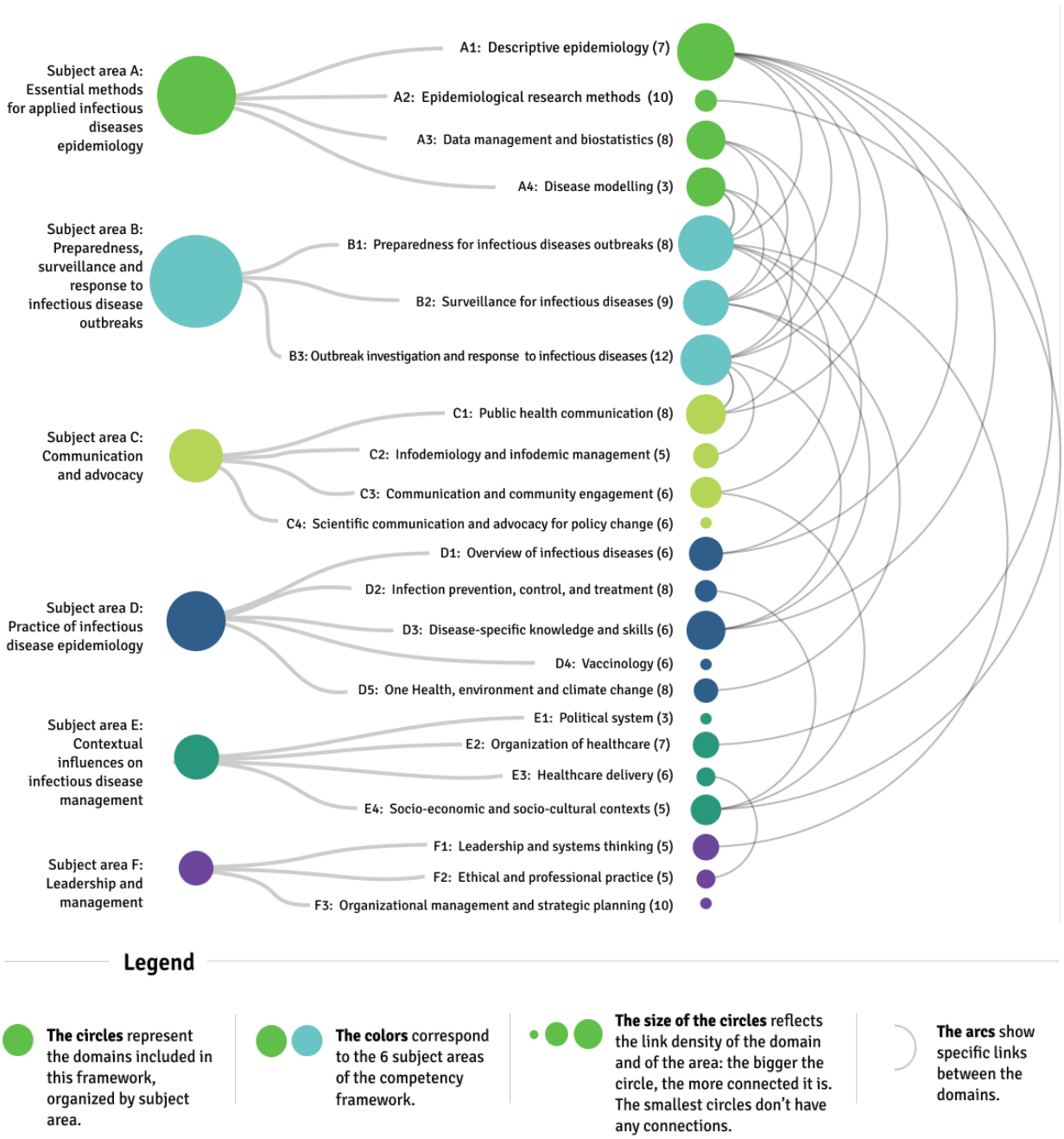
Subject area F: Leadership and management (20).

Cross referencing of domains

During the process of developing the core competency framework, every effort was made to reduce or eliminate repetition/duplication of competencies. However, topics or themes in one domain may relate to a greater or lesser extent to those in another domain. Where this occurs, domains have been cross-referenced with each other. Cross referencing has been done by domain, rather than by competency or within domain. Hyperlinks to cross-referenced domains are provided in the title box of each domain for ease of navigation.

Figure 1 shows all the domains organised by subject area, while the cross-references are represented as arcs on the right hand side of the image. The number of competences appears in parenthesis after the domain name. The size of the circle reflects the cross-reference density of a domain and its respective subject area: the bigger the circle, the more connected it is.

Figure 1. Organisation of domains by subject area and cross reference



Companion tools

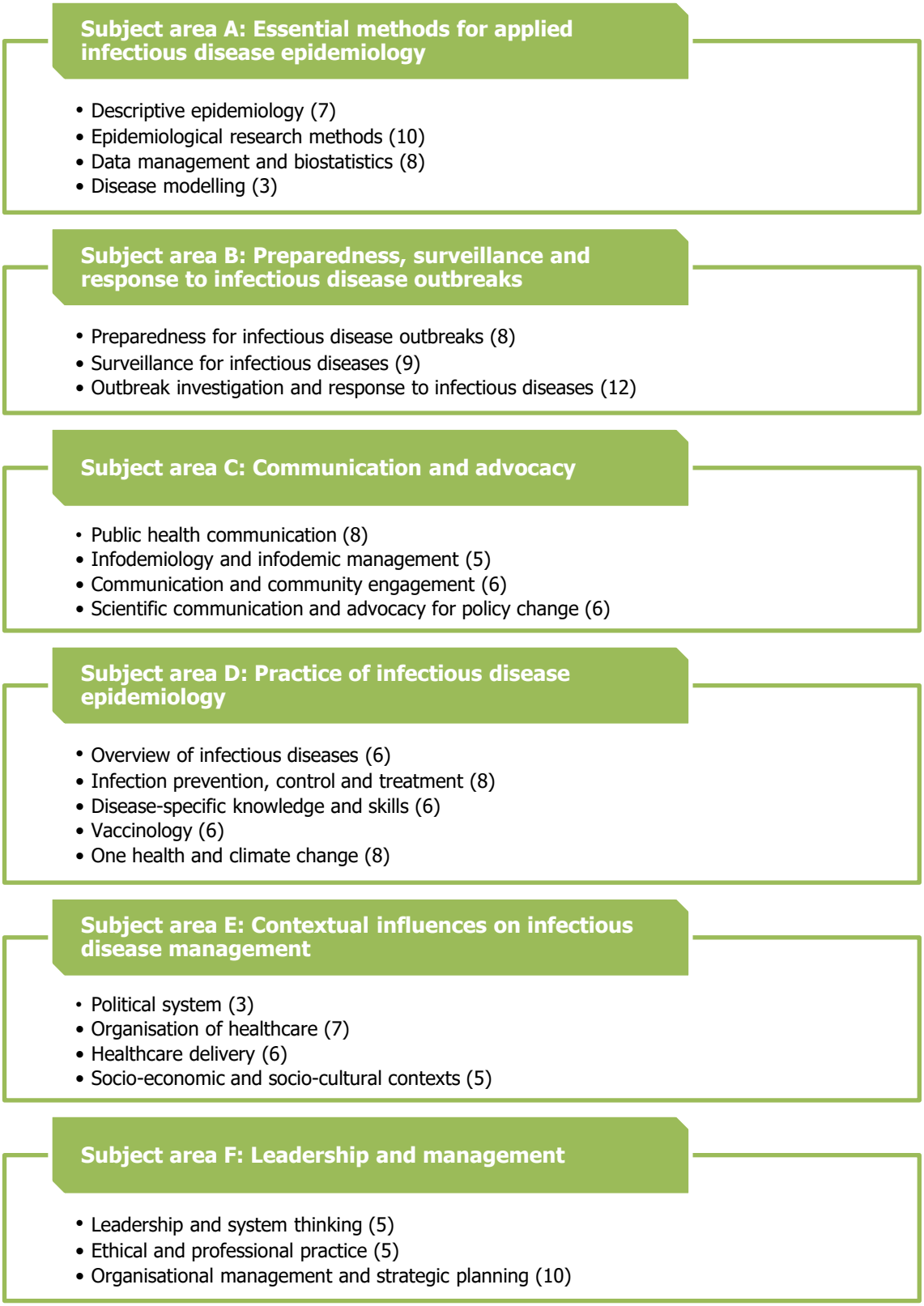
This framework is launched with a companion tool-kit for self-assessment available in the ECDC Virtual Academy EVA. The self-assessment tool enables individuals to evaluate their level in each competence. The tool provides a visual report showing the aggregated competency level per domain. The framework has also been translated and is available in other EU languages.

ECDC will also provide a space in EVA for providing feedback on this framework so that ongoing improvements can be made.

Furthermore, training resources will be linked to the competencies in order to support the further development of competencies in the different subject areas.

Competency framework

Figure 2. Competency framework outline



Subject area A: Essential methods for applied infectious disease epidemiology (28)

Description: a competent mid-career professional in applied infectious diseases epidemiology should have a thorough understanding of epidemiology, research methods, data management and biostatistics. He/she should be skilled in the application of research methods, knowledge synthesis and the interpretation of data for disease surveillance and investigation.

Domain A1: Descriptive epidemiology (7) ***Cross-referenced domains:*** B1; B2; B3; C1; D1; D3; E2	
A1.1	Describe the demographic profiles of populations, including population pyramids, and the factors that impact on population structure (e.g. mortality, fertility, and migration).
A1.2	Identify the methods employed nationally and internationally to ensure comprehensive notification of infectious diseases to relevant statutory agencies.
A1.3	Identify the available sources of individual and aggregated data on infectious diseases, such as surveillance data, hospital data, human health data, animal health data and data on sources of infection.
A1.4	Calculate and interpret measures of diseases frequency (incidence, prevalence, age-specific rates, case fatality rates) and trends in disease rates over time.
A1.5	Conduct analysis and comparison of disease rates between regions, between populations and over time, using direct and indirect standardisation procedures, as relevant.
A1.6	Interpret disease trends from time series analyses.
A1.7	Derive and interpret graphically represented data on disease rates and explain to relevant audiences.
Domain A2: Epidemiological research methods (10) ***Cross-referenced domains:*** E4	
A2.1	Conduct critical appraisal of scientific literature using established tools, such as checklists for systematic reviews, rapid and long-term risk assessments, randomised controlled trials, cohort studies, case-control studies, economic evaluations, diagnostic studies, and qualitative studies, as relevant.
A2.2	Write a study protocol, detailing the public health problem to be investigated and appropriate investigation techniques consistent with the problem and context.
A2.3	Design epidemiological studies (e.g. population-based studies, cross-sectional studies, ecological studies) to investigate disease burden in a population, using appropriate sampling strategies.
A2.4	Design epidemiological studies to investigate the determinants of disease, to ascertain associations and/or disease causation (e.g. cohort studies, case-control studies, cross-sectional studies, recognising the multifactorial nature of disease).
A2.5	Design qualitative studies that are informed by behavioural sciences to explore qualitative aspects of the impact of infectious diseases on individuals, the community and health services.
A2.6	Design, test and evaluate data collection methods, including case report forms and questionnaires.
A2.7	Assess study instruments and their measurement properties, specifically their validity, reliability, and cross-cultural applicability.
A2.8	Explain and apply the concepts of correlation and association in observational studies and apply relevant criteria for inferring causation from observational studies.
A2.9	Recognise sources of bias, confounding, interaction and effect modification, and how to recognise and adjust for these in the study design and analytical techniques.
A2.10	Estimate and interpret measures of effect from cohort studies, case control studies and randomised control trials.
Domain A3: Data management and biostatistics (8) **Cross-referenced domains:** B1; B2; B3	
A3.1	Distinguish between variables and observations and describe the attributes of variables, including types of variables and level of measurement.
A3.2	Describe the principles of data management including standardisation in data collection, collation of data electronically and assurance of the validity of data in a database.
A3.3	Adhere to personal data privacy regulations and data protection legal frameworks, demonstrating data safety and security in all aspects of work.
A3.4	Conduct data management and statistical analysis as an independent user of at least one statistical type of software (e.g. SPSS, R, STATA, SAS).

A3.5	Describe the basic concept of probability and apply basic statistical procedures, such as descriptive statistics and basic inferential statistics.
A3.6	Derive and interpret point estimates, confidence intervals, estimates of risk and significance levels, including p-values.
A3.7	Describe the principles of multivariable analysis and survival analysis, conduct the analysis, and interpret the results.
A3.8	Participate in the development and interpretation of statistical protocols.
Domain A4: Disease modelling (3) **Cross-referenced domains:** B1; B2; B3	
A4.1	Communicate with disease modellers to ascertain the assumptions and processes of infectious disease predictive modelling.
A4.2	Describe the applications and limitations of infectious disease predictive modelling in preparedness planning, forecasting and guidance for policy-makers.
A4.3	Compare and interpret the results of different infectious disease models and scenarios, taking into account their assumptions.

Subject area B: Preparedness, surveillance and response to infectious disease outbreaks (29)

Description: a public health response to any infectious disease outbreak, epidemic or pandemic necessitates a level of preparedness, swift and appropriate action for case definition, identification of cases (including testing and diagnoses), contact management, isolation and support.

Domain B1: Preparedness for infectious disease outbreaks (8) **Cross-referenced domains:** A1; A3; A4; C1; C3; D1; F1	
B1.1	List the necessary steps to carry out preparedness planning for outbreaks, epidemics, and pandemics of infectious diseases, taking into account the lessons learned from recent pandemics.
B1.2	Establish basic elements of preparedness, including health protection strategies and health promotion messages (e.g. for mass gatherings).
B1.3	Characterise the general human health consequences of population exposure to chemical and biological hazards.
B1.4	Design, implement and evaluate public health response strategies (e.g. case identification, contact management, quarantine, isolation, and support).
B1.5	Describe the role of major stakeholders in preparedness planning and assess the capacity of field epidemiologists and public health teams to respond to infectious disease outbreaks, epidemics and pandemics.
B1.6	Consider appropriate public health preparedness and response plans to infectious diseases in all relevant settings (e.g. healthcare facilities, schools, workplaces, direct provision centres).
B1.7	Outline the steps in the development and application of multi-sectoral evidence-based responses to the control of infectious diseases in all settings.
B1.8	Design, implement and evaluate epidemic and pandemic management strategies, including all effective public health and social measures.
Domain B2: Surveillance for infectious diseases (9) **Cross-referenced domains:** A1; A3; A4; D3; D5	
B2.1	Define the type of surveillance data needed for risk assessment of public health threats and for the evaluation of public health measures.
B2.2	Operate routine surveillance systems and develop new surveillance systems as required by public health needs, guiding their design and content.
B2.3	Operate routine early warning systems and develop new early warning systems as the need arises, paying particular attention to the completeness and accuracy of data capture.
B2.4	Analyse surveillance data for action, using event-based and indicator-based surveillance systems to identify cases or clusters of infectious disease in need of further investigation.
B2.5	Recognise the role of surveillance data and outbreak management in protecting vulnerable groups and settings.
B2.6	Recognise the value and limitations of working with data that were not primarily designed for surveillance or research, such as secondary data, electronic health records or 'big data', and integrate this into practice.
B2.7	Be familiar with laws and declarations on surveillance and reporting at national, EU and international level (International Health Regulations).
B2.8	Establish cross-border relationships and collaboration in the area of surveillance with public health teams in bordering geographical areas and engage with points of entry (PoE) in relation to international travel.
B2.9	Evaluate existing surveillance systems of communicable diseases.
Domain B3: Outbreak investigation and response to infectious diseases (12) **Cross-referenced domains:** A1; A3; A4; C1; C2; D3	
B3.1	Establish case definitions and be prepared to revise them on the basis of emerging evidence.
B3.2	Conduct public health risk assessments for outbreaks of infectious disease (including rapid and long-term risk assessments), coordinate data collection and outbreak investigation.
B3.3	Investigate likely infectious disease transmission patterns and vectors.
B3.4	Identify vulnerable groups early on and implement appropriate protective measures (e.g. infection prevention and control, use of personal protective equipment and vaccination).

B3.5	Identify existing and required diagnostic tests and testing capacity for infectious diseases outbreaks.
B3.6	Describe and implement methods to interrupt transmission of infectious diseases based on knowledge of disease dynamics, including non-pharmacological interventions, contact tracing, quarantine, isolation, restricted access and other mitigation strategies.
B3.7	Act decisively to set up contact tracing systems and train a contact tracing workforce.
B3.8	Derive and interpret the epidemic curve for an infectious disease outbreak; use the data to implement action and draw conclusions.
B3.9	Analyse and disseminate the geographical distribution of infectious disease cases, identifying possible clustering of cases using spatial/geographical information system mapping.
B3.10	Evaluate and interpret the contribution of whole genome sequencing (WGS), and metagenomics data to outbreak investigation and control.
B3.11	Establish interdisciplinary, cross-sectoral, and multi-sectoral collaborations and approaches to outbreak investigation and control.
B3.12	Actively engage in risk communication during outbreak investigations, targeting relevant leaders, professionals and audiences.

Subject area C: Communication and advocacy (25)

Description: the public health response to infectious disease outbreaks necessitates clear communication policies and strategies. It requires strong communication, diplomacy and advocacy skills, and the use of a variety of communication and advocacy methods designed to reach relevant groups in organisations and communities.

Domain C1: Public health communication (8) **Cross-referenced domains:** A1; B1; B3	
C1.1	Participate in developing clear communication strategies targeting groups, communities, settings, and organisations (e.g. workplaces, schools, healthcare facilities).
C1.2	Select the available means and channels to communicate the required information to targeted audiences, including policy makers and the general public.
C1.3	Develop an interdisciplinary approach to communication, engaging with professionals in relevant disciplines and media, using knowledge transfer and exchange methodologies.
C1.4	Communicate with traditional media, including preparation of press releases and participation in interviews.
C1.5	Make use of social media to reach targeted groups.
C1.6	Participate in identifying and defining key public health messages for the particular infectious disease, in order to optimise individual and population protection.
C1.7	Explain basic concepts of infectious disease transmission to the general public as the basis for public health protective measures at individual and population level.
C1.8	Explain the key concepts of validity, reliability, absolute and relative risk to stakeholders.
Domain C2: Infodemiology and infodemic management (5) **Cross-referenced domains:** B3	
C2.1	Collaborate with specialists in infodemiology to provide credibility to the dissemination of public health information on social media platforms.
C2.2	Promote both the use of evidence-based and evidence-informed decision making for successful infodemic management.
C2.3	In collaboration with communication experts and data scientists, work to ascertain the origin and spread of misinformation on social media platforms.
C2.4	Identify misinformation patterns on different platforms which may increase the risk of infection for certain areas, populations and settings (e.g. testing hesitancy, vaccine hesitancy, resistance to public health advice during an outbreak).
C2.5	Measure and quantify the penetration of infodemics within a population and evaluate approaches for infodemic interventions.
Domain C3: Communication and community engagement (6) **Cross-referenced domains:** B1; E4	
C3.1	Participate in the investigation of knowledge, attitudes, practices and behaviours of infectious disease within specific population groups.
C3.2	Adapt communication content and methods to different levels of health literacy in different groups.
C3.3	Apply and evaluate the principles of risk communication during emergencies or non-emergencies.
C3.4	Demonstrate sensitivity towards people with diverse backgrounds, health status and lifestyle preferences.
C3.5	Share information effectively at different organisational levels to gain political commitment, policy support and social acceptance for a specific objective or intervention.
C3.6	Advocate effectively in community-based organisations and at community level to enhance commitment to public health interventions, including promoting adherence to public health advice and vaccine uptake.
Domain C4: Scientific communication and advocacy for policy change (6)	
C4.1	Write a report on an epidemiological investigation for decision-makers.
C4.2	Write and submit a scientific abstract and make a presentation to a scientific conference.
C4.3	Analyse and synthesise the main points from a presentation and provide objective feedback.
C4.4	Write a scientific article for publication in a peer-reviewed scientific journal.
C4.5	Use appropriate mechanisms to impact on public health policy based on scientific evidence (e.g. professional body position papers, synthesis of evidence for policy change).
C4.6	Prepare a press release and engage with health journalists and media to promote public health policy.

Subject area D: Practice of infectious disease epidemiology (34)

Description: as the principal subject area of applied infectious disease epidemiology, competencies in infectious diseases are fundamental. This includes competencies in infectious diseases generally and also in specific infectious diseases.

Domain D1: Overview of infectious diseases (6) **Cross-referenced domains:** A1; B1	
D1.1	Analyse the global, regional and local distribution of infectious diseases.
D1.2	Explain the role of relevant agencies responsible for monitoring infectious diseases regionally, nationally and internationally (e.g. ECDC, CDC, WHO).
D1.3	Apply the relevant infectious disease legislation (international/country-specific).
D1.4	Explain potential sources of infection (e.g. food-borne, water-borne, air-borne, blood-borne, vector-borne, zoonotic, and travel-related infections).
D1.5	Be familiar with the applicable legal and statutory obligations in relation to the monitoring and notification of infectious diseases, including the country-specific notifiable diseases.
D1.6	Evaluate the threat of new and emerging infectious disease epidemics and pandemics and actively engage in contingency planning.
Domain D2: Infection prevention, control, and treatment (8) **Cross-referenced domains: E4**	
D2.1	Recognise the role of living conditions (e.g. hygiene, sanitation, waste disposal, burial practices, ventilation and environmental contamination) on the occurrence of infectious diseases.
D2.2	Recognise the role of lifestyle and behaviour in infection dissemination and prevention.
D2.3	Describe disease control measures relating to food, air, water, travel and other vectors in infection prevention and control.
D2.4	Recognise the role of personal behaviour in IPC, including the adherence to guidelines and use of personal protective equipment (PPE).
D2.5	Describe the development and role of antimicrobial agents in infection prevention and control (IPC) and treatment.
D2.6	Explain the evolution and implications of antimicrobial resistance (AMR).
D2.7	Collaborate with educational programmes on the use of antibiotics and antimicrobial agents.
D2.8	Explain the evolution of healthcare-associated infections, including their risk factors and management.
Domain D3: Disease-specific knowledge and skills (6) **Cross-referenced domains:** A1; B2; B3	
D3.1	Define disease-specific critical time periods (e.g. incubation period, infectious period, contagious period).
D3.2	Explain infectious agent transmissibility and dynamics, including reproductive number.
D3.3	Work with laboratory scientists to integrate the scope and applications of public health microbiology.
D3.4	Describe different diagnostic tests (e.g. immunological tests, nucleic acid amplification tests), their applications and properties, including diagnostic accuracy, reliability and predictive values.
D3.5	Interpret results from laboratory methods for infectious disease detection and diagnosis.
D3.6	Explain how genomic analysis and disease-specific molecular epidemiology can be applied and interpreted in communicable disease prevention and control.
Domain D4: Vaccinology (6)	
D4.1	Outline the processes of vaccine development, including the role of randomised controlled trials.
D4.2	Describe the regulation, safety, and efficacy of vaccines.
D4.3	Describe the implementation of regional and national vaccination programmes, including the logistical aspects of mass vaccination campaigns in the population.
D4.4	Describe vaccine monitoring (vaccination registry) and evaluation.
D4.5	Estimate vaccine effectiveness and vaccine efficacy in the population as a whole, and in defined population sub-groups.
D4.6	Describe aspects of behavioural science relevant to vaccine uptake and hesitancy within different population sub-groups.

Domain D5: One Health, environment and climate change (8) **Cross-referenced domains: B2**	
D5.1	Implement a collaborative, multisectoral and transdisciplinary approach between human, animal, and environmental health sectors to identify health risks and prevent and control infectious disease.
D5.2	Assess One-Health factors (e.g. animal health, food safety/security, the influence of ecosystems etc.) and investigate the evolution, dissemination prevention and control of zoonotic infections.
D5.3	Recognise the risks and threats at the interfaces of human-animal-environment interaction both at local and international level.
D5.4	Critically analyse the key factors and resources that shape the One-Health approach in order to influence actions (emergency preparedness planning and response) at the local and international level.
D5.5	Collaborate effectively with the animal health and environmental health sectors during a zoonotic outbreak response and in preparing for such a response.
D5.6	Describe the components and importance of food safety and the food chain (including a farm-to-fork approach).
D5.7	Recognise the disruptive effect of climate change and the impact of climatic events on the ecosystem, increasing the risk of infectious disease transmission.
D5.8	Review and disseminate knowledge from the Sustainable Development Goals 2015 on the impact of climate change on infectious diseases, both now and in the future.

Subject area E: Contextual influences on infectious disease management (21)

Description: this subject area addresses the system and context influences on the management of infectious diseases. It includes the political system in place, the organisation and structure of health services and delivery, and the socioeconomic and sociocultural contexts, all of which impact on the delivery of services and the capacity to adjust to the local need.

Domain E1: Political system (3)	
E1.1	Describe and link the political system, electoral processes, advocacy and political decision-making processes of the region or state.
E1.2	Interpret the legal basis and legislation for the operation of public health.
E1.3	Engage in appropriate advocacy in the interests of public health.
Domain E2: Organisation of healthcare (7) **Cross-referenced domains:** A1	
E2.1	Establish contact with the government agency tasked with organising the health system in the country/region.
E2.2	Review the code of governance of the health service agency in the country or region, including how it directs and controls its functions and manages its business.
E2.3	Outline the structure of the health service agency at national and regional level.
E2.4	Work with relevant statutory structures and agencies of the region or state (e.g. census data collation, disease registries and surveillance systems).
E2.5	Access and use national or regional census data, vital statistics and sources of health data to determine services needed.
E2.6	Act on statutory obligations to notify infectious diseases that have been deemed notifiable in the public interest.
E2.7	Interpret and comply with the relevant EU, international and national legislation on infectious diseases.
Domain E3: Healthcare delivery (6) **Cross-referenced domains:** F2	
E3.1	Explain the framework within which healthcare services are delivered to the public (i.e. primary, secondary, tertiary, long-term care, community, mental health and social care services).
E3.2	Explain the role of key stakeholders in the health system.
E3.3	Map the scope of practice specific to the healthcare setting or service with the country or region.
E3.4	Locate and follow the policies, procedures, protocols and guidelines of the healthcare delivery agency or system, in particular as they relate to infectious disease (e.g. infection prevention and control guidelines).
E3.5	Summarise the relevant accountability, quality assurance guidelines and medico-legal context specific to the healthcare setting or service in the country or region.
E3.6	Participate in the relevant professional body/bodies in which scope of practice and continuous professional education is developed, available and accredited.
Domain E4: Socio-economic and socio-cultural contexts (5) **Cross-referenced domains:** A2; C3; D2	
E4.1	Explain basic concepts of sociology and health economics as they relate to healthcare.
E4.2	Identify the main socioeconomic determinants and indicators of health in the population.
E4.3	Estimate the impact of health and social inequality on infectious disease spread and severity in order to propose strategies to reduce it.
E4.4	Identify vulnerable populations in society (e.g. ethnic minorities, migrant populations, people with disabilities).
E4.5	Identify services needed by and available to vulnerable groups (e.g. residential care facilities, direct provision centres, social health services).

Subject area F: Leadership and management (20)

Description: competencies in leadership, resource management and professional ethical practice are required to develop and implement policy in relation to the management of infectious disease outbreaks, epidemics and pandemics.

Domain F1: Leadership and systems thinking (5) **Cross-referenced domains:** B1	
F1.1	Inspire and motivate others to work towards a common vision and/or organisational goals related to infectious disease control.
F1.2	Demonstrate flexibility and adaptability in working with others.
F1.3	Demonstrate emotional intelligence, with an awareness of the impact of one's own beliefs, values and behaviour upon decision-making and the reactions of others.
F1.4	Apply the principles of systems-thinking and infectious disease policies when planning and developing responses to infectious disease control.
F1.5	Categorise the intersection and power of the stakeholders having an impact on public health policies in relation to infectious disease control, and engage with them effectively.
Domain F2: Ethical and professional practice (5) **Cross-referenced domains:** E3	
F2.1	Adopt ethical standards and norms with integrity, promoting professional accountability for the public good.
F2.2	Review and evaluate own practices in relation to public health principles, including critical self-reflection.
F2.3	Implement and promote evidence-based best professional practice.
F2.4	Identify and manage conflict-of-interest situations, as defined by organisational regulations, policies, and procedures.
F2.5	Apply data protection and confidentiality standards to all data and products of the organisation and activities undertaken.
Domain F3: Organisational management and strategic planning (10)	
F3.1	Delegate responsibilities and tasks based on the skills and expertise of team members.
F3.2	Support an environment of trust and learning within an organisation.
F3.3	Identify and participate in leadership training opportunities.
F3.4	Perform effectively as a team member or team leader.
F3.5	Identify and apply the strategic priorities of the organisation and the system.
F3.6	Recognise the need for change when it arises and develop and apply methods and approaches to support change.
F3.7	Collaborate with governance structures at different organisational levels.
F3.8	Collaborate with financial colleagues to formulate, implement and support budget plans for programmes and audit functions.
F3.9	Estimate budget resources consistent with strategies and adjust activities within budget.
F3.10	Seek additional resources/prepare funding proposals.

References

1. European Centre for Disease Prevention and Control. Core competencies for EU public health epidemiologists in communicable disease surveillance and response. Stockholm: ECDC; 2009. Available from: https://www.ecdc.europa.eu/en/publications-data/core-competencies-eu-public-health-epidemiologists-communicable-disease
2. André AM, Lopez A, Perkins S, Lambert S, Chace L, Noudeke N, et al. Frontline field epidemiology training programs as a strategy to improve disease surveillance and response. Emerg Infect Dis. 2017; 23(13): S166-S173.
3. Aziz HA. A review of the role of public health informatics in healthcare. J Taibah Univ Med Sci. 2017; 12(1): 78-81.
4. Brownson RC, Samet JM, Chavez GF, Davies MM, Galea S, Hiatt RA, et al. Charting a future for epidemiologic training. Ann Epidemiol. 2015; 25(6): 458-465.
5. Brownson RC, Samet JM, Bensyl DM. Applied epidemiology and public health: are we training the future generations appropriately? Ann Epidemiol. 2007; 27(2): 77-82.
6. Brunner Huber LR, Fennie K, Patterson H. Competencies for master and doctoral students in epidemiology: What is important, what is unimportant, and where is there room for improvement? Ann Epidemiol. 2015; 25(6): 466-468.
7. Carter-Pokras OD, Spirtas R, Bethune L, Mays V, Freeman VL, Cozier YC. The Training of epidemiologists and diversity in epidemiology: Findings from the 2006 congress of epidemiology survey. Ann Epidemiol. 2009; 19(4): 268-275.
8. Chung C, Fischer LS, O'Connor A, Shultz A. CDC's "flexible" epidemiologist: A strategy for enhancing health department infectious disease epidemiology capacity. J Public Heal Manag Pract. 2017; 23(3): 295-301.
9. Czabanowska K. Public health competencies: Prioritization and leadership. Eur J Public Health. 2016; 26(5): 734-735.
10. Dankner R, Gabbay U, Leibovici L, Sadeh M, Sadetzki S. Implementation of a competency-based medical education approach in public health and epidemiology training of medical students. Isr J Health Policy Res. 2018; 7(1).
11. Dickmann P, Abraham T, Sarkar S, Wysocki P, Cecconi S, Apfel F, et al. Risk communication as a core public health competence in infectious disease management: Development of the ECDC training curriculum and programme. Eurosurveillance. 2016; 21(14). https://www.eurosurveillance.org/content/10.2807/1560-7917.ES.2016.21.14.30188
12. Dixon BE, McFarlane TD, Dearth S, Grannis SJ, Gibson PJ. Characterizing informatics roles and needs of public healthworkers: Results from the public health workforce interests and needs survey. J Public Heal Manag Pract. 2015; 21: S130-S140.
13. Gase KA, Leone C, Khoury R, Babcock HM. Advancing the competency of infection preventionists. Am J Infect Control. 2015; 43(4): 370-379.
14. Hsu CE, Dunn K, Juo HH, Danko R, Johnson D, Mas FS, et al. Understanding public health informatics competencies for mid-tier public health practitioners: a web-based survey. J Health Inform. 2012; 18(1): 66-76.
15. Kaye KS, Anderson DJ, Cook E, Huang SS, Siegel JD, Zuckerman JM, et al. Guidance for infection prevention and healthcare epidemiology programs: Healthcare epidemiologist skills and competencies. Infect Control Hosp Epidemiol. 2015; 36(4): 369-380.
16. Koo D, Miner K. Outcome-based workforce development and education in public health. Annu Rev Public Health. 2010; 31: 253-269.
17. La Torre G, Damiani G, Mancinelli S, De Vito C, Maurici M, Bucci R, et al. Public health training and research competencies in 2015: a review of literature. Eur J Public Health. 2015; 25(suppl_3)
18. Lee MS, Kim EY, Lee SW. Experience of 16 years and its associated challenges in the field epidemiology training program in Korea. Epidemiol Health. 2017; 39: e2017058.
19. Malilay J, Heumann M, Perrotta D, Wolkin AF, Schnall AH, Podgornik MN, et al. The role of applied epidemiology methods in the disaster management cycle. Am J Public Health. 2014; 104(11): 2092-2102.
20. McGowan JE. The 2016 Garrod Lecture: The role of the healthcare epidemiologist in antimicrobial chemotherapy: A view from the USA. J Antimicrob Chemother. 2016; 71(9): 2370-2378.
21. Mor SM, Robbins AH, Jarvin L, Kaufman GE, Lindenmayer JM. Curriculum asset mapping for one health education. J Vet Med Educ. 2013; 40(4): 363-369.
22. Murphy DM, Hanchett M, Olmsted RN, Farber MR, Lee TB, Haas JP, et al. Competency in infection prevention: A conceptual approach to guide current and future practice. Am J Infect Control. 2012; 40(4): 296-303.
23. Neta G, Brownson RC, Chambers DA. Opportunities for epidemiologists in implementation science: A primer. Am J Epidemiol. 2018; 187(5): 899-910.
24. Olsen J, Bertollini R, Victora C, Saracci R. Global response to non-communicable diseases-the role of epidemiologists. Int J Epidemiol. 2012; 41(5): 1219-1220.
25. Spitz MR, Lam TK, Schully SD, Khoury MJ. The next generation of large-scale epidemiologic research: Implications for training cancer epidemiologists. Am J Epidemiol. 2014; 180(10): 964-967.
26. Traicoff DA, Suarez-Rangel G, Espinosa-Wilkins Y, Lopez A, Diaz A, Caceres V. Strong and Flexible: developing a three-tiered curriculum for the regional central america field epidemiology training program. Pedagog Heal Promot. 2015; 1(2): 74-82.
27. Wholey DR, LaVenture M, Rajamani S, Kreiger R, Hedberg C, Kenyon C. developing workforce capacity in public health informatics: Core competencies and curriculum design. Front Public Heal. 2018; 6: 124.
28. Czabanowska K, Kuhlmann E. Public health competences through the lens of the COVID-19 pandemic: What matters for health workforce preparedness for global health emergencies. Int J Health Plann Manage. 2021; 36(S1): 14-19.
29. Kuhlmann E, Dussault G, Correia T. Global health and health workforce development: What to learn from COVID-19 on health workforce preparedness and resilience. Int J Health Plann Manage. 2021; 36(S1): 5-8.
30. European Observatory on Health Systems and Policies, World Health Organization. Regional Office for Europe, Williams GA, Maier CB, Scarpetti G, de Belvis AG, Fattore G, Morsella A, et al. What strategies are countries using to expand health workforce surge capacity during the COVID-19 pandemic? Eurohealth. 2020;26(2):51-57. Available from: https://apps.who.int/iris/handle/10665/336296
31. Zapata T, Buchan J, Azzopardi-Muscat N. The health workforce: Central to an effective response to the COVID-19 pandemic in the European Region. Int J Health Plann Manage. 2021; 36(S1): 9-13.

32. World Health Organization (WHO). The 10 essential public health operations [Internet]. Geneva: WHO; 2021 [cited 10 December 2021]. Available from: https://www.euro.who.int/en/health-topics/Health-systems/public-health-services/policy/the-10-essential-public-health-operations
33. European Centre for Disease Prevention and Control (ECDC). Core competencies for public health epidemiologists working in the area of communicable disease surveillance and response, in the European Union. Stockholm: ECDC; 2008. Available from: https://www.ecdc.europa.eu/en/publications-data/core-competencies-public-health-epidemiologists-working-area-communicable-disease
34. European Centre for Disease Prevention and Control (ECDC). Public health emergency preparedness: Core competencies for EU Member States. Stockholm: ECDC; 2017. Available from: https://www.ecdc.europa.eu/en/publications-data/public-health-emergency-preparedness-core-competencies-eu-member-states
35. European Centre for Disease Prevention and Control (ECDC). Vaccine-preventable diseases and immunisation: Core competencies. Stockholm: ECDC; 2017. Available from: https://www.ecdc.europa.eu/en/publications-data/vaccine-preventable-diseases-and-immunisation-core-competencies
36. World Health Organization (WHO). Laboratory leadership competency framework. Geneva: WHO; 2019. Available from: https://apps.who.int/iris/handle/10665/311445
37. WHO Regional Office for Europe (WHO Europe). WHO-ASPHER competency framework for the public health workforce in the European Region. Copenhagen: WHO; 2020. Available from: https://www.euro.who.int/en/health-topics/Health-systems/public-health-services/publications/2020/who-aspher-competency-framework-for-the-public-health-workforce-in-the-european-region-2020
38. Plymoth A, Ndirangu M , Varela C, Filipe R, Pommier J. Core competencies for applied infectious disease epidemiologists in Europe. European Scientific Conference on Applied Infectious Disease Epidemiology; 2021 Nov 16-19; Stockholm: ECDC. Abstract ID: 203. Available from: https://www.escaide.eu/sites/default/files/documents/ESCAIDE2021_Abstract-Book.pdf

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European Centre for Disease Prevention and Control (ECDC)

Gustav III:s Boulevard 40, 16973 Solna, Sweden

Tel. +46 858601000
Fax +46 858601001
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